PROFIdrive – SC6, SI6
Manual

STÖBER

Table of contents
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Table of contents

Table of contents 2

1 Foreword 5

2 User information 6
    2.1 Storage and transfer 6
    2.2 Described product 6
    2.3 Timeliness 6
    2.4 Original language 6
    2.5 Limitation of liability 6
    2.6 Formatting conventions 7
        2.6.1 Display of safety instructions 7
        2.6.2 Markup of text elements 8
        2.6.3 Mathematics and formulas 8
    2.7 Trademarks 9
    2.8 Explanation of terms 9

3 What you should know before commissioning 10
    3.1 Program interfaces 10
        3.1.1 DS6 program interface 10
        3.1.2 TIA Portal program interface 13
    3.2 Meaning of parameters 15
        3.2.1 Parameter groups 15
        3.2.2 Parameter types and data types 16
        3.2.3 Parameter types 17
        3.2.4 Parameter structure 17
        3.2.5 Parameter visibility 18
    3.3 Signal sources and process data mapping 19
    3.4 Power-failure-proof storage 19

4 Commissioning 20
    4.1 Setting the control 21
    4.2 DS6: Configuring the drive controller 22
        4.2.1 Initiating the project 22
        4.2.2 Parameterizing general PROFINET settings 23
        4.2.3 Configuring PZD transmission 23
        4.2.4 Parameterizing the STOBER motor 24
        4.2.5 Mapping the mechanical axis model 25
        4.2.6 Parameterizing limits 29
        4.2.7 Optional: Referencing the absolute position 30
        4.2.8 Transmitting and saving the configuration 32
        4.2.9 Activating the control panel and testing the configuration 34

1   Foreword

The DriveControlSuite commissioning software for STOBER 6th generation drive controllers offers convenient functions for efficient project configuration and commissioning of drive controllers in multi-axis and single-axis applications.

The PROFIdrive application included in the software contains various application classes for controller and drive-based motion profiles. Jog mode is available in all application classes for commissioning, emergency operation,and maintenance or repair work.

This documentation describes the general functions of the PROFIdrive application and guides you step by step through the setup and project configuration of your drive project in the individual application classes.

2   User information

This documentation supports you during the setup and project configuration of your drive system with the PROFIdrive application, which is based on the internationally standardized PROFIdrive drive profile for electric drives in accordance with IEC 61800-7-303 (version 4.2).

Commissioning is described using examples of a PROFINET network with STOBER 6th generation drive controllers in combination with a Siemens AG controller.

Technical knowledge

To be able to commission one or more drive controllers in combination with a controller using the PROFIdrive application, you should have basic knowledge of handling 6th generation STOBER drive controllers and of the DriveControlSuite commissioning software. Operating your PROFINET network requires being familiar with PROFINET network technology and the basics of the associated Siemens SIMATIC automation systems.

Technical requirements

Before you begin operating your PROFINET network, you need to wire the drive controllers and initially check that they are functioning correctly. To do this, follow the instructions in the manual for the relevant drive controller.

2.1   Storage and transfer

As this documentation contains important information for handling the product safely and efficiently, it must be stored in the immediate vicinity of the product until product disposal and be accessible to qualified personnel at all times.

Also pass on this documentation if the product is transferred or sold to a third party.

2.2   Described product

This documentation is binding for:

SC6 or SI6 series drive controllers in conjunction with the DriveControlSuite software (DS6) in V 6.5-F or higher and associated firmware in V 6.5-F-PN or higher.

2.3   Timeliness

Check whether this document is the latest version of the documentation. We make the latest document versions for our products available for download on our website:
http://www.stoeber.de/en/downloads/.

2.4   Original language

The original language of this documentation is German; all other language versions are derived from the original language.

2.5   Limitation of liability

This documentation was created taking into account the applicable standards and regulations as well as the current state of technology.

No warranty or liability claims for damage shall result from failure to comply with the documentation or from use that deviates from the intended use of the product. This is especially true for damage caused by individual technical modifications to the product or the project configuration and operation of the product by unqualified personnel.

2.6 Formatting conventions

Orientation guides in the form of signal words, symbols and special text markups are used to emphasize specific information so that you are able identify it in this documentation quickly.

2.6.1 Display of safety instructions

Safety instructions are identified with the following symbols. They indicate special risks when handling the product and are accompanied by relevant signal words that express the extent of the risk. Furthermore, useful tips and recommendations for efficient, error-free operation are specially highlighted.

ATTENTION!

Attention

This indicates that damage to property may occur

- if the stated precautionary measures are not taken.

⚠ **CAUTION!**

Caution

This word with a warning triangle indicates that minor personal injury may occur

- if the stated precautionary measures are not taken.

⚠ **WARNING!**

Warning

This word with a warning triangle means there may be a considerable risk of fatal injury

- if the stated precautionary measures are not taken.

⚠ **DANGER!**

Danger

This word with a warning triangle indicates that there is a considerable risk of fatal injury

- if the stated precautionary measures are not taken.

Information

Information indicates important information about the product or serves to emphasize a section in the documentation that deserves special attention from the reader.

2.6.2   Markup of text elements

Certain elements of the continuous text are distinguished as follows.

Important information	Words or expressions with a special meaning
Interpolated position mode	Optional: File or product name or other name
Detailed information	Internal cross-reference
http://www.samplelink.com	External cross-reference

Software and other displays

The following formatting is used to identify the various information content of elements referenced by the software interface or a drive controller display, as well as any user entries.

Main menu Settings	Window names, dialog box names, page names or buttons, combined proper nouns, functions referenced by the interface
Select `Referencing method A`	Predefined entry
Save your `<own IP address>`	User-defined entry
EVENT 52: COMMUNICATION	Displays (status, messages, warnings, faults)

Keyboard shortcuts and command sequences or paths are represented as follows.

[Ctrl], [Ctrl] + [S]	Key, shortcut
Table > Insert table	Navigation to menus/submenus (path specification)

2.6.3   Mathematics and formulas

The following signs are used to represent mathematical relationships and formulas.

-	Subtraction
+	Addition
×	Multiplication
÷	Division
| |	Absolute value

2.7   Trademarks

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PROFIBUS®, PROFINET®	PROFIBUS® and PROFINET® are registered trademarks of PROFIBUS Nutzerorganisation e.V., Karlsruhe, Germany.
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All other trademarks not listed here are the property of their respective owners.

Products that are registered as trademarks are not specially indicated in this documentation. Existing property rights (patents, trademarks, protection of utility models) are to be observed.

2.8   Explanation of terms

As relevant standards and products of other manufacturers are referenced, different manufacturer- or standard-specific names are used for the same term in this documentation.

For improved understandability, the names in this documentation are standardized to the terminology of STOBER to the greatest extent possible. The correlation of STOBER names to other sources can be found in the following table.

STOBER	PROFINET
Controller	IO controller
Drive controller	IO device

Tab. 1: Correlation of STOBER terminology to PROFINET

STOBER	PROFIdrive
Motion block operating mode	Program mode
Command operating mode	MDI mode
Referencing	Homing
Jog	Jogging

Tab. 2: Correlation of STOBER terminology to PROFIdrive

3   What you should know before commissioning

The following chapters provide a quick introduction to the structure of the program interface and accompanying window designations as well as relevant information about parameters and generally saving your project configuration.

3.1   Program interfaces

The following chapters include an overview of the program interfaces for the described software components.

3.1.1   DS6 program interface

Using the graphical interface of the DriveControlSuite commissioning software (DS6), you can project, parameterize and commission your drive project quickly and efficiently. In case of service, you can evaluate diagnostic information such as operating states, fault memories and fault counters of your drive project using DriveControlSuite.

Information

The program interface of DriveControlSuite is available in German, English and French. To change the language of the program interface, select Settings > Language.
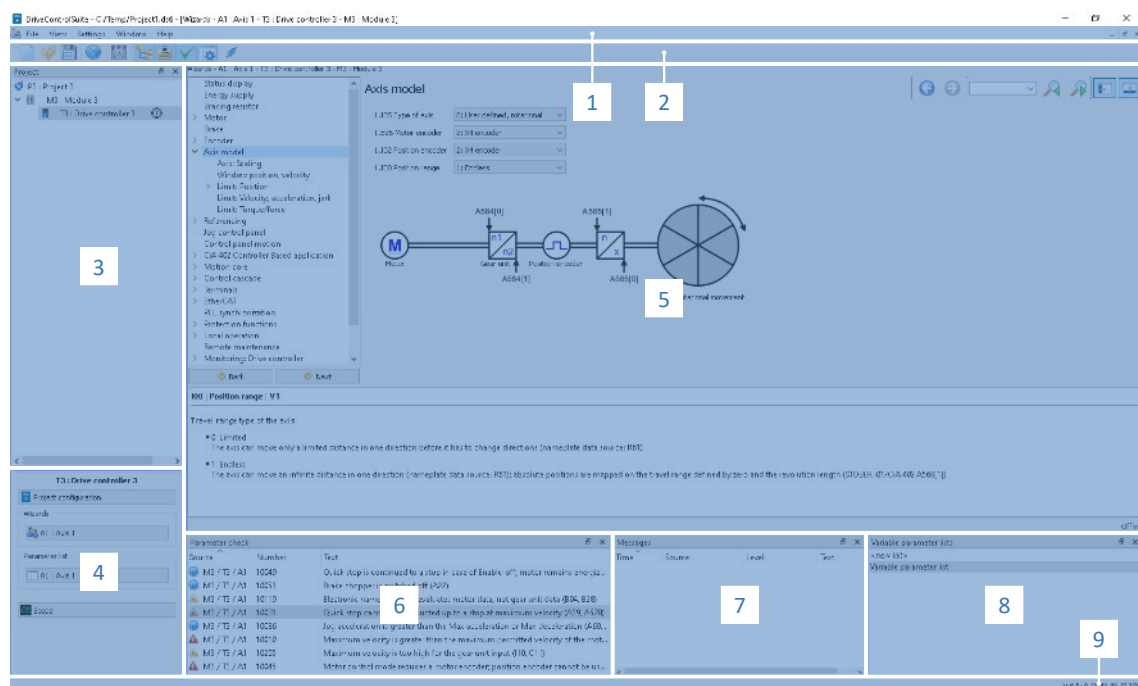
Fig. 1: DS6: Program interface

No.	Area	Description
1	Menu bar	Using the File, View, Settings and Window menus, you can open and save projects, display and hide program windows, select the interface language and access level and change between different windows in the workspace.
2	Toolbar	The toolbar enables quick access to frequently needed functions, like opening and saving projects and hiding and displaying windows in the program interface.
3	Project tree	The project tree forms the structure of your drive project in the form of modules and drive controllers. Select an element using the project tree first in order to edit it using the project menu.
4	Project menu	The project menu offers you various functions for editing the project, module and drive controller. The project menu adapts to the element that you selected in the project tree.
5	Workspace	The different windows which can be used to edit your drive project, such as the configuration dialog, wizards, the parameter list or the scope analysis tool, open in the workspace.
6	Parameter check	The parameter check points out irregularities and inconsistencies that were detected in the plausibility check of calculable parameters.
7	Messages	The entries in the messages log the connection and communication status of the drive controllers, incorrect inputs caught by the system, errors when opening a project or rule violations in the graphical programming.
8	Variable parameter lists	You can use variable parameter lists to compile any parameters in individual parameter lists for a quick overview.
9	Status bar	In the status bar, you can find the specifications of the software version and get additional information about the project file, the devices and the progress of the process during processes such as loading projects.

3.1.1.1   Configuring the view

In DriveControlSuite, you can change the visibility and arrangement of areas and windows, such as to optimize the available space in the workspace when working with smaller screens.

Showing/hiding areas

Use the icons in the toolbar or the items in the View menu to show or hide specific areas in DriveControlSuite as needed.

Icon	Item	Description
–	Reset	Resets the view to factory settings.
	Project	Shows/hides the Project window (project tree, project menu).
	Messages	Shows/hides the Messages window.
	Parameter check	Shows/hides the Parameter check window.
	Variable parameter lists	Shows/hides the Variable parameter lists window.

Arrange and group areas

You can undock and rearrange the individual areas via drag and drop. If you drag an undocked window to the edge of DriveControlSuite, you can release it there in a color-highlighted area either next to or on top of another window to redock it.

When you release the window onto another window, the two areas are merged into one window where you can use tabs to switch between the areas.
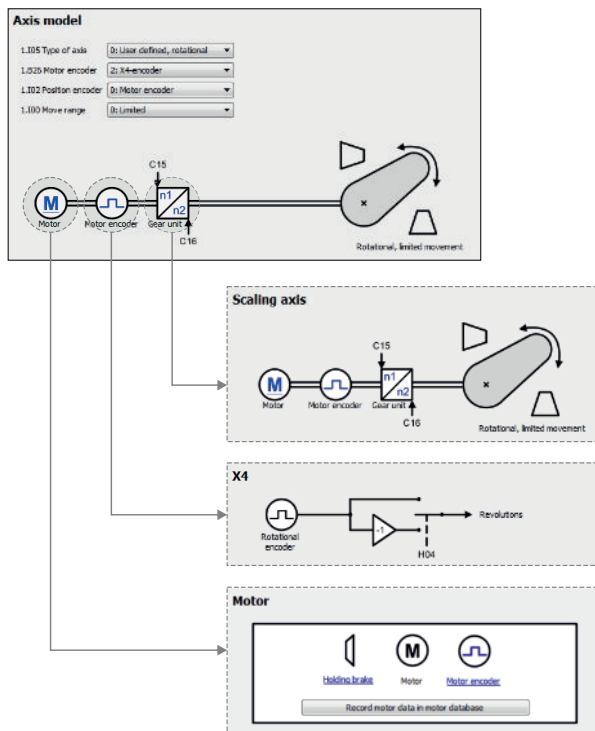
3.1.1.2   Navigation using sensitive circuit diagrams

Fig. 2: DriveControlSuite: Navigation using text links and symbols

In order to illustrate graphically the processing sequence of actual and set values, the use of signals or certain drive component arrangements and to make configuring the accompanying parameters easier, they are displayed on the respective wizard pages of the workspace in the form of circuit diagrams.

Blue text links or clickable icons indicate links within the program. These refer to the corresponding wizard pages and, as a result, allow you to reach additional helpful detail pages with just a click.

3.1.2   TIA Portal program interface

The Siemens Totally Integrated Automation Portal (TIA Portal) offers a platform you can use to commission your PROFINET system. The TIA Portal is broken down into the portal view and the project view.

TIA portal view

The TIA overall functionality is broken down into different task areas that you can reach using portals. The following graphic shows the interface elements of the TIA portal view relevant to this documentation.
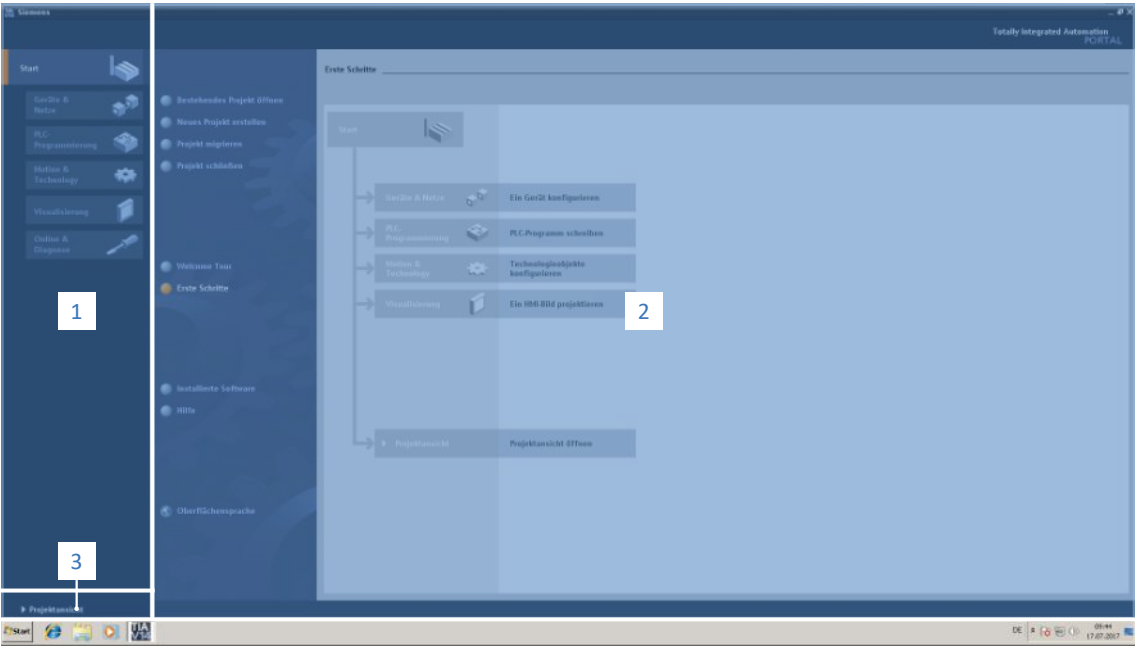
Fig. 3: TIA Portal: Program interface of the portal view

No.	Area	Description
1	Portal selection	The portal selection offers you access to various portals for different tasks and functions.
2	Portal functions	Depending on the selected portal, the portal functions are available here.
3	Project view	The button lets you change to the project view.

TIA project view

The TIA project view offers you access to all components of a project. The following graphic shows the interface elements of the TIA portal view relevant to this documentation.
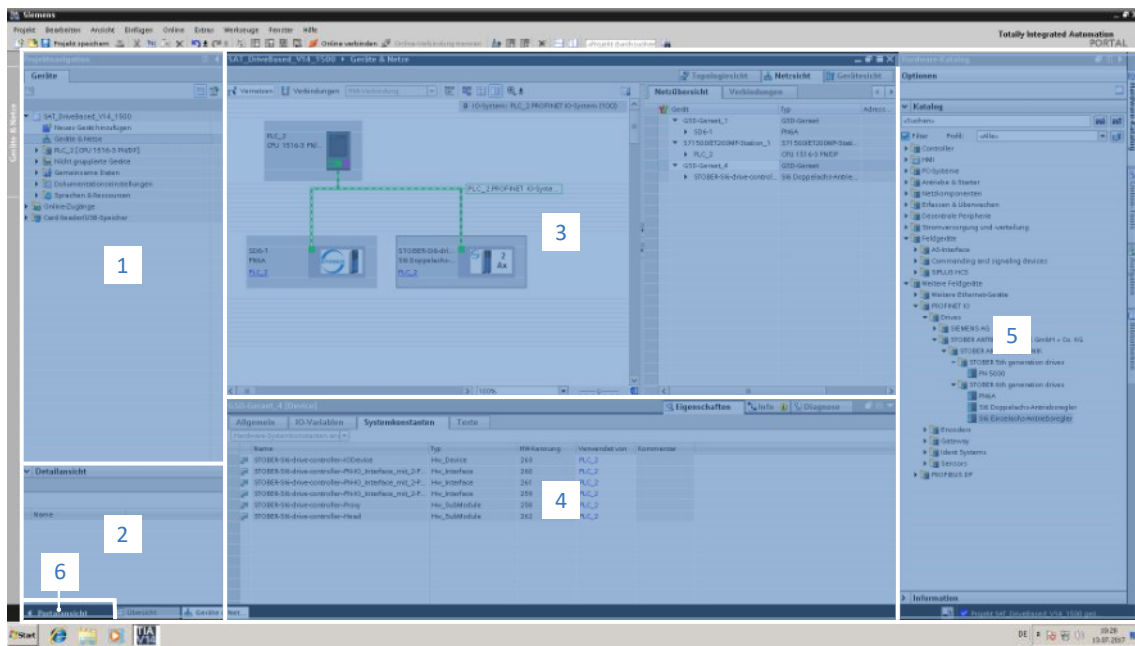
Fig. 4: TIA Portal: Program interface of the project view

No.	Area	Description
1	Project navigation	Project navigation offers you access to all components of your TIA project.
2	Detail view	The detail view shows you additional information about a selected object.
3	Workspace	In the workspace, you can edit objects in the topology view, network view or device view, for example.
4	Inspector window	The inspector window shows you additional information about a selected object.
5	Task cards	Task cards are available depending on the selected object and grant you access to the hardware catalog, online tools, tasks or libraries, for example.
6	Portal view	The button lets you change to the portal view.

3.2   Meaning of parameters

You can use parameters to adapt the function of the drive controller to your individual application. In addition, parameters visualize the current actual values (actual velocity, actual torque, etc.) and trigger actions such as Save values, Test phase, etc.

Interpretation of parameter identification

Parameter identification consists of the following elements, where short forms are also possible, i.e. only specifying a coordinate or the combination of coordinate and name.

E50 | **Drive controller** | **G6** | **V0**

Coordinate   Name   Version

Drive controller
generation/series
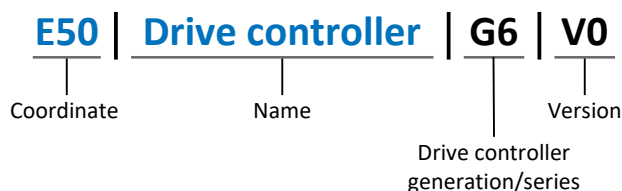
3.2.1   Parameter groups

Parameters are assigned to individual groups by topic. The 6th generation of STOBER drive controllers differentiates between the following parameter groups.

Group	Topic
A	Drive controllers, communication, cycle times
B	Motor
C	Machine, velocity, torque/force, comparators
D	Set value
E	Display
F	Terminals, analog and digital inputs and outputs, brake
G	Technology – Part 1 (application-dependent)
H	Encoder
I	Motion (all motion settings)
J	Motion blocks
K	Control panel
L	Technology – Part 2 (application-dependent)
M	Profiles (application-dependent)
N	Additional functions (application-dependent; e.g. extended cam control unit)
P	Customer-specific parameters (programming)
Q	Customer-specific parameters, instance-dependent (programming)
R	Production data for the drive controller, motor, brakes, motor adapter, gear unit and geared motor
S	Safety (safety technology)
T	Scope
U	Protection functions
Z	Fault counter

Tab. 3: Parameter groups

3.2.2   Parameter types and data types

In addition to topic-based sorting in individual groups, all parameters belong to a certain data type and parameter type. The data type of a parameter is displayed in the parameter list, properties table. The connections between parameter types, data types and their value range can be found in the following table.

Data type	Parameter type	Length	Value range (decimal)
INT8	Integer or selection	1 byte (signed)	-128 – 127
INT16	Integer	2 bytes (1 word, signed)	-32768 – 32767
INT32	Integer or position	4 bytes (1 double word, signed)	-2147483648 – 2147483647
BOOL	Binary number	1 bit (internal: LSB in 1 byte)	0, 1
BYTE	Binary number	1 byte (unsigned)	0 – 255
WORD	Binary number	2 bytes (1 word, unsigned)	0 – 65535
DWORD	Binary number or parameter address	4 bytes (1 double word, unsigned)	0 – 4294967295
REAL32 (single type according to IEE754)	Floating-point number	4 bytes (1 double word, signed)	-3.40282×10^{38} – 3.40282×10^{38}
STR8	Text	8 characters	—
STR16	Text	16 characters	—
STR80	Text	80 characters	—

Tab. 4: Parameters: data types, parameter types, possible values

Parameter types: Use

- Integer, floating-point number
  For general computing processes
  Example: Set and actual values

- Selection
  Numeric value to which a direct meaning is assigned
  Example: Sources for signals or set values

- Binary number
  Bit-oriented parameter information that is collected in binary
  Example: Control and status words

- Position
  Integer combined with associated units and decimal places
  Example: Actual and set values of positions

- Velocity, acceleration, deceleration, jerk
  Floating-point number combined with associated units
  Example: Actual and set values for velocity, acceleration, deceleration, jerk

- Parameter address
  Referencing of a parameter
  Example: In F40 AO1 source, for example, E08 n-motor filtered can be parameterized

- Text
 Outputs or messages

3.2.3   Parameter types

The following types of parameters are differentiated.

Parameter type	Description	Example
Simple parameters	Consist of one group and one line with a defined value.	A21 Brake resistor R: Value = 100 ohms
Array parameters	Consist of a group, a line and multiple sequential (listed) elements, which have the same properties but different values.	A10 Access level ▪ A10[0] access level: Value = Access level via operating unit ▪ A10[2] access level: Value = Access level via CANopen and EtherCAT ▪ A10[4] access level: Value = Access level via PROFINET
Record parameters	Consist of a group, a line and multiple sequential (listed) elements, which can have different properties and different values.	A00 Save values ▪ A00[0] Start: Value = Start action ▪ A00[1] Progress: Value = Display action progress ▪ A00[2] Result: Value = Display action result

Tab. 5: Parameter types

3.2.4   Parameter structure

Every parameter has specific coordinates with the following structure.
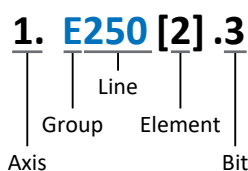
▪ Axis (optional)

In case of multiple axes, the one to which a parameter is assigned; not applicable for global parameters (value range: 1 – 4).

▪ Group

The thematic group to which a parameter belongs (value range: A – Z).

▪ Line

Distinguishes the parameters within a parameter group (value range: 0 – 999).

▪ Element (optional)

Elements of an array or record parameter (value range: 0 – 16000).

▪ Bit (optional)

Selection of a single bit for complete data addressing; depends on the data type (value range: 0 – 31).

3.2.5   Parameter visibility

The visibility of a parameter is primarily controlled by the access level you set in DriveControlSuite and by the properties you project for the respective drive controller (e.g. hardware, firmware and application). A parameter can also be shown or hidden depending on other parameters or settings. For example, the parameters of an additional function are only shown as soon as you activate the relevant additional function.

Access level

The access options for the individual software parameters are ranked hierarchically and divided into individual levels. This means that parameters can be hidden for a specific purpose and, relatedly, their configuration options can be locked starting from a specific level.

Each parameter has 2 access levels: the access level for read access (visibility) and the access level for write access (editability). The following levels are present:

- Level 0
  Elementary parameters

- Level 1
  Important parameters of an application

- Level 2
  Important parameters for service with extensive diagnostic options

- Level 3
  All parameters needed for commissioning and optimizing an application

The parameter A10 Access level controls general access to parameters:

- Over CANopen or EtherCAT (A10[2])

- Over PROFINET (A10[3])

Information

It is not possible to write to or read the parameter hidden in DriveControlSuite during communication via fieldbus.

Hardware

Which parameters are available to you in DriveControlSuite is determined by which series you select in the configuration dialog for the drive controller, for example, or whether you project an option module. Basically, the only parameters that are displayed are the ones you need to parameterize the configured hardware.

Firmware

Due to the further development and updating of functions for the 6th generation of STOBER drive controllers, new parameters and also new versions of existing parameters are continuously being implemented in DriveControlSuite and in the firmware. The parameters are displayed in the software according to the DriveControlSuite version used and the configured firmware version of the respective drive controller.

Applications

Applications generally differ in terms of functions and their control. For this reason, different parameters are available with each application.

3.3   Signal sources and process data mapping

The transmission of control signals and set values in DriveControlSuite meets the following principles.

Signal sources

Drive controllers are controlled either over a fieldbus, using mixed operation consisting of a fieldbus system and terminals or exclusively using terminals.
You can use the corresponding selection parameters, referred to as signal sources, to configure whether the control signals and set values of the application are obtained over a fieldbus or using terminals.

In case of activation over a fieldbus, parameters that are selected as data sources for control signals or set values must be part of the subsequent process data mapping. In the case of activation using terminals, the respective analog or digital inputs are specified directly.

Process data mapping

In the PROFIdrive application, the process data mapping is specified by the controller as soon as you establish an online connection between the controller and the drive controller. It is not necessary to manually assign the process data channels for transmission of the receive and transmit process data in DriveControlSuite.

3.4   Power-failure-proof storage

All project configurations, parameterizations and related changes to parameter values are in effect after transmission to the drive controller, but are not yet stored in non-volatile memory.

Saving to a drive controller

You have the following options for saving the configuration to a drive controller in non-volatile memory:

- Saving the configuration using the Save values wizard:
  Project menu > Wizards area > Projected axis > Save values wizard: Select the Save values action

- Saving the configuration using the parameter list:
  Project menu > Parameter list area > Projected axis > Group A: Drive controller > A00 Save values: Set the parameter A00[0] to the value 1: Active

Saving to all drive controllers within a project

You have the following options for saving the configuration to multiple drive controllers in non-volatile memory:

- Saving the configuration using the toolbar:
  Toolbar > Save values symbol: Click on the Save values symbol

- Saving the configuration using the Online functions window:
  Project menu > Online connection button > Online functions window: Click on Save values (A00)

Information

Do not shut off the drive controller while saving. If the supply voltage to the control unit is interrupted while saving, the drive controller starts without an executable configuration when it is next switched on. In this case, the configuration must be transferred to the drive controller again and saved in non-volatile memory.

---

4 Commissioning

The following chapters describe the commissioning of a PROFINET network, consisting of a controller from Siemens and multiple drive controllers from STOBER, with the help of STOBER DriveControlSuite and the Siemens TIA Portal.

We assume the following system environment **as an example** so that you can better follow the individual commissioning steps:

- Drive controllers from the SC6 or SI6 series with firmware version V 6.5-F-PN or later

- DriveControlSuite commissioning software in version 6.5-F or later

in combination with

- Siemens SIMATIC S7-1500 controller

- Siemens Totally Integrated Automation Portal (TIA Portal) automation software in V16 or later

Commissioning is divided into the following steps:

1. First, define how the drive controllers are to be controlled.

2. DriveControlSuite:
   After that, project all drive controllers (device control and application), parameterize the general PROFINET settings, the required limits as well as the motor, then transfer your configuration to the drive controllers of your PROFINET network.

3. TIA Portal:
   Next, map your real PROFINET network in TIA Portal, configure the individual nodes and parameterize the control of the drive controllers. Transfer the configuration to the controller and start up your PROFINET network.

Information

Before you start commissioning your PROFINET network using DriveControlSuite and TIA Portal, you must network all nodes of your PROFINET network with each other.

Detailed information about using and commissioning the optional safety technology via PROFINET (PROFIsafe) or via terminals can be found in the corresponding manual (see).

4.1   Setting the control

The options described below are available for controlling STOBER drive controllers via the TIA Portal.

Siemens function blocks (FB) from the DriveLib

Function block	Description	Application
FB SINA_SPEED	Control of a speed-controlled axis	Drive-based application
FB SINA_POS	Control of a position-controlled axis	Drive-based application

Tab. 6: Siemens function blocks DriveLib

The function blocks can be downloaded free of charge from the Siemens website and imported into the TIA Portal (https:// support.industry.siemens.com, search term: Drive_Lib_S7_1200_1500). If you are already using the function blocks in TIA Portal, make sure that you are working with the latest version.

Siemens technology objects (TO)

Technology object	Description	Application
TO_SpeedAxis	Control of a speed-controlled axis	Controller-based application
TO_PositioningAxis, TO_SynchronousAxis	Control of a position-controlled axis	Controller-based application
TO_BasicPos	Control of a position-controlled axis	Drive-based application

Tab. 7: Siemens technology objects

You can access the technology objects directly in TIA Portal and add them to your controller.

Possible combinations

The following table shows an overview of the possible combinations of function blocks or technology objects with the available application classes and telegrams.

Control	Application class	Telegrams
FB SINA_SPEED	AC1	Standard telegram 1
FB SINA_POS	AC3	Siemens telegram 111
TO_SpeedAxis	AC1	Standard telegrams 1, 2, 3
TO_PositioningAxis, TO_SynchronousAxis	AC4	Standard telegram 3
TO_BasicPos	AC3	Siemens telegram 111

Tab. 8: Combinations: function block or technology object with telegram

During commissioning in the TIA Portal, you will learn how to configure your control system.

Information

This documentation focuses on the device-specific settings that must be considered for drive controllers from STOBER for controlling Siemens function blocks or parameterizing technology objects. For settings that are not described in detail, refer to the Siemens documentation.

4.2   DS6: Configuring the drive controller

Project and configure all drive controllers for your drive system in DriveControlSuite (see also DS6 program interface [▶ 10]).

Information

Always perform the steps described below in the specified order!

Some parameters are interdependent and do not become accessible to you until you have first configured certain settings. Follow the steps in the specified sequence so that you can finish the parameterization completely.

4.2.1   Initiating the project

In order to be able to configure all drive controllers and axes of your drive system using DriveControlSuite, you must record them as part of a project.

4.2.1.1   Projecting the drive controller and axis

Create a new project and project the first drive controller along with the accompanying axis.

Creating a new project

1. Start DriveControlSuite.

2. On the start screen, click Create new project.

    ⇨ The new project is created and the configuration dialog for the first drive controller opens.

    ⇨ The Drive controller button is active.

Projecting the drive controller

1. Properties tab:
   Establish the relationship between your circuit diagram and the drive controller to be projected in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the drive controller.
   Designation: Give the drive controller a unique name.
   Version: Version your project configuration.
   Description: If necessary, specify additional supporting information, such as the change history of the project configuration.

2. Drive controller tab:
   Select the series and device type of the drive controller.
   Firmware: Select the PROFINET version 6.x -**PN**.

3. Option modules tab:
   Safety module: If the drive controller is part of a safety circuit, select the corresponding safety module.

4. Device control tab:
   Device control: Select the PROFIdrive device control.
   Rx process data, Tx process data: Select PROFINET Rx and PROFINET Tx for transmitting PROFINET process data.

Projecting the axis

1. Click on Axis 1.

2. Properties tab:
   Establish the connection between your circuit diagram and the axis to be projected in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the axis.
   Designation: Give the axis a unique name.
   Version: Version your project configuration.
   Description: If necessary, specify additional supporting information, such as the change history of the project configuration.

3. Application tab:
   Select PROFIdrive.

4. Motor tab:
   Select the type of motor operated using this axis. If you are working with motors from third-party suppliers, enter the accompanying motor data at a later time.

5. Repeat steps 2 – 4 for the 2nd axis (only for double-axis controllers).

6. Confirm with OK.

4.2.1.2   Configuring safety technology

If the drive controller is part of a safety circuit, you must configure the safety technology in accordance with the commissioning steps outlined in the corresponding manual in the next step.

4.2.2   Parameterizing general PROFINET settings

✓ You have projected the PROFINET Rx and PROFINET Tx process data for the drive controller.

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the PROFINET wizard.

3. A100 Fieldbus scaling:
   Leave the default value at 1: Native (values are passed unchanged).

4. A273 PN device name:
   Shows the PROFINET device name that was assigned in TIA Portal if there is an online connection between the drive controller and controller. Alternatively, you can assign the device name for use in PROFINET. To do this, enter the desired device name both in A273[0] and in A273[3]. If you do this, you do not have to search for the nodes in the TIA Portal to be able to assign names there.

5. A109 PZD-Timeout:
   Define the time that results from the tolerated failure time for monitoring the PZD communication plus the watchdog time of the controller (TIA Portal: watchdog time) in the PROFINET network (default value: 20 ms).

4.2.3   Configuring PZD transmission

The PZD channel (process data transmission channel) serves to transfer control and status information as well as actual and set values between a controller (IO controller) and drive controller (IO device) cyclically in real time.

The direction of data flow is important in this data exchange. From the perspective of the drive controller, PROFINET IO system distinguishes between receive PZD (RxPZD) and transmit PZD (TxPZD). STOBER drive controllers of the 6th generation support a flexible assignment of the parameter values to be transmitted.

In the PROFIdrive application, the mapping of the process data is specified by the controller in online operation.

4.2.4   Parameterizing the STOBER motor

You have projected one of the following motors:

STOBER synchronous servo motor with EnDat 2.2 digital encoder or EnDat 3 (with optional brake)

By projecting the corresponding motor, limiting values for currents and torques as well as associated temperature data are automatically transferred to the respective parameters of the individual wizards. All additional data on the brake and encoder is transferred at the same time.

STOBER Lean motor without encoder (with optional brake)

By projecting the corresponding motor, limiting values for currents and torques as well as associated temperature data are automatically transferred to the respective parameters of the individual wizards. You only have to parameterize the cable length in use. Even the brake purging and engaging times are already stored. You just have to activate the brake.

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Motor wizard.

3. B101 Cable length:
   Select the cable length of the power cable in use.

4. Repeat the steps for the 2nd axis (only for double-axis controllers).

Then activate the brake.

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Brake wizard.

3. F00 Brake:
   Select 1: Active.

4. Repeat the steps for the 2nd axis (only for double-axis controllers).

Motor protection

All models of the 6th STOBER drive controller generation feature an i²t model – a computational model for thermal monitoring of the motor. To activate it and set up the protective function, configure the following settings (deviating from the presets): U10 = 2: Warning and U11 = 1.00 s. This model can be used instead of or in addition to temperature-monitored motor protection.

4.2.5   Mapping the mechanical axis model

For a control in combination with telegram 111, you must map your complete mechanical environment in DriveControlSuite to be able to commission your real drive train with one or more drive controllers. For all other telegrams, this step is optional. In this case, parameterize the required limits (see Parameterizing limits [▶ 29]).

4.2.5.1   Parameterizing the axis model

Parameterize the setup of your drive in this order:

- Define the axis model

- Scale the axis

- Parameterize the position and velocity window

- Limit the axis (optional)
  - Limit the position
  - Limit the velocity, acceleration and jerk
  - Limit the torque and force

Information

If you are using a double-axis controller with two projected axes, you must parameterize the axis model for each axis individually.

4.2.5.1.1   Define the axis model

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the project menu > Wizard area.

2. Select the Axis model wizard.

3. I05 Type of axis:
    Define whether the axis type is rotational or translational.

    3.1.   If you would like to configure the units of measure and the number of decimal places individually for specifying and displaying position set values, velocities, accelerations and jerk, select 0: User defined, rotational or 1: User defined, translational.

    3.2.   If the units of measure and the number of decimal places for specifying and displaying position set values, velocities, accelerations and jerk are to be fixed, select 2: Rotational or 3: Translational.

4. B26 Motor encoder:
    Define the interface to which the motor encoder is connected.

5. I02 Position encoder (optional):
    Define the interface to which the position encoder is connected.

6. I00 Position range:
    Define whether the travel range of the axis is limited or endless (modulo).

7. If you have selected 1: Endless for I00, parameterize a revolution length (see Scale the axis [▶ 27]).

Information

When you parameterize I05 Type of axis, you can either use the selection 0: User defined, rotational or 1: User defined, translational to configure units of measure and the number of decimal places for the axis model individually or use the selections 2: Rotational and 3: Translational to revert to preset values.

Selection 0: User defined, rotational and selection 1: User defined, translational let you configure the unit of measure (I09) and the decimal places (I06) individually. Velocity, acceleration and jerk are represented as the derivative of the unit of measure with respect to time.

Selection 2: Rotational sets the following units of measure for the axis model: position in °, velocity in rpm, acceleration in rad/s^2, jerk in rad/s^3.

Selection 3: Translational sets the following units of measure for the axis model: position in mm, velocity in m/s, acceleration in m/s^2, jerk in m/s^3.

Information

If you do not parameterize it differently for I02 Position encoder, B26 Motor encoder is used for position control as standard.

4.2.5.1.2   Scale the axis

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu >
    Wizard area.

2. Select the Axis model wizard > Axis: Scaling.

3. Scale the axis by configuring the overall gear ratio between the motor and output.
    To simplify this scaling for you, you are provided with the scaling calculator Conversion of positions, velocities,
    accelerations, torque/force, which calculates the effects of changed motion variables on the entire system.

4. I01 Circular length:
    If you have selected 1: Endless for I00 Position range, enter the revolution length.

5. I06 Decimal places position (optional):
    If you have selected 0: User defined, rotational or 1: User defined, translational for I05 Type of axis, define the desired
    number of decimal places.

6. I09 Measure unit (optional):
    If you have selected 0: User defined, rotational or 1: User defined, translational for I05 Type of axis, define the desired
    unit of measure.

Information

A change to parameter I06 moves the decimal separator for all axis-specific values!

Ideally, change I06 before parameterizing other axis-specific values and then check them afterwards.

Information

Parameter I297 Maximum speed position encoder must be parameterized according to your application case. If I297 is set
too low, the permitted maximum speed is exceeded even at normal operating speeds. On the other hand, if I297 is set too
high, measuring errors of the encoder can be overlooked.

I297 depends on the following parameters: I05 Type of axis, I06 Decimal places position, I09 Measure unit as well as
I07 Distance factor numerator position and I08 Distance factor denominator position for Drive Based or PROFIdrive or
A585 Feed constant for CiA 402. If you have made changes to one of the parameters listed, select I297 accordingly as well.

4.2.5.1.3   Parameterizing the position and velocity window

Enter position limits and velocity zones for set values. To do so, parameterize boundary values for reaching a position or
velocity.

1. Select the Axis model wizard > Window position, velocity.

2. C40 Velocity window:
    Parameterize a tolerance range for velocity tests.

3. I22 Target window:
    Parameterize a tolerance range for position tests.

4. I87 Actual position in window time:
    Parameterize how long a drive must stay in the specified position window before a corresponding status message is
    output.

5. I21 Maximal following error
    Parameterize a tolerance range for lag tests.

4.2.5.1.4   Limiting the axis

If necessary, limit the movement variables for position, velocity, acceleration, jerk as well as torque/force according to the applicable conditions for your axis model.

Limiting the position (optional)

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Axis model wizard > Limit: Position.

3. If necessary, limit the position of your axis using a software or hardware limit switch to secure the travel range.

Limiting velocity, acceleration, jerk (optional)

The default values are designed for slow velocities without gear units. For this reason, adapt the saved values.

For example, verify the maximum velocity of the motor (B83) against the velocity of the output (I10).

1. Select the Motor wizard.

2. Determine the maximum possible motor velocity in parameter B83 v-max motor.

3. Select the Axis model wizard > Axis: Scaling > Conversion of positions, velocities, accelerations, torque/force area.

4. Velocity line:
    Enter the maximum motor velocity from B83 in the Velocity line of the Motor column and confirm with ENTER.

    ⇨ The maximum velocity of the motor has been transferred to the output.

5. Repeat the procedure for other limits, such as for the gear unit input speed (C11).

6. Select the Axis model wizard > Limit: Velocity, acceleration, jerk.

7. I10 Maximal speed:
    Limit the maximum velocity of the output, taking into account the determined system limits and the maximum motor velocity B83.

8. Determine the limiting values for acceleration and jerk if necessary and enter them into the associated parameters.

Limiting torque/force (optional)

The default values take into account the rated operation together with the overload reserves.

1. Select the Axis model wizard > Limit: Torque/force.

2. If the motor force must be limited, adapt the saved values as necessary.

4.2.6   Parameterizing limits

Limit the motion variables velocity, acceleration and jerk and define the quick stop deceleration according to the conditions applicable to your application.

✓ You have parameterized the general PROFINET settings.

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Axis model wizard > Limit: Velocity, acceleration, jerk.

3. I10 Maximal speed:
   Limit the maximum velocity of the output.

4. I11 Maximal acceleration:
   Limit the maximum acceleration of the output.

5. I16 Maximal jerk:
   Limit the maximum jerk of the output.

6. I17 Quickstop deceleration:
   Limit the quick stop deceleration of the output.

7. Set the parameters for the 2nd axis also (only for double-axis controllers).

Then define the reference value for the target and actual velocities. For a control in combination with standard telegram 1, 2 or 3, the reference value is mandatory to ensure the function of the application. For a control in combination with telegram 111, the reference value is not evaluated.

1. Mark the drive controller in the project tree and click in the Project menu > Parameter list area on the first projected axis.

2. Group M > Parameter M571 Velocity reference value:
   Define the reference value for the target and actual velocities.

3. Set the parameter for the 2nd axis also (only for double-axis controllers).

Information

When you set the corresponding parameters on the controller side during commissioning in TIA Portal, note that some units on the drive controller and controller side may be different.

Parameter (DS6)	Description	Parameter (TIA Portal)
I10	Maximal speed	Maximum permitted velocity ≤ I10
I11	Maximal acceleration	Maximum permitted acceleration/deceleration ≤ I11
I16	Maximal jerk	Maximum permitted jerk ≤ I16
I17	Quickstop deceleration	Emergency deceleration ≤ I17
M571	Velocity reference value, reference value for target and actual velocities	Reference speed = M571

Tab. 9: Required parameters on drive controller and controller sides

4.2.7   Optional: Referencing the absolute position

When commissioning a system with position measurement systems, the relation of a measured to an actual axis position must be determined.

For a control in combination with telegram 111, you must reference your drive if you are working with absolute positions. For all other controls, this step is not necessary. In this case, transfer and save the configuration (see Transmitting and saving the configuration [▶ 32]).

Information

If you are using a double-axis controller with two projected axes, you must reference the absolute position for each axis individually.

4.2.7.1   Defining the referencing method

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Referencing wizard.

3. I30 Referencing type, I31 Referencing direction, I35 Referencing with zero pulse:
    For information on possible combinations of the named characteristics as well as detailed descriptions of the individual referencing methods, see Referencing methods [▶ 62].

4. I43 Move to reference position:
    If the axis is to automatically move to the referenced position after a reference run, set this parameter to 1: Active.

4.2.7.2   Parameterizing the reference switch

If you are working with absolute positions and would like to determine a reference position while referencing using the reference switch, proceed as follows.

1. Select the PROFIdrive application wizard > Data sources > Application digital signals: Data source.

2. I103 Source reference switch:

    2.1.   If a digital input (direct or inverted) acts as the signal source, select the corresponding input.

    2.2.   If bit 3 of the control word I210 of the PROFIdrive application is the signal source, select 2: Parameter.
            Bit 3 is thus defined as the source for the reference switch.
            Note that individual bits of the control word are transmitted only if the control word is part of the process data mapping.

4.2.7.3   Setting the reference

If you are working with absolute positions and would like to reference without using a referencing run, the value of the current actual position is applied directly as a parameter value from I34 using the Set reference signal.

1. Select the PROFIdrive application wizard > Data sources > Application digital signals: Data source.

2. I111 Source set reference:

    2.1.   If a digital input (direct or inverted) acts as the signal source, select the corresponding input.

    2.2.   If the control word I210 of the PROFIdrive application acts as the signal source, select 2: Parameter.
            Bit 11 of the control word is set as a reference source.
            Note that individual bits of the control word are transmitted only if the control word is part of the process data mapping.

4.2.7.4   Parameterizing the limit switch

Using the limit switch, you can limit the travel range in the positive and negative direction using sensor signals, regardless of the operating mode. Both signals are protected against wire breaks (= low active, i.e. a low level leads to a limit switch fault).

Parameterizing a positive limit switch

1. Select the PROFIdrive application wizard > Data sources > Application digital signals: Data source.

2. I101 Source positive /limit switch:

    2.1.   If a digital input (direct or inverted) acts as the signal source, select the corresponding input.

    2.2.   If the control word I210 of the PROFIdrive application acts as the signal source, select 2: Parameter.
            Bit 1 of the control word is set as a data source for the positive limit switch.
            Note that individual bits of the control word are transmitted only if the control word is part of the process data mapping.

Parameterizing a negative limit switch

1. Select the PROFIdrive application wizard > Data sources > Application digital signals: Data source.

2. I102 Source negative /limit switch:

    2.1.   If a digital input (direct or inverted) acts as the signal source, select the corresponding input.

    2.2.   If the control word I210 of the PROFIdrive application acts as the signal source, select 2: Parameter.
            Bit 2 of the control word is set as a data source for the negative limit switch.
            Note that individual bits of the control word are transmitted only if the control word is part of the process data mapping.

4.2.8   Transmitting and saving the configuration

In order to transmit and save the configuration to one or more drive controllers, you must connect your PC and the drive controllers over the network.

> ⚠ **WARNING!**

Injury to persons and material damage due to axis movement!

If there is an online connection between DriveControlSuite and the drive controller, changes to the configuration can lead to unexpected axis movements.

- Only change the configuration if you have visual contact with the axis.

- Make sure that no people or objects are within the travel range.

- For access via remote maintenance, there must be a communication link between you and a person on site with eye contact to the axis.

> **Information**

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Prerequisites for finding a drive controller in the network:

- Network supports IPv4 limited broadcast

- All drive controllers and the PC are in the same subnet (broadcast domain)

Transmitting the configuration

✓ The drive controllers are switched on.

1. In the project tree, highlight the module under which you have recorded your drive controller and click Online connection in the project menu.

   ⇨ The Add connection dialog box opens. All drive controllers found via IPv4 limited broadcast are displayed.

2. Direct connection tab > IP address column:
   Activate the IP addresses in question and confirm your selection with OK.

   ⇨ The Online functions window opens. All drive controllers connected through the selected IP addresses are displayed.

3. Select the drive controller to which you would like to transfer the configuration. Change the selection of transmission type from Read to Send.

4. Change the selection Create new drive controller:
   Select the configuration that you would like to transfer to the drive controller.

5. Repeat steps 3 and 4 for all other drive controllers to which you would like to transfer your configuration.

6. Online tab:
   Click Establish online connections.

   ⇨ The configuration is transferred to the drive controllers.

Saving a configuration

✓ You have successfully transferred the configuration.

1. Online functions window:
    Click Save values (A00).

    ⇨ The Save values (A00) window opens.

2. Click Start action.

    ⇨ The configuration is saved on the drive controllers in non-volatile memory.

3. Close the Save values (A00) window.

Information

For the configuration to take effect on the drive controller, a restart is required when the configuration is saved on the drive controller for the first time or when changes are made to the firmware or process data mapping.

Restarting a drive controller

✓ You have saved the configuration on the drive controller in non-volatile memory.

1. Online functions window:
    Click Restart (A09).

    ⇨ The Restart (A09) window opens.

2. Select which of the connected drive controllers you want to restart.

3. Click Start action.

4. Confirm the safety instruction with OK.

    ⇨ The Restart (A09) window closes.

⇨ The fieldbus communication and connection between DriveControlSuite and drive controllers are interrupted.

⇨ The selected drive controllers restart.

4.2.9   Activating the control panel and testing the configuration

⚠ **WARNING!**

Injury to persons and material damage due to axis movement!

When you activate the control panel, DriveControlSuite gives you sole control of the motions of the axis. If you are using a controller, it no longer monitors the axis movements after the control panel is activated. The controller cannot intervene to prevent collisions. The controller takes over control again when the control panel is deactivated, which can cause unexpected axis movements.

- Do not switch to other windows when the control panel is active.

- Only use the control panel if you have visual contact with the axis.

- Make sure that no people or objects are within the travel range.

- For access via remote maintenance, there must be a communication link between you and a person on site with eye contact to the axis.

✓ You have successfully saved the configuration.

✓ There must not be any active safety function.

✓ The drive controller is switched on and connected to the network.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Highlight the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.

2. Select the Jog control panel wizard.

3. Click Control panel on and then Enable.
   ⇨ The drive is controlled using the activated control panel.

4. Move the axis step-by-step and test the direction of motion, velocity, distances, etc. using the Jog+, Jog−, Jog step+ and Jog step− buttons.

5. Optimize your project configuration based on your test results as necessary.

6. To deactivate the control panel, click on Control panel off.

Information

Jog+ and Jog− cause a continual manual movement in the positive or negative direction. Jog step+ and Jog step- move the axis relative to the current actual position by the increment specified in I14.

Jog+ and Jog− have a higher priority than Jog step+ and Jog step−.

4.3   TIA Portal: Setting up a PROFINET network

A PROFINET networks generally consists of a controller (IO controller) and multiple drive controllers (IO devices). Using
TIA Portal, map your real PROFINET network in a TIA project, configure all PROFINET nodes and link them logically with each
other. Then, transfer the configuration to the controller and check the cyclical communication.

Information

Always perform the steps described below in the specified order!

Some parameters are interdependent and do not become accessible to you until you have first configured certain settings.
Follow the steps in the specified sequence so that you can finish the parameterization completely.

4.3.1   Installing the GSD file

To be able to map the STOBER drive controllers of your PROFINET network in your TIA project, you must import and install a
GSD file (general station description file) from STOBER in your TIA project. STOBER drive controllers are available in the
hardware catalog of your TIA project as soon as the GSD file has been installed.

Information

If you have already downloaded a GSD file from the STOBER download area at an earlier point, make sure that you are using
the current version of the GSD file required.

✓ You have downloaded the current version of the GSD file from the STOBER download area and saved it locally.

✓ You have created a TIA project and are in the TIA project view.

1. In the menu bar, select Options > Manage general station description files (GSD).

   ⇨ The Manage general station description files window opens.

2. Installed GSDs tab, Source path area:
   Select the directory in which you have stored the GSD file from STOBER and confirm with OK.

   ⇨ The GSD file is displayed in the Content of the imported path area.

3. Content of the imported path area:
   Select the desired GSD file and click on Install.

⇨ The GSD file is installed; the STOBER drive controllers are available in the hardware catalog.

4.3.2   Projecting the PROFINET network

Map the controller and all drive controllers of your PROFINET network in a TIA project by selecting the corresponding modules from the hardware catalog and incorporating them into the project.

4.3.2.1   Projecting the controller

Project the controller of your PROFINET network.

✓ You have created a TIA project and installed the GSD file from STOBER.

✓ You are in the TIA network view; the hardware catalog is open.

1. Hardware catalog:
    Select Controller > SIMATIC S7-1500 > CPU and open the folder of the CPU type that belongs to your controller.

2. Drag and drop the desired controller into the network view.

⇨ The controller is incorporated into your TIA project.

4.3.2.2   Optional: Projecting synchronized operation

For standard telegram 3, configure the following settings for clock synchronization via PROFINET IRT if you want to implement control in application class 4. This step is omitted for standard telegram 3 in application class 1 and for other combinations.

✓ You have projected a controller.

✓ You are in the TIA network view.

1. Network view:
    Double-click on the controller of your PROFINET network.

    ⇨ This switches you to the respective device view; the Inspector window shows the device properties.

2. Inspector window > General tab:
    Select PROFINET interface > Advanced options > Clock synchronization in the area navigation.
    Clock synchronization for local modules area:
    Clock synchronization: Activate the option.

⇨ You have projected synchronized operation.

4.3.2.3   Projecting the drive controller

Project all drive controllers of your PROFINET network.

✓ You have created a TIA project and installed the STOBER-specific GSD.

✓ You are in the TIA network view; the hardware catalog is open.

1. Hardware catalog:
    Select Other field devices > PROFINET IO > Drives > STOBER ANTRIEBSTECHNIK GmbH & Co. KG > STOBER ANTRIEBSTECHNIK > STOBER 6th generation drive controllers > SI6, SC6 double-axis controllers+ PD2 or SI6, SC6 single-axis controllers + PD2.

2. Drag and drop the desired drive controller into the network view.

    ⇨ The drive controller is incorporated into your TIA project.

3. Repeat steps 1 and 2 for all drive controllers of your PROFINET network.

> **Information**
>
> To be able to project the SU6 safety module and use PROFIsafe, you must project a PROFIsafe-capable drive controller. You can identify a PROFIsafe-capable drive controller in the hardware catalog by the addition of **+ PROFIsafe** or **+ PS** in the device name.

4.3.2.4   Linking the controller and drive controller logically

Establish a logical gate link between the controller and drive controllers in order to enable the communication between the devices.

✓ You are in the TIA network view.

✓ You have projected the controller and drive controllers.

1. Click on the port of the controller and drag a connection to the port of the first drive controller while holding the mouse button.

2. Repeat the process for all drive controllers of your PROFINET network.

⇨ The controller and drive controllers of your PROFINET network are linked logically with each other.

> **Information**
>
> To be able to link the controller and drive controllers with each other logically, you must be in the TIA network view.

4.3.3   Configuring the controller

Configure the network addresses for the controller as needed.

4.3.3.1   Configuring network addresses

As needed, you can change the IP address and subnet mask of the controller.

✓ You are in the TIA network view.

1. Network view:
   Double-click on the controller of your PROFINET network.

   ⇨ This switches you to the respective device view; the Inspector window shows the device properties.

2. General tab:
   Select PROFINET interface > Ethernet addresses in the area navigation.

3. IP protocol area > Set IP address in the project:
   If not set by default, activate this option and change the IP address and subnet mask of the controller.

⇨ The IP address and subnet mask of the controller are configured.

4.3.4   Configuring the drive controller

Assign a device name for the drive controllers of your TIA project to be able to identify them in the PROFINET network. Project a telegram for each axis and configure the settings for synchronization afterwards if necessary.

4.3.4.1   Assigning device names

Assign a device name for your drive controllers to be able to identify them in the PROFINET network.

✓ You are in the TIA network view.

1. Network view:

    Double-click on a drive controller of your PROFINET network.

    ⇨ This switches you to the respective device view; the inspector window shows the device properties.

2. General tab:

    Select General in the area navigation.

    ⇨ The general settings for the drive controller open.

3. Name:

    Assign a device name for the drive controller that corresponds to the PROFINET naming conventions.

4. Device view:

    Mark the drive controller in question and select Assign device name using its context menu.

    ⇨ The Assign PROFINET device name window opens.

5. Click on Update list.

    ⇨ All drive controllers are listed that were found in the subnet.

    ⇨ Depending on the drive controller, the device type, IP address and MAC address are displayed.

6. Mark the drive controller that you would like to name and click on Assign name.

⇨ The device name is assigned to the selected drive controller.

Information

Using Flash LED, you can identify which drive controller you have currently selected if multiple drive controllers are found in the same subnet.

As an alternative, you can identify the drive controller by its MAC address. The MAC address of the drive controller can be read off in parameter A279 PN MAC addresses in DriveControlSuite (PROFINET wizard > Diagnostics).

4.3.4.2   Projecting a standard telegram

Project one standard telegram per axis.

✓   You are in the TIA network view; the hardware catalog is open.

1.   Network view:
     Double-click on a drive controller of your PROFINET network.

     ⇨   This switches you to the respective device view; the Inspector window shows the device properties.

2.   Hardware catalog > Module:
     Select PROFIdrive module.

3.   Drag and drop the module into the device overview of the drive controller at slot 1.

4.   Hardware catalog > Module > Submodules:
     Select a standard telegram.

5.   Drag and drop the selected standard telegram into the device overview of the drive controller at slot 1 2.

6.   If you are using a double-axis controller, repeat steps 2 – 5 for the second axis and slots 2 as well as 2 2.

4.3.4.3   Optional: Setting a drive controller synchronously

For standard telegram 3, configure the following settings for clock synchronization via PROFINET IRT if you want to implement control in application class 4. This step is omitted for standard telegram 3 in application class 1 and for other combinations.

✓   You are in the TIA network view.

1.   Network view:
     Double-click on a drive controller of your PROFINET network.

     ⇨   This switches you to the respective device view; the Inspector window shows the device properties.

2.   Inspector window > General tab:
     Select PROFINET interface > Advanced options > Clock synchronization in the area navigation.
     Clock synchronization for local modules area:
     Clock synchronization: Activate the option.

3.   Detail overview area:
     Activate the module with the inserted standard telegram 3 in the Clock synchronization column to assign the synchronized operation to the telegram. If it is a double-axis controller, activate the 2nd module with the inserted standard telegram 3.

     ⇨   The times are recalculated and entered in the Clock synchronization for local modules area. The transmission cycle is taken from the GSD file.

⇨   You have configured the drive controller for synchronized operation.

4.3.5   Configuring the control

The following chapters describe how to configure the control using 5 example combinations. Follow the description that applies to your application.

4.3.5.1   FB SINA_SPEED and standard telegram 1

With the function block SINA_SPEED, you can implement the control of a speed-controlled axis. You can use this function block with standard telegram 1.

Programming the control

```
                    #SINA_SPEED_
                      Instance
                       %FB285
                    "SINA_SPEED"
        ... ── EN
      0 ── EnableAxis        AxisEnabled ── 0
      0 ── AckError              Lockout ── 0
    0.0 ── SpeedSp          ActVelocity ── 0.0
 3000.0 ── RefSpeed               Error ── 0
16#003F ── ConfigAxis            Status ── 0
    267 ── HWIDSTW              DiagId ── 16#0000
    267 ── HWIDZSW                 ENO ──
```
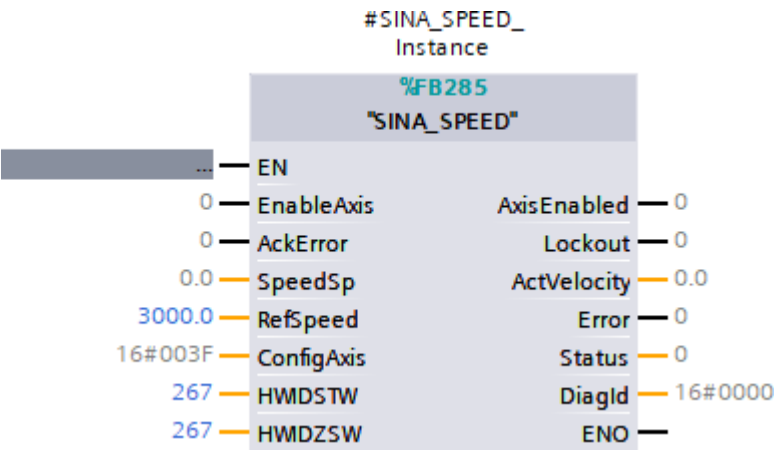
Fig. 5: Function block SINA_SPEED

For communication with the drive controller, you need the hardware identifier of the standard telegram hardware submodule on the controller side. The hardware identifier, 267 in this example, is displayed in the Inspector window > System constants tab if you mark the standard telegram in the device overview of the workspace.

Store the address for the inputs HWIDSTW (transmitting side from controller view) and HWIDZSW (receiving side from controller view).

Input	Data type	Required value
HWIDSTW	HW_IO	Hardware identifier of the standard telegram hardware submodule
HWIDZSW	HW_IO	Hardware identifier of the standard telegram hardware submodule

Tab. 10: Function block SINA_SPEED: Required values

For further information about the control of the function block, see the DriveLib documentation from Siemens.

Testing the application

Test the correct function of the application in the TIA Portal via a corresponding user program.

4.3.5.2   FB SINA_POS and telegram 111

With the function block SINA_POS, you can implement the control of a position-controlled axis. You can use this function block with Siemens telegram 111.

Programming the control
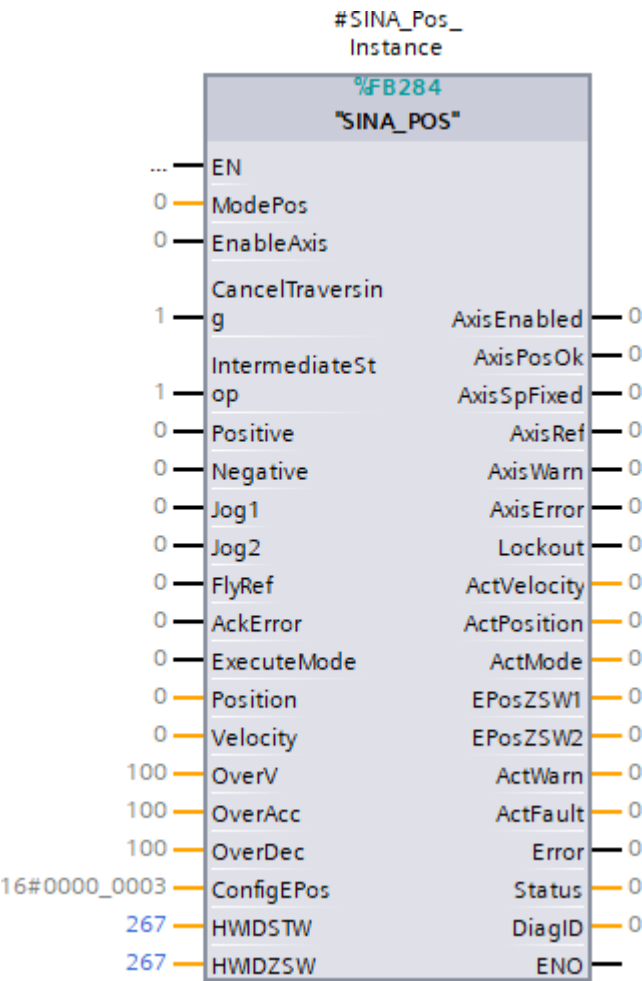
Fig. 6: Function block SINA_POS

For communication with the drive controller, you need the hardware identifier of the standard telegram hardware submodule on the controller side. The hardware identifier, 267 in this example, is displayed in the Inspector window > System constants tab if you mark the standard telegram in the device overview of the workspace.

Store the address for the inputs HWIDSTW (transmitting side from controller view) and HWIDZSW (receiving side from controller view).

Input	Data type	Required value
HWIDSTW	HW_IO	Hardware identifier of the standard telegram hardware submodule
HWIDZSW	HW_IO	Hardware identifier of the standard telegram hardware submodule

Tab. 11: Function block SINA_SPEED: Required values

For further information about the control of the function block, see the DriveLib documentation from Siemens.

Testing the application

Test the correct function of the application in the TIA Portal via a corresponding user program or via the interface of the function block SINA_POS.

4.3.5.3   TO_SpeedAxis and standard telegram 1, 2 or 3

With the technology object TO_SpeedAxis, you can implement the control of a speed-controlled axis. You can use this technology object with the standard telegrams 1, 2 or 3.

Parameterizing the control

✓ You have added the technology object to your controller in TIA Portal.

1. Project tree > Devices tab:
    Navigate to the technology object of the relevant drive controller.

    ⇨ Switch to the Function view via the configuration of the technology object.

2. In the area navigation, select Hardware interface > Drive.
    Drive type: Select PROFIdrive.
    Data connection: Select Drive.
    Drive: Select the drive with the hardware submodule that is already inserted.

3. In the area navigation, select Hardware interface > Data exchange with the drive.
    Drive data area:
    Drive telegram: Select the standard telegram that corresponds to the telegram of the inserted hardware module.
    Reference speed: Enter the reference speed for the set speed value. The reference speed must match parameter M571 on the drive controller side. Note the different units on the drive controller and controller sides.
    Maximum speed: Enter the maximum permitted speed. This must match or be smaller than parameter I10 on the drive controller side. Note the different units on the drive controller and controller sides.
    Additional data area:
    These functions are currently not supported.

4. In the area navigation, select Extended Parameters > Limits > Dynamic limits.
    Implement the settings necessary for your application.
    Maximum velocity: Enter the maximum permitted velocity. This must match or be smaller than parameter I10 on the drive controller side.
    Maximum acceleration: Enter the maximum permitted acceleration. This must match or be smaller than parameter I11 on the drive controller side.
    Maximum deceleration: Enter the maximum permitted delay. This must match or be smaller than parameter I11 on the drive controller side.

Programming the control

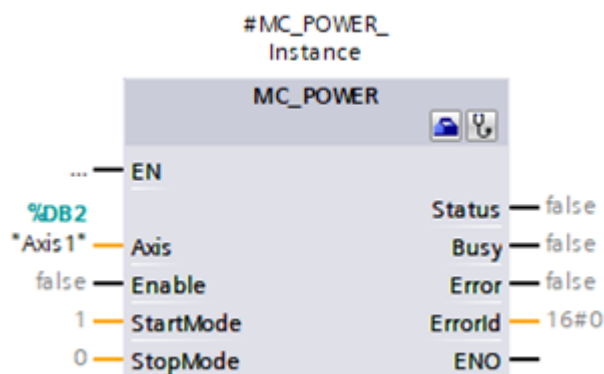The technology object is controlled via the PLCopen blocks MC_Power, MC_Halt, MC_Reset and MC_MoveVelocity:
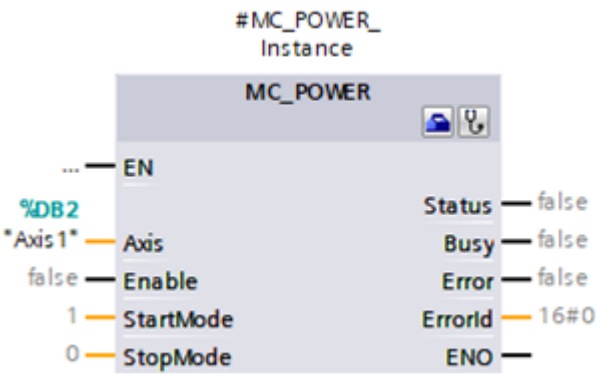
Fig. 7: PLCopen block MC_Power
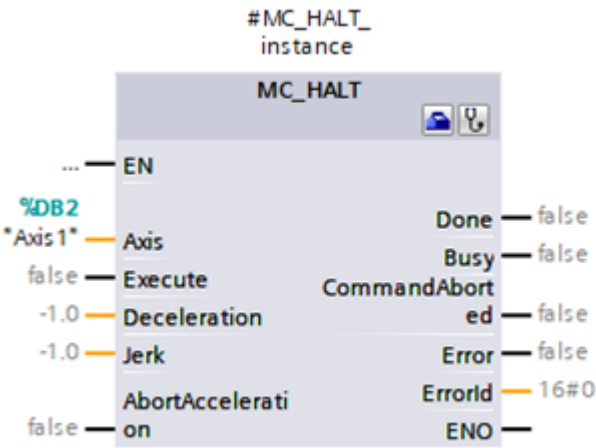
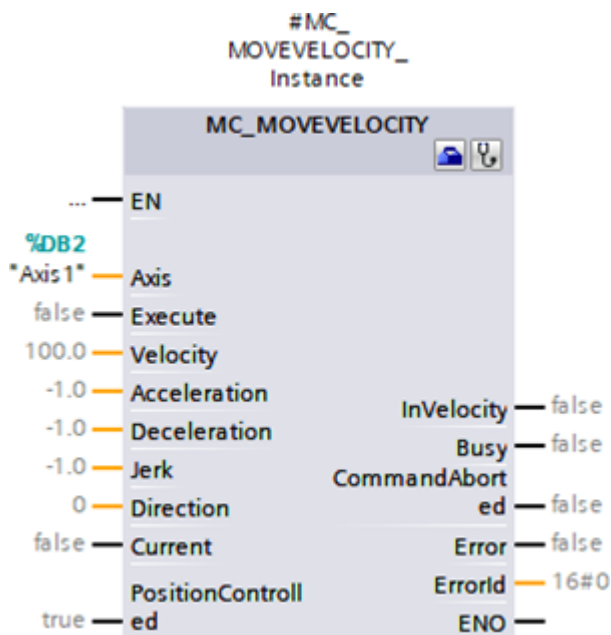Fig. 8: PLCopen block MC_Halt

Fig. 9: PLCopen block MC_Reset

```
                    #MC_
                MOVEVELOCITY_
                   Instance

                MC_MOVEVELOCITY
                                    [icons]

        ...  —  EN

      %DB2
    "Axis1"  —  Axis
      false  —  Execute
      100.0  —  Velocity
       -1.0  —  Acceleration
       -1.0  —  Deceleration          InVelocity  —  false
       -1.0  —  Jerk                       Busy  —  false
          0  —  Direction          CommandAbort
      false  —  Current                      ed  —  false
                PositionControll          Error  —  false
       true  —  ed                       ErrorId  —  16#0
                                            ENO  —
```
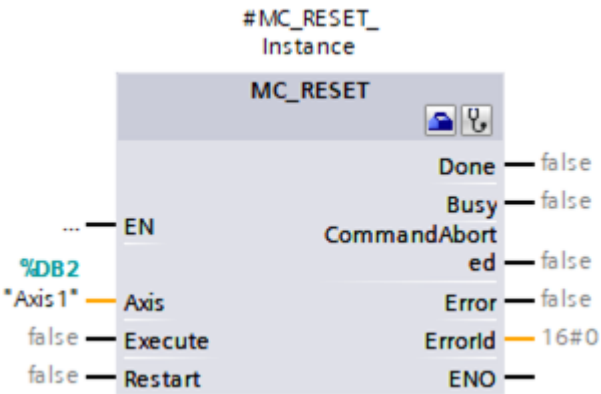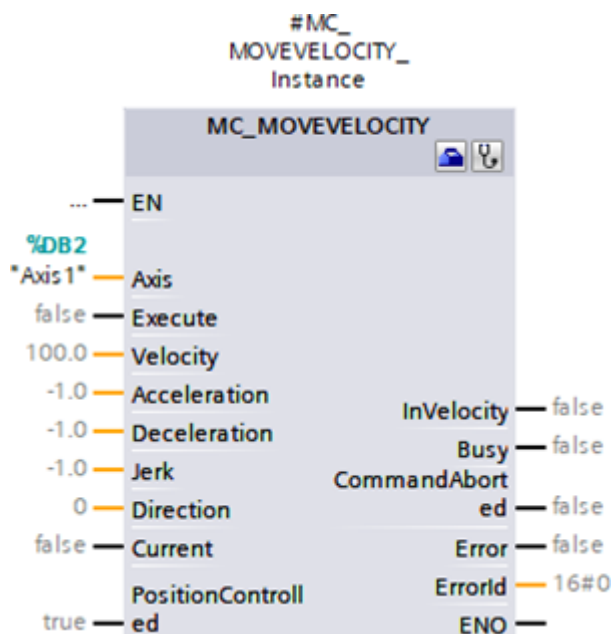
Fig. 10: PLCopen block MC_MoveVelocity

For more information about the control of the PLCopen blocks, see the documentation from Siemens or the online help in the TIA Portal.

Testing the application

Test the correct function of the application in TIA Portal via a user program using PLCopen programming for technology objects.

For commissioning, you can check the axis functionality via the axis control panel of the technology object (Project tree > Devices tab > Technology object of the relevant controller > Commissioning).

For diagnostics, you can check status and error bits, the status of the movement as well as the PROFIdrive telegram (Project tree > Devices tab > Technology object of the relevant controller > Diagnostics).

4.3.5.4   TO_PositioningAxis, TO SynchronousAxis and standard telegram 3

With the technology objects TO_PositioningAxis and TO_SynchronousAxis, you can implement the control of a position-controlled axis. TO_SynchonousAxis includes all functions of TO_PositioningAxis, but slave axes can follow the movements of a master axis. You can use both technology objects with standard telegram 3.

From the perspective of the drive, the parameterization of the technology objects is identical.

Parameterizing the control

✓ You have added the technology object to your controller in TIA Portal.

1. Project tree > Devices tab:
    Navigate to the technology object of the relevant drive controller.

    ⇨ Switch to the Function view via the configuration of the technology object.

2. In the area navigation, select Basic parameters.
    Set the basic parameters according to your requirements. These basic parameters are independent of the parameterization in the drive controller.
    Name: Enter the name to be used for the axis assignment at the PLCopen blocks.

3. In the area navigation, select Hardware interface > Drive.
    Drive type: Select PROFIdrive.
    Data connection: Select Drive.
    Drive: Select the drive with the hardware submodule that is already inserted.

4. In the area navigation, select Hardware interface > Encoder.
    Data connection: Select Encoder.
    Encoder: Select the drive with the hardware submodule already inserted, as this contains the required encoder data.
    Encoder type: Select the type of encoder connected to the drive controller. If an absolute encoder is connected to the drive controller, select Absolute. If, on the other hand, an incremental encoder is connected, select Incremental.

5. In the area navigation, select Hardware interface > Data exchange with the drive.
    Drive data area:
    Drive telegram: Select the standard telegram that corresponds to the telegram of the inserted hardware module.
    Reference speed: Enter the reference speed for the set speed value. The reference speed must match parameter M571 on the drive controller side. Note the different units on the drive controller and controller sides.
    Maximum speed: Enter the maximum permitted speed. This must match or be smaller than parameter I10 on the drive controller side. Note the different units on the drive controller and controller sides.
    Additional data area:
    These functions are currently not supported.

6. In the area navigation, select Hardware interface > Data exchange with encoder.
    Encoder telegram: Select the telegram that corresponds to the telegram of the inserted hardware module.
    Automatically accept encoder values at run time (online): Activate this option so that the technology object reads the required values from the drive controller. If automatic readout is not supported by the controller, you must enter the required encoder values manually (see Required encoder values [▶ 50]).

7. In the area navigation, select Extended Parameters > Mechanics.
    Encoder mounting type: Select On motor shaft. Other options are not supported.

8. In the area navigation, select Extended Parameters > Dynamic default values.
    Implement the settings necessary for your application.
    Velocity: Enter the velocity. This must match or be smaller than parameter I10 on the drive controller side.
    Acceleration: Enter the acceleration. This must match or be smaller than parameter I11 on the drive controller side.
    Delay: Enter the delay. This must match or be smaller than parameter I11 on the drive controller side.

9.   In the area navigation, select Extended Parameters > Emergency stop.

Implement the settings necessary for your application.

Maximum velocity: Enter the maximum permitted velocity. This must match or be smaller than parameter I10 on the
drive controller side.

Emergency deceleration: Enter the quick stop deceleration. This must match or be smaller than parameter I17 on the
drive controller side.

10. In the area navigation, select Extended Parameters > Limits > Dynamic limits.

Implement the settings necessary for your application.

Maximum velocity: Enter the maximum permitted velocity. This must match or be smaller than parameter I10 on the
drive controller side.

Maximum acceleration: Enter the maximum permitted acceleration. This must match or be smaller than parameter
I11 on the drive controller side.

Maximum deceleration: Enter the maximum permitted delay. This must match or be smaller than parameter I11 on
the drive controller side.

Programming the control

The technology object is controlled via the PLCopen blocks MC_Power, MC_Halt, MC_Reset, MC_MoveVelocity, MC_Home,
MC_MoveRelative, MC_MoveAbsolute and MC_MoveJog:

Fig. 11: PLCopen block MC_Power

Fig. 12: PLCopen block MC_Halt

#MC_RESET_
Instance

```
               MC_RESET
                                  [icon][icon]
                          Done ── false
                          Busy ── false
    ··· ── EN         CommandAbort
                           ed ── false
%DB2
"Axis1" ── Axis           Error ── false
  false ── Execute      ErrorId ── 16#0
  false ── Restart         ENO ──
```

Fig. 13: PLCopen block MC_Reset

#MC_
MOVEVELOCITY_
Instance

```
            MC_MOVEVELOCITY
                                  [icon][icon]
    ··· ── EN
%DB2
"Axis1" ── Axis
  false ── Execute
  100.0 ── Velocity
   -1.0 ── Acceleration
   -1.0 ── Deceleration    InVelocity ── false
                               Busy ── false
   -1.0 ── Jerk          CommandAbort
      0 ── Direction          ed ── false
  false ── Current           Error ── false
          PositionControll  ErrorId ── 16#0
   true ── ed                  ENO ──
```

Fig. 14: PLCopen block MC_MoveVelocity

#MC_HOME_
Instance

```
               MC_HOME
                                  [icon][icon]
                      ReferenceMarkP
                          osition ── 0.0
                          Done ── false
    ··· ── EN            Busy ── false
%DB2               CommandAbort
"Axis2" ── Axis            ed ── false
  false ── Execute        Error ── false
    0.0 ── Position      ErrorId ── 16#0
      0 ── Mode             ENO ──
```

Fig. 15: PLCopen block MC_Home

Fig. 16: PLCopen block MC_MoveRelative
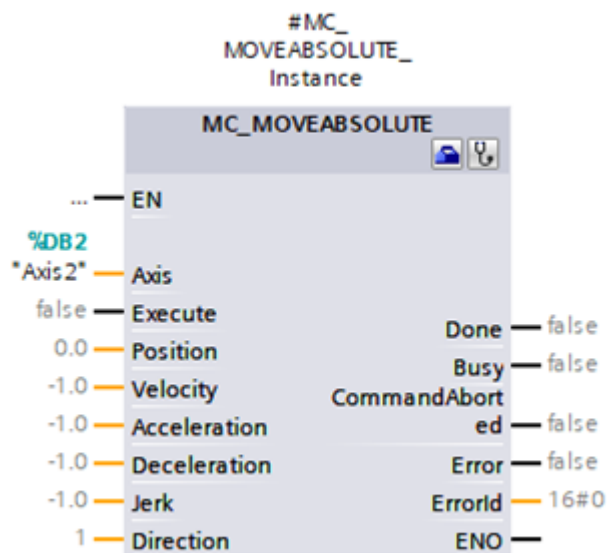
Fig. 17: PLCopen block MC_MoveAbsolute
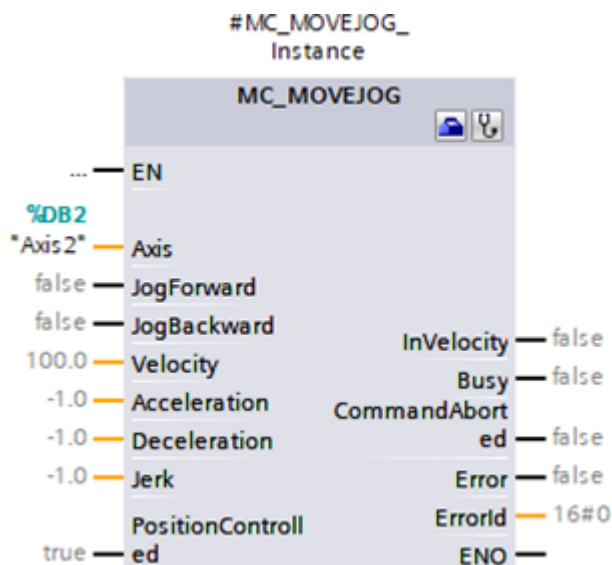
Fig. 18: PLCopen block MC_MoveJog

For the technology object SynchronousAxis, the PLCopen blocks MC_GearIn and MC_MoveSuperimposed are also available:
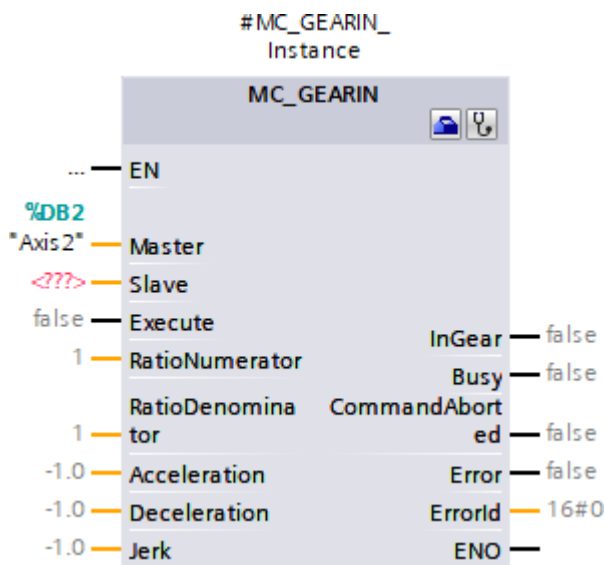
Fig. 19: PLCopen block MC_GearIn
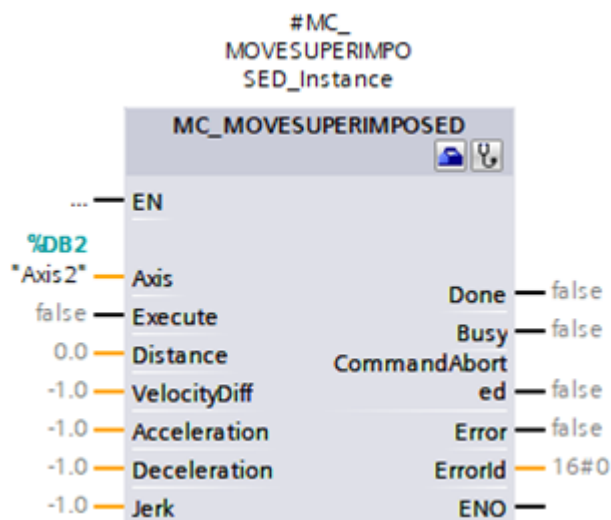
Fig. 20: PLCopen block MC_MoveSuperimposed

For more information about the control of the PLCopen blocks, see the documentation from Siemens or the online help in the TIA Portal.

Testing the application

Test the correct function of the application in TIA Portal via a user program using PLCopen programming for technology objects.

For commissioning, you can check the axis functionality via the axis control panel of the technology object (Project tree > Devices tab > Technology object of the relevant controller > Commissioning).

For diagnostics, you can check status and error bits, the status of the movement as well as the PROFIdrive telegram (Project tree > Devices tab > Technology object of the relevant controller > Diagnostics).

4.3.5.4.1   Required encoder values

Required encoder values

If automatic readout from the drive controller is not supported on the controller side, you can take the information from the parameter M537 Sensor format. The following table contains the required values for encoders from STOBER as an example:

Encoder model	Measuring system	ST bit	MT bit	Increments per revolution M537[2]	Number of revolutions M537[5]	Bit in Gx_XIST1 M537[3]	Bit in Gx_XIST2 M537[4]
Resolver 2-pole	Rotational	16	1	65536	1	0	0
Inductive 2.1 ECI 1118	Rotational	18	1	262144	1	0	0
Inductive 2.2 ECI 1118-G2	Rotational	18	1	262144	1	0	0
Optical 2.1 ECN 1123	Rotational	13	1	8192	1	0	0
Optical 2.2 ECN 1123	Rotational	23	1	8388608	1	0	0
Inductive 2.2 EBI 1135	Rotational	18	16	65536	65536	3	0
Inductive 2.2 EQI 1131	Rotational	19	12	524288	4096	0	0
Inductive 3.0 EQI 1131	Rotational	19	12	524288	4096	0	0
Inductive 2.1 EQI 1130	Rotational	18	12	262144	4096	0	0
Optical 2.1 EQN 1125	Rotational	13	12	8192	4096	0	0
Optical 2.2 EQN 1135	Rotational	13	23	1048576	4096	0	0
Inductive 2.1 ECI 119 hollow shaft	Rotational	19	1	524288	1	0	0
Inductive 2.2 ECI 119-G2 hollow shaft	Rotational	19	1	524288	1	0	0
Inductive 2.2 EBI 135 hollow shaft	Rotational	19	16	65536	65536	3	0
Optical 2.1 EQN 1325	Rotational	13	12	8192	4096	0	0
Optical 2.2 EQN 1337	Rotational	25	12	1048576	4096	5	0
HIPERFACE EKM36-0KF0A0S01	Rotational	18	12	262144	4096	0	0
HIPERFACE EDM35-2KF0A024A	Rotational	24	12	1048576	4096	4	0
Incremental encoder 1024 inc./rev.	Rotational	10	0	4096	0	0	0
Without encoder (Lean motor)	Rotational	16	0	65536	0	0	0

Tab. 12: Required encoder values

4.3.5.5   TO_BasicPos and Siemens telegram 111

With the technology object TO_BasicPos, you can implement the control of a position-controlled axis. You can use this technology object with Siemens telegram 111.

Parameterizing the control

✓ You have added the technology object to your controller in TIA Portal.

1. Project tree > Devices tab:
   Navigate to the technology object of the relevant drive controller.

   ⇨ Switch to the Function view via the configuration of the technology object.

2. In the area navigation, select Hardware interface > Drive.
   Drive: Select the drive with the hardware submodule that is already inserted.

Programming the control

The technology object is controlled via its function block:
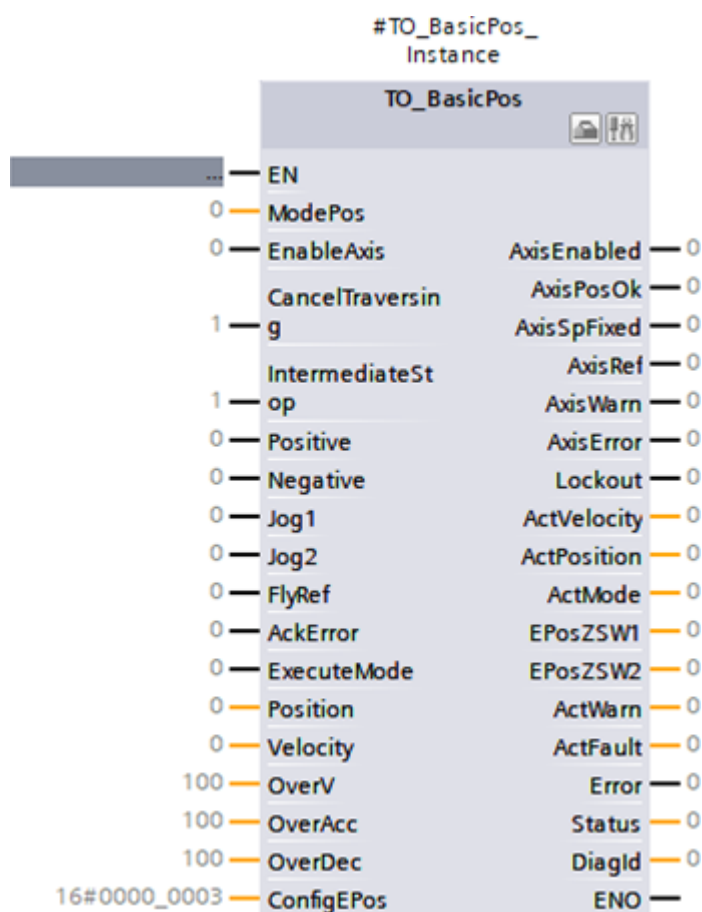
Fig. 21: TO_BasicPos block

For more information about the control of the block, see the documentation from Siemens or the online help in the TIA Portal.

Testing the control

Test the correct function of the application in TIA Portal via a corresponding user program or via the interface of the block TO_BasicPos.

4.3.6   Transmitting the configuration

Transmit the configuration of your TIA project from your PC to your controller.

✓ You have fully mapped and parameterized your PROFINET network in the TIA project.

1. Project navigation > Devices tab:
    Select the folder of the controller in question.

2. Select Online > Advanced download to device in the menu bar.

    ⇨ The Advanced download window opens.

3. Select target device area:
    Select Show all compatible nodes and click on Start search.

    ⇨ All controllers are listed that were found in the subnet.

4. Select the controller where you would like to transfer the configuration and click on Download.

    ⇨ The Software synchronization before downloading to a device window opens.

5. Click on Continue without synchronizing.

    ⇨ The Preview download window opens.

6. Click on Download.

    ⇨ The configuration is transmitted to the selected controller and the Results of the download process window
       opens.

7. Click on Finish.

⇨ The download process is complete; the configuration was transmitted successfully to the controller.

Information

If there is an online connection, you can identify which controller you have currently selected using Flash LED if multiple
controllers are located in the same subnet.

---

5   More on PROFIdrive?

The following chapters summarize the important terms and relationships concerning the application PROFIdrive.

5.1   PROFIdrive – Concept

Depending on the selected control, you can implement drive- or controller-based applications using the PROFIdrive application. The drive-based applications provide full motion calculation and execution in the drive. Here, the set values for position and velocity are converted into movements accurately and precisely. Referencing and jogging are performed, like all movements, with jerk limitation during commissioning. In controller-based applications with cyclic set value specification by the controller, the drive controllers can also perform motion tasks independently, for example referencing and the jog function during commissioning. The drive controllers are either networked via PROFINET or receive signals and set values via digital hardware inputs.

5.1.1   Control

The application is based on the internationally standardized drive profile PROFIdrive for electric drives (version 4.2) according to IEC 61800-7-303. Accordingly, the drive controller is controlled using the PROFIdrive-compliant control and status words.

5.1.2   Application classes and telegrams

The PROFIdrive application provides you with 3 application classes in production mode.

Application class 1 (AC1)

- Set velocity specification by a controller
- Standard telegrams 1, 2 or 3

Application class 3 (AC3)

- Set position specification by a controller
- Siemens telegram 111

Application class 4 (AC4)

- Synchronized, cyclic set velocity specification by a controller
- Standard telegram 3

For commissioning, emergency operation and maintenance or repair work, you can use jog mode (manual operation) to move the drive independently of the controller.

For more information, see .

5.1.3   Source for digital signals

Certain signals can be controlled by digital hardware inputs.

In DriveControlSuite, you can flexibly select the source for control signals such as limit switches and reference switches.

5.1.4 Control panels

The control panels are special wizards in DriveControlSuite, which you can use to take control of the axis. With the help of the control panels, you can manually release and move an axis even if the drive controller has no operating unit or is difficult to access.

Using control panels, you can check the connection wiring, the project configuration of your physical axis model or the parameterization of your application before you start commissioning the controller or switch to normal operation.

The following control panels are available:

- Jog control panel is used to check the projected axis model in jog mode.

- Control panel motion provides you with a standard set of motion commands based on PLCopen. Via the control panel, independent of the application and fieldbus interface, you can parameterize a motion profile directly for the motion core of the axis in order to check the basic functions of the drive controller.

Because control panels override normal operation, they can be activated only with a deactivated enable signal and should be operated by experienced users only.

5.2 Axis model

With the help of the axis model, you map the real mechanical environment of your drive project in DriveControlSuite by parameterizing the axis type and the arrangement of existing encoders. The parameterization of the axis model is required for the smooth operation and easy diagnosis of your drive train.

With I05 Type of axis, you select a rotational or a translational axis model and define whether the scaling of the axis is done using either predefined or individually configured units of measure. With I00 Position range, you parameterize either an endless or a limited travel range. You parameterize the encoder arrangement by using B26 Motor encoder and I02 Position encoder.

The 6th generation of STOBER drive controllers are specially developed for communication between the drive controller and controller on the basis of the actual variables at the output (° or mm of real axis movement). The scaling of the axis model is calculated by the drive controller's firmware independently of the encoder model, without any rounding errors or drift.

If your axis model is not followed by any other gear ratios, you can operate the axis with output-side motion variables where all nominal and actual values correspond to the real axis movement.

Information

The firmware processes values for the motion variables velocity, acceleration and jerk in the data type REAL32 (floating-point number, 32 bits). Position values are processed in the INT32 data type (integer, 32 bits) to eliminate rounding errors and enable precise movements.

Abbreviation	Meaning
M	Motor
MEnc	Motor encoder
PEnc	Position encoder

Rotational axis models

The following figures each show a rotational axis model consisting of a motor, a gear unit and a rotary table (endless rotational) or a pointer (limited rotational). Rotational axis models support rotational motor encoders as well as rotational position encoders.
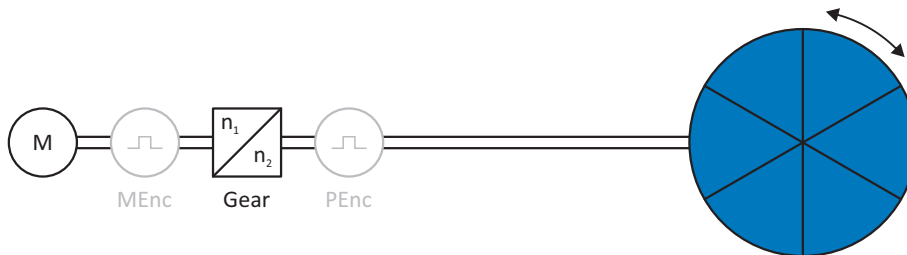
Fig. 22: Endless-rotational motion: Rotary table
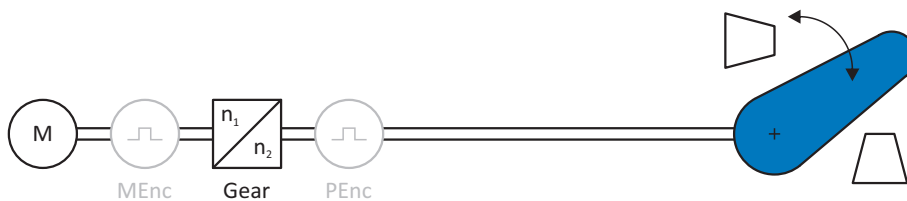
Fig. 23: Limited-rotational motion: Pointer

Translational axis models

The following figures each show a translational axis model consisting of a motor, gear unit, feed and conveyor belt (endless translational) or tool slide (limited translational). Translational axis models support rotational motor encoders as well as rotational or translational position encoders.
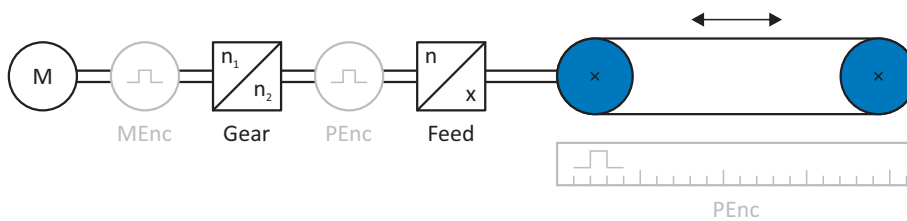
Fig. 24: Endless translational motion: Conveyor belt
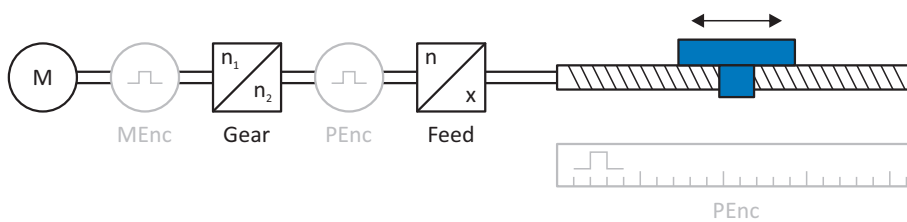
Fig. 25: Limited translational motion: Tool slide

Encoder arrangement

You parameterize the encoder arrangement by using B26 Motor encoder and I02 Position encoder. The motor encoder for velocity control is located on the motor shaft. The position encoder for position control is located on the gear unit output. If you use only one of the two encoders, it will be used for both velocity and position control.

Encoder	Parameterization	Encoder arrangement
Motor encoder	B26 ≠ 0: Inactive I02 = 0: Motor encoder	
Position encoder	B26 ≠ 0: Inactive I02 = B26	
Motor encoder & position encoder	B26 ≠ 0: Inactive I02 ≠ B26	

5.3   Limit switches

Limit switches are sensors that detect when a certain position has been reached.

A distinction is made here between hardware limit switches and software limit switches. While a hardware limit switch is a real switch (hardware), a software limit switch refers to the position limiting or position monitoring implemented in the software.

There are hardware and software limit switches on real axes, while virtual masters only have software limit switches.

Behavior in jog mode, reaching the +/- 31 bit computing limit and simultaneous triggering of positive and negative limit switches are special cases.

5.3.1   Real axes

There are hardware and software limit switches on real axes.

5.3.1.1   Faults

If a hardware or software limit switch is overshot, a fault is triggered.

Fault

53: Limit switch

Causes

- 1: Hardware-Limit-Switch positive

- 2: Hardware-Limit-Switch negative

- 3: SW-limit switch positive

- 4: SW-limit switch negative

- 5: +/- 31 bit computing limit reached

- 7: Both limit switches not connected

The fault can be acknowledged. Note that movement is only possible in the opposite direction of the limit switch, since the direction of the triggered hardware or software limit switch is locked. A direction lock is displayed in parameter I196.

5.3.1.2 Denial

If the axis is at a hardware limit switch (I441 or I442 = High) or if it is beyond of the software limit switch, movement is denied in the locked direction. An active direction lock is only deactivated when the axis is again within the limit switches for at least 1 s.

In this case, parameter I91 Error = 1: Active.

The cause is output in parameter I90. Possible causes are:

- 1: Illegal direction

- 2: SW-limit switch positive

- 3: SW-limit switch negative

- 10: Denied because position is not in circular length

- 11: HW-limit switch positive

- 12: HW-limit switch negative

> **Information**
>
> There are no software limit switches for an infinite axis, since this would contradict the nature of an infinite axis.

A movement limitation is also displayed in parameter E80:

- If E80 = 20: Limit switch, check the parameterization and the connection of the limit switches.

- If E80 = 15: Illegal direction, check the set values and a possible direction lock in parameter I196.

Also check I196 if the permitted direction was limited with I04.

> **Information**
>
> Parameter I04 is only available for infinite axes.

5.3.1.3 Hardware limit switches

Hardware limit switches apply if your sources are defined in parameters I101 and I102.

Relevant parameters

- I101 Source positive /limit switch

- I102 Source negative /limit switch

- I441 Signal /HW limit switch positive

- I442 Signal /HW limit switch negative

- I805 Actual value HW-Limit switch positive

- I806 Actual value HW-Limit switch negative

- I52 Delete limit switch memory

- I196 Direction blocking

If I441 and I442 = 0: Inactive, fault 53 is triggered with cause 7: Both limit switches not connected. Therefore, after parameterizing I101 and I102, check whether the hardware limit switches are also connected physically.

If I101 and I102 = 2: Parameter, the fault is triggered by the control word of the application (I210). In this case, check the controller connection.

Passable hardware limit switches

The hardware limit switches can be passed over. It is therefore possible to use an infinite cam as a hardware limit switch. The limit switch is detected if the signal goes to 0: Inactive (parameters I441 and I442).

If the hardware limit switch is overshot, the position at which the limit switch was detected is saved. When resetting limit switches, the axis must have reached or passed back over this saved position before the signal is valid again.
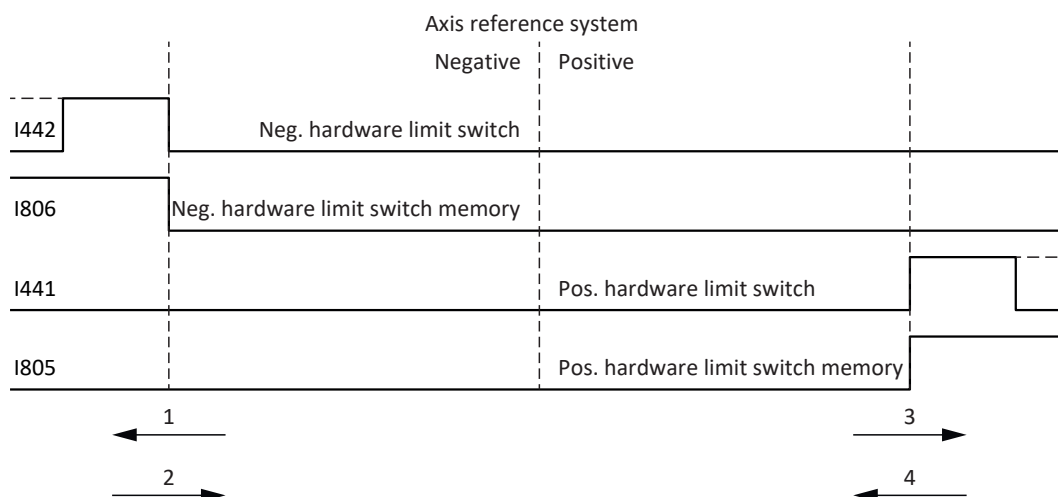
Fig. 26: Hardware limit switch memory

1	Setting the memory (negative hardware limit switch) with rising edge
2	Resetting the memory (negative hardware limit switch) with falling edge
3	Setting the memory (positive hardware limit switch) with rising edge
4	Resetting the memory (positive hardware limit switch) with falling edge

---

Information

The passable hardware limit switch is no longer effective once the position at which the edge of the limit switch was detected has been passed over again.

Note that the positions are not saved in non-volatile memory. This means that if the axis is beyond a passable limit switch after activation, it must first be reset to the regular travel range.

The entire system is simpler if you do not use any passable limit switches.

During commissioning or in case of defective hardware limit switch connections, problems can arise with the saved positions. These can be deleted with parameter I52. However, deletion only takes place if the corresponding limit switch signal is inactive. Stored positions can also be deleted by referencing, setting a reference can be deleted using I452 or by restarting the drive controller.

During referencing, the hardware limit switches are not evaluated as limit switches. There are referencing methods in which the hardware limit switches are used for referencing.

Example

A positive limit switch ranges from position 100 to 120.
When moving in the positive direction, it is detected at 100.
On the return journey, due to tolerances, it can be the case that the limit switch has already been left at 101.
Despite this, position 100 must be undershot in order to leave the effective limit switch.

5.3.1.4   Hardware limit switches when referencing

Hardware limit switches assume a special position when referencing.

Limit switch as reference switch

The hardware limit switches can be used in place of a reference switch (I30 = 2: Limit switch).

Change of direction

In other referencing types, a hardware limit switch signal leads to a change of direction. However, the signal only causes a change if it matches the direction of travel.

If the detected hardware limit switch does not match the direction of travel (e.g. negative limit switch with positive direction of travel), a fault is then triggered.

Example

At the start of referencing, the axis is between the reference switch and positive limit switch. The referencing direction is positive. The axis moves in the positive direction and first encounters the positive limit switch, not the reference switch. The axis reverses and searches for the reference switch in the other direction.

5.3.1.5   Software limit switches

Software limit switches only apply if the axis has been referenced.

Only limited axes have software limit switches (I00 = 0: Limited).

Relevant parameters

- I50 Software stop positive

- I51 Software stop negative

- I196 Direction blocking

If the values defined in parameter I50 and parameter I51 are the same, the software limit switches are deactivated.

5.3.1.6   Software limit switches when referencing

Software limit switches are not evaluated when referencing.

5.3.1.7   Shutting down by the limit switch

If a limit switch is approached from the permitted travel range, a fault is immediately triggered after detecting the limit switch edge.

If the current position is on or beyond the limit switch, a fault is only triggered again if the limit switch area has been left for at least 1 s.

5.3.2   Special cases

A few special cases are described below.

5.3.2.1   Behavior in jog mode

The jog behavior depends on the selected control type for jog mode (I26).

> ⚠ **DANGER!**
>
> **Risk of fatal injury due to gravity-loaded vertical axis!**
>
> If you select 0: Velocity control as the control type for jog mode, a gravity-loaded vertical axis descends as soon as jog mode is activated via the control panel, the application or the operating unit (SD6) (parameter I26).
>
> ▪ Only use the 0: Velocity control control type with axes that do not have a gravity load.

I26 = 0: Velocity control:
As soon as the axis moves to a software limit switch, a quick stop is triggered instead of a fault. As a result, the axis does not stop precisely on the software limit switch, but shortly thereafter depending on the quick stop ramp. It can immediately be shut down again by the software limit switch. The "incorrect" direction is locked.

I26 = 1: Position control:
The axis is braked during jog mode (with jog deceleration and jog jerk) in such a way that the axis comes to a stop shortly before the software limit switch and does not overrun it.

5.3.2.2   Reaching the +/- 31 bit computing limit

Fault:
53: Limit switch

Cause:
5: +/- 31 bit computing limit reached

The computing limit can be reached if, for example, so many commands follow after each other for the moving axis that the total distance to be traveled (including decimal places) adds up to over 2^31.

5.3.2.3   Simultaneous detection of positive and negative hardware limit switches

Fault:
53: Limit switch

Cause:
7: Both limit switches not connected

This fault is triggered if I441 and I442 are both 0: Inactive. Check whether the hardware limit switches are also connected physically.

If I101 and I102 = 2: Parameter, the fault is triggered by the control word of the application (I210). In this case, check the controller connection.

The fault can be acknowledged with I52.

5.4 Referencing in AC3

When commissioning a system with a position measurement system, the relation of a measured axis to an actual axis position must be determined.

During initial commissioning or after changes to the axis model, the actual position of the axis is unknown. A defined initial position is necessary.
As a rule, this is either identified through a reference search or referencing setting. The associated process is referred to as referencing.
Absolute movements can be performed only in a referenced state.
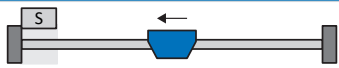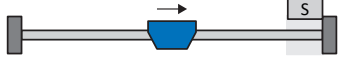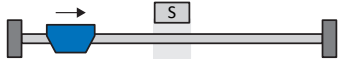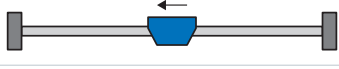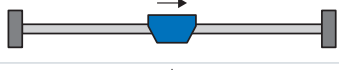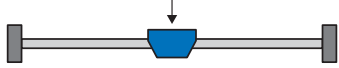
5.4.1 Referencing methods

The following table shows an overview of the possible referencing methods.

Abbreviation	Meaning
S	Switch
M/F	Torque or force

	Method	Initial movement	Zero pulse	Feature
	A	Negative	Yes	Negative limit switch
	B	Negative	Yes	Negatively positioned reference switch
	C	Negative	–	Negative limit switch
	D	Negative	–	Negatively positioned reference switch
	E	Positive	Yes	Positive limit switch
	F	Positive	Yes	Positively positioned reference switch
	G	Positive	–	Positive limit switch
	H	Positive	–	Positively positioned reference switch
	I	Positive	Yes	Centrally positioned reference switch
	J	Positive	–	Centrally positioned reference switch
	K	Negative	Yes	Centrally positioned reference switch
	L	Negative	–	Centrally positioned reference switch
	M	Negative	Yes	Zero pulse
	N	Positive	Yes	Zero pulse
	O	–	–	Setting the reference
	P	Positive	–	Torque/force stop
	Q	Positive	Yes	Torque/force stop
	R	Negative	–	Torque/force stop
	S	Negative	Yes	Torque/force stop

Tab. 13: Referencing methods

5.4.1.1   Referencing methods in detail

The following chapters show the individual referencing methods in detail.

The following abbreviations are used in the graphs on the referencing methods:

Abbreviation	Meaning
ALT	Alternative
LS	Limit Switch
RS	Reference Switch
ZP	Zero Pulse

Information

For graphically representing axes, the left is the smallest and the right is the largest position value. This means a positive movement goes to the right and a negative to the left.

The following parameters are used in the descriptions of the referencing methods:

Coordinate	Name
I28	Homing torque/force limit
I29	Time homing torque/force limit
I30	Referencing type
I31	Referencing direction
I32	Referencing speed fast
I33	Referencing speed slow
I34	Reference position
I35	Referencing with zero pulse
I39	Referencing acceleration
I43	Move to reference position
I44	Reference à-coup
I53	Index search offset
I101	Source positive /limit switch
I102	Source negative /limit switch
I103	Source reference switch

5.4.1.1.1   Referencing method A

Referencing method A determines a reference using a run to the negative limit switch and zero pulse.
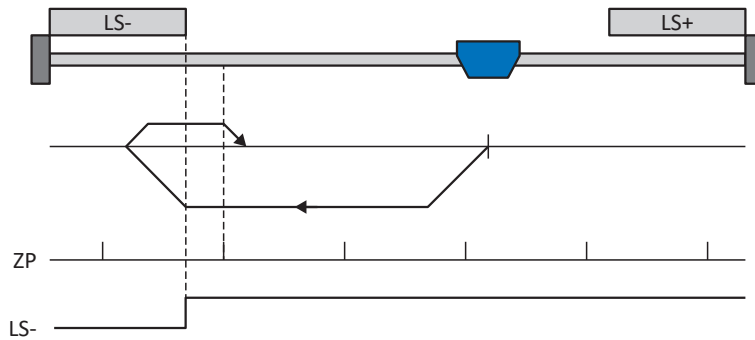
Preparation

1. Activate referencing method A by setting the following parameters to the specified values:
    I30 to 2: Limit switch,
    I31 to 1: Negative,
    I35 to 1: Active.

2. I102:
    Enter the data source for the negative limit switch.

3. I32, I33, I39, I44, I34:
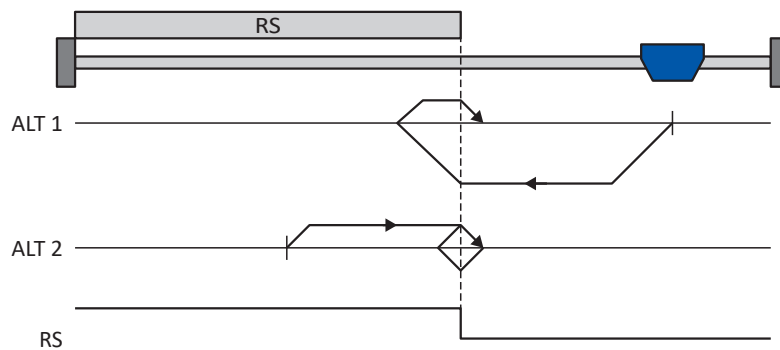   Define the set values necessary for referencing.

4. I53:
    Define the start of the search for the zero pulse search

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:
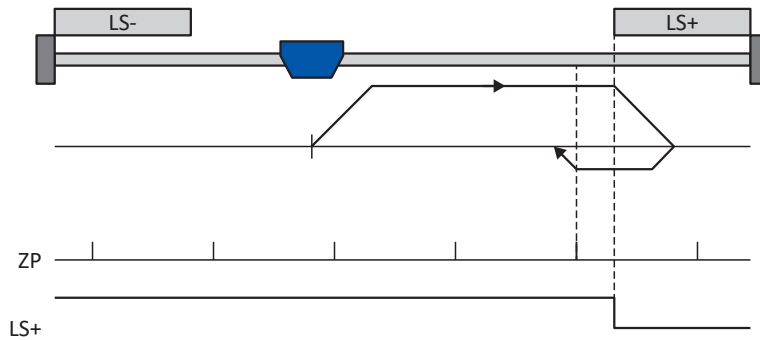
1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the negative limit switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the limit switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.2   Referencing method B

Referencing method B determines the reference using a run to the negatively positioned reference switch and zero pulse.
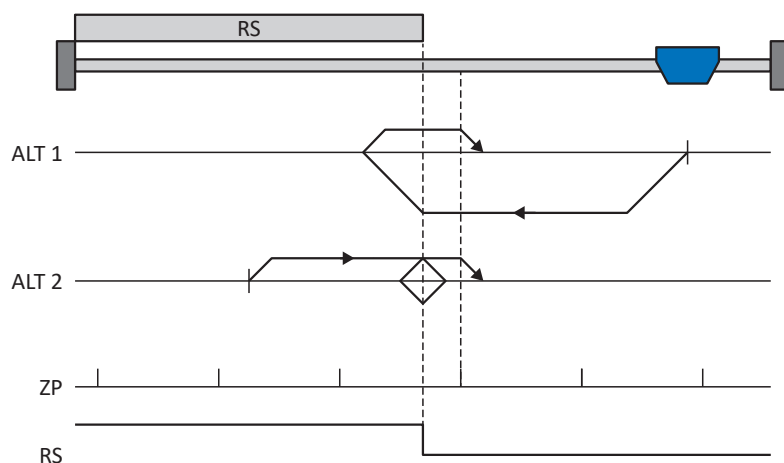
Preparation

1. Activate referencing method B by setting the following parameters to the specified values:
    I30 to 1: Reference input,
    I31 to 1: Negative,
    I35 to 1: Active.

2. I103:
    Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

4. I53:
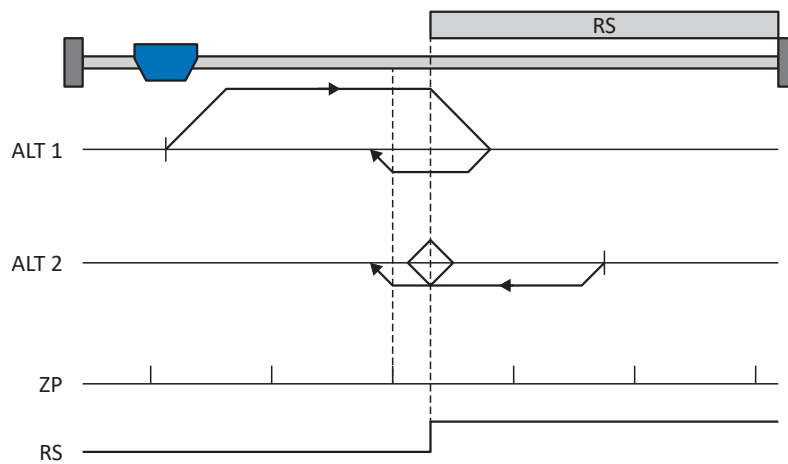   Define the start of the search for the zero pulse search

Referencing

If the PLCopen command MC_Home is active, a distinction is made between two referencing variants.

✓ Alternative 1: Drive is positioned in front of the reference switch

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the reference switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

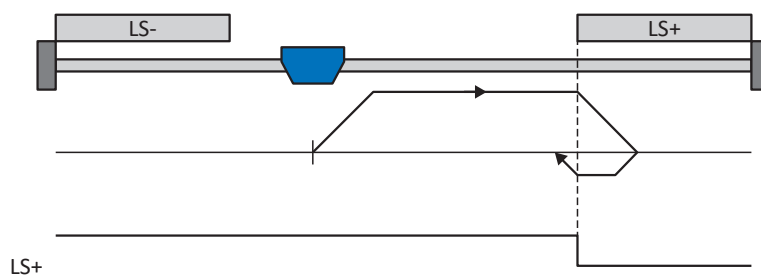✓ Alternative 2: Drive stopped at reference switch

1. The drive starts in the positive direction with acceleration I39 and velocity I33.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction again and continues at velocity I33 until it reaches the zero pulse.

4. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.3   Referencing method C

Referencing method C determines the reference using a run to the negative limit switch.
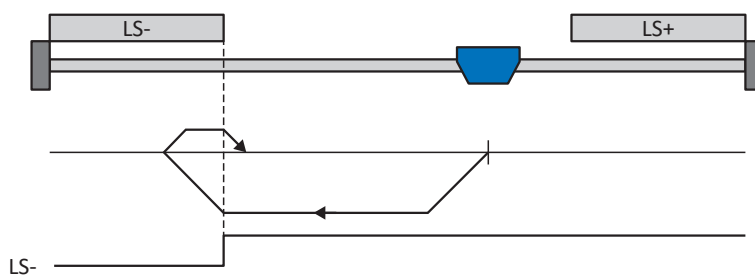
Preparation

1. Activate referencing method C by setting the following parameters to the specified values:
   I30 to 2: Limit switch,
   I31 to 1: Negative,
   I35 to 0: Inactive.

2. I102:
   Enter the data source for the negative limit switch.

3. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the negative limit switch and continues its run with velocity I33 until it leaves the limit switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the limit switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.4   Referencing method D

Referencing method D determines the reference using a run to the negatively positioned reference switch.

Preparation

1. Activate referencing method D by setting the following parameters to the specified values:
    I30 to 1: Reference input,
    I31 to 1: Negative,
    I35 to 0: Inactive.

2. I103:
    Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
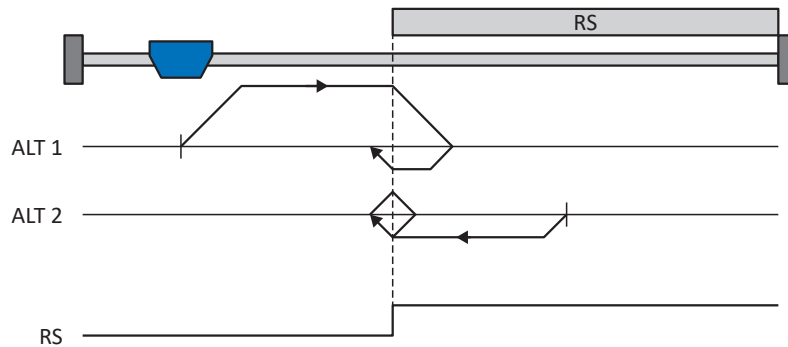   Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, a distinction is made between two referencing variants.

✓ Alternative 1: Drive is positioned in front of the reference switch

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it leaves the reference switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 2: Drive stopped at reference switch

1. The drive starts with acceleration I39 and velocity I33 in the positive direction until it leaves the reference switch.

2. It changes its direction upon leaving the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction and continues its run at velocity I33 until it reaches the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon reaching the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.5 Referencing method E

Referencing method E determines the reference using a run to the positive limit switch and zero pulse.

Preparation

1. Activate referencing method E by setting the following parameters to the specified values:
   I30 to 2: Limit switch,
   I31 to 0: Positive,
   I35 to 1: Active.

2. I101:
   Enter the data source for the positive limit switch.

3. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

4. I53:
   Define the start of the search for the zero pulse search

Referencing

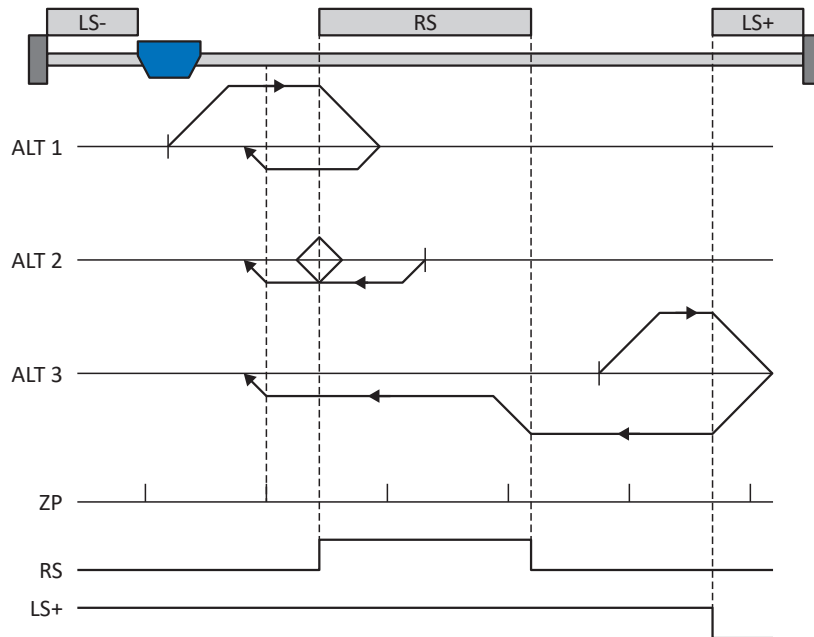If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the positive limit switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the limit switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.6 Referencing method F

Referencing method F determines the reference using a run to the positively positioned reference switch and zero pulse.

Preparation

1. Activate referencing method F by setting the following parameters to the specified values:

   I30 to 1: Reference input,

   I31 to 0: Positive,

   I35 to 1: Active.

2. I103:

   Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:

   Define the set values necessary for referencing.

4. I53:

   Define the start of the search for the zero pulse search

Referencing

If the PLCopen command MC_Home is active, a distinction is made between two referencing variants.

✓ Alternative 1: Drive is positioned in front of the reference switch

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the reference switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

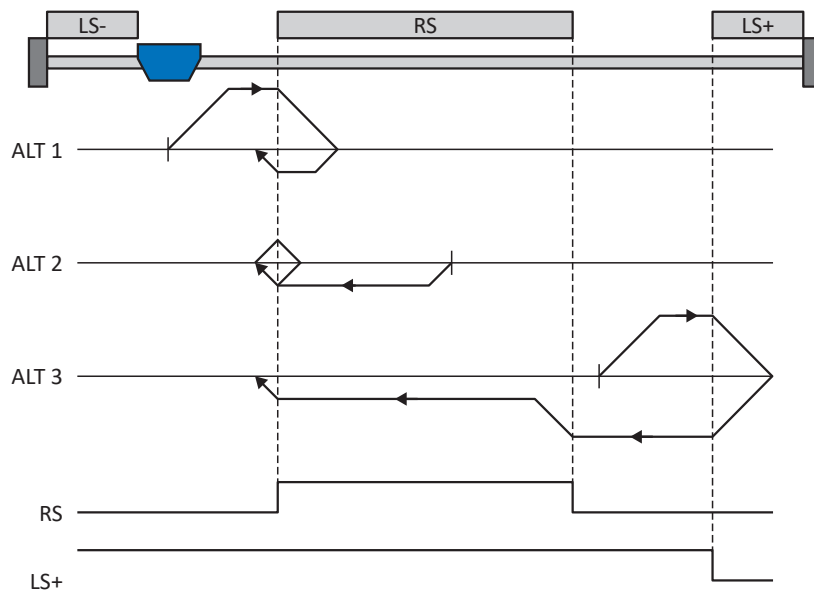✓ Alternative 2: Drive stopped at reference switch

1. The drive starts in the negative direction with acceleration I39 and velocity I33.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction again and continues at velocity I33 until it reaches the zero pulse.

4. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.7 Referencing method G

Referencing method G determines the reference using a run to the positive limit switch.

Preparation

1. Activate referencing method G by setting the following parameters to the specified values:
   I30 to 2: Limit switch,
   I31 to 0: Positive,
   I35 to 0: Inactive.

2. I101:
   Enter the data source for the positive limit switch.

3. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the positive limit switch and continues its run with velocity I33 until it leaves the limit switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the limit switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.8   Referencing method H

Referencing method H determines the reference using a run to the positively positioned reference switch.

Preparation

1. Activate referencing method H by setting the following parameters to the specified values:
    I30 to 1: Reference input,
    I31 to 0: Positive,
    I35 to 0: Inactive.

2. I103:
    Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, a distinction is made between two referencing variants.

✓ Alternative 1: Drive is positioned in front of the reference switch

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it leaves the reference switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 2: Drive stopped at reference switch

1. The drive starts with acceleration I39 and velocity I33 in the negative direction until it leaves the reference switch.

2. It changes its direction upon leaving the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction and continues its run at velocity I33 until it reaches the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon reaching the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.9 Referencing method I

Referencing method I determines the reference using a run to the centered reference switch and zero pulse.

Preparation

1. Activate referencing method I by setting the following parameters to the specified values:
   I30 to 1: Reference input,
   I31 to 0: Positive,
   I35 to 1: Active.

2. I103:
   Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

4. I53:
   Define the start of the search for the zero pulse search

Referencing

If the PLCopen command MC_Home is active, a distinction is made between three referencing sequences.

✓ Alternative 1: Drive is positioned between the negative limit and reference switches

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the reference switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.
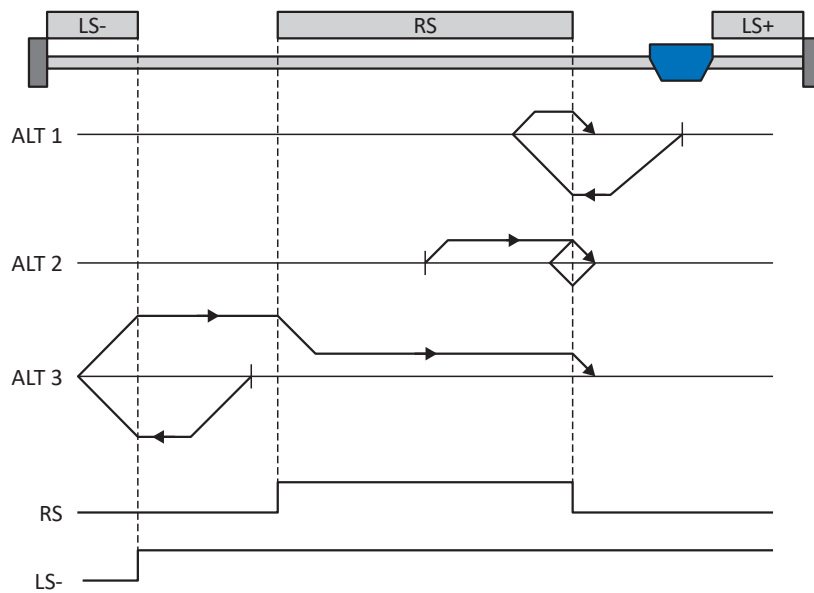
✓ Alternative 2: Drive stopped at reference switch

1. The drive starts in the negative direction with acceleration I39 and velocity I33.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction again and continues at velocity I33 until it reaches the zero pulse.

4. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 3: Drive is positioned between the reference and positive limit switches

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the positive limit switch until the reference switch is reached.

3. Upon reaching the reference switch, the drive changes its velocity to I33 until it leaves the reference switch again.

4. The current actual position is set to the value of the reference position I34 after leaving the reference switch and upon reaching the next zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.10   Referencing method J

Referencing method J determines the reference using a run to the centered reference switch.

Preparation

1. Activate referencing method J by setting the following parameters to the specified values:
   I30 to 1: Reference input,
   I31 to 0: Positive,
   I35 to 0: Inactive.

2. I103:
   Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, a distinction is made between three referencing sequences.

✓ Alternative 1: Drive is positioned between the negative limit and reference switches

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it leaves the reference switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.
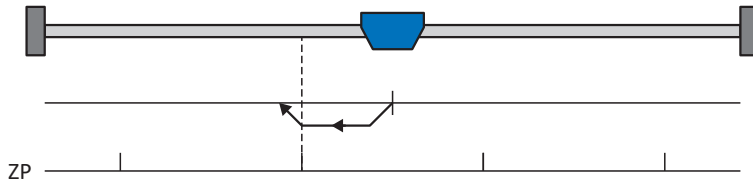
✓ Alternative 2: Drive stopped at reference switch

1. The drive starts in the negative direction with acceleration I39 and velocity I33.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I32 until it leaves the reference switch.

3. When the drive comes to a stop after the reference switch, it changes direction and continues its run at velocity I33 until it reaches the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon reaching the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 3: Drive is positioned between the reference and positive limit switches

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. Upon reaching the positive limit switch, the drive changes its direction and continues its run until it reaches the reference switch.

3. Upon reaching the reference switch, the drive changes its velocity to I33 until it leaves the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.11   Referencing method K

Referencing method K determines the reference using a run to the centered reference switch and zero pulse.
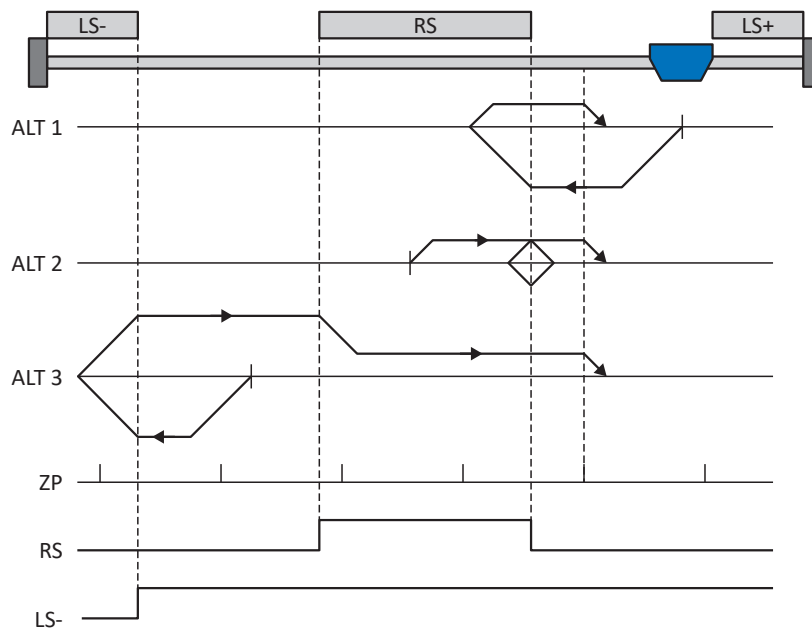
Preparation

1. Activate referencing method K by setting the following parameters to the specified values:
    I30 to 1: Reference input,
    I31 to 1: Negative,
    I35 to 1: Active.

2. I103:
    Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

4. I53:
    Define the start of the search for the zero pulse search

Referencing

If the PLCopen command MC_Home is active, a distinction is made between three referencing variants.

✓ Alternative 1: Drive is positioned between the reference and positive limit switches

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it reaches the next zero pulse after leaving the reference switch.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 2: Drive stopped at reference switch

1. The drive starts in the positive direction with acceleration I39 and velocity I33.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction again and continues at velocity I33 until it reaches the zero pulse.

4. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 3: Drive is positioned between the negative limit and reference switches

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the negative limit switch and continues its run until the reference switch is reached.

3. Upon reaching the reference switch, the drive changes its velocity to I33 and continues its run until it reaches the next zero pulse after leaving the reference switch.

4. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.12   Referencing method L

Referencing method L determines the reference using a run to the centered reference switch.

Preparation

1. Activate referencing method L by setting the following parameters to the specified values:
    I30 to 1: Reference input,
    I31 to 1: Negative,
    I35 to 0: Inactive.

2. I103:
    Enter the data source for the reference switch.

3. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

Referencing

If the PLCopen command MC_Home is active, a distinction is made between three referencing variants.

✓ Alternative 1: Drive is positioned between the reference and positive limit switches

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the reference switch and continues its run with velocity I33 until it leaves the reference switch again.

3. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

4. The drive comes to a standstill with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 2: Drive stopped at reference switch

1. The drive starts with acceleration I39 and velocity I33 in the positive direction until it leaves the reference switch.

2. It changes its direction upon leaving the reference switch and continues its run with velocity I32.

3. When the drive comes to a stop after the reference switch, it changes direction and continues its run at velocity I33 until it reaches the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon reaching the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

✓ Alternative 3: Drive is positioned between the negative limit and reference switches

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the negative limit switch and continues its run until the reference switch is reached.

3. When the reference switch is reached, the drive changes its velocity to I33 and continues its run until it leaves the reference switch again.

4. The current actual position is set to the value of the reference position I34 upon leaving the reference switch.

5. The drive comes to a standstill with deceleration I39.

6. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.13   Referencing method M

This method determines the reference using a run to the zero pulse.

Preparation

1. Activate referencing method M by setting the following parameters to the specified values:
   I30 to 3: Zero pulse,
   I31 to 1: Negative,

2. I32, I39, I44, I34:
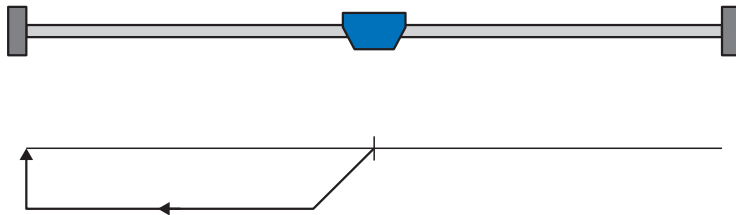   Define the set values necessary for the referencing.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

3. The drive comes to a standstill with deceleration I39.

4. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.14   Referencing method N

Referencing method N determines the reference using a run to the zero pulse.
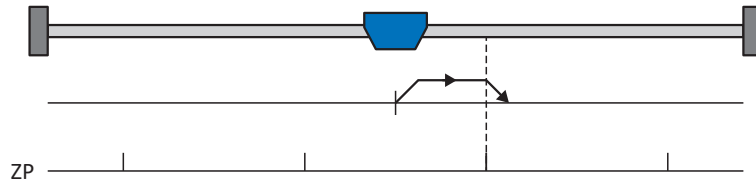
Preparation

1. Activate referencing method N by setting the following parameters to the specified values:
    I30 to 3: Zero pulse,
    I31 to 0: Positive,

2. I32, I39, I44, I34:
    Define the set values necessary for the referencing.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

3. The drive comes to a standstill with deceleration I39.

4. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.15   Referencing method O

Referencing method O determines the reference by setting the reference to any position.
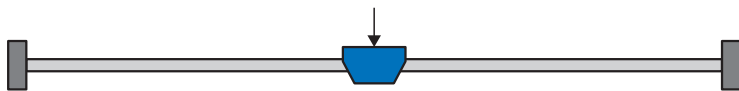
Preparation

1. I30:
   Activate referencing method O by setting this parameter to 5: Define home.

2. I34:
   Define the reference position.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

The current actual position is set to the value of the reference position I34.

5.4.1.1.16   Referencing method P

Referencing method P determines the reference using a run with a torque/force stop.
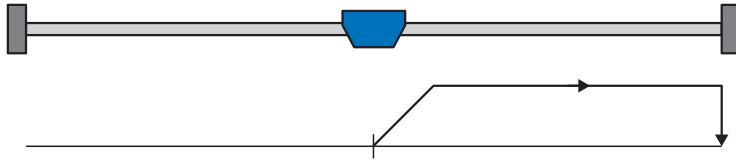
Preparation

1. Activate referencing method P by setting the following parameters to the specified values:
    I30 to 4: Torque/force stopper,
    I31 to 0: Positive,
    I35 to 0: Inactive.

2. I32, I39, I44, I34:
    Define the set values necessary for the referencing.

3. I28, I29:
    Define the torque/force limit. If the actual torque for the time stored in I29 is above the limit defined in I28 for an ongoing period, the torque/force limit is reached.

> **Information**
>
> In case of a selected value for the torque/force variable that is too big, the machine can be damaged. In case of a selected value that is too small, an incorrect reference position may be applied.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. The current actual position is set to the value of the reference position I34 when the torque/force limit is reached and the time stored in I29 has elapsed.

3. The set values are set to the value 0 with deceleration I39.

4. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.17   Referencing method Q

Referencing method Q determines the reference using a run with a torque/force stop and zero pulse.
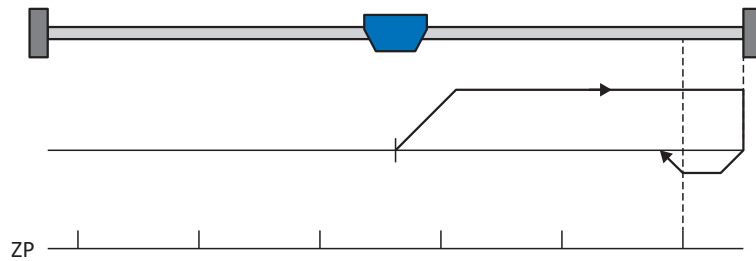
Preparation

1. Activate referencing method Q by setting the following parameters to the specified values:
    I30 to 4: Torque/force stopper,
    I31 to 0: Positive,
    I35 to 1: Active.

2. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

3. I28, I29:
    Define the torque/force limit. If the actual torque for the time stored in I29 is above the limit defined in I28 for an ongoing period, the torque/force limit is reached.

4. I53:
    Define the start of the search for the zero pulse search.

Information

In case of a selected value for the torque/force variable that is too big, the machine can be damaged. In case of a selected value that is too small, an incorrect reference position may be applied.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the positive direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the torque/force stop and when the time stored in I29 has passed, and continues its run with velocity I33 until it reaches the next zero pulse.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The set values are set to the value 0 with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.18   Referencing method R

Referencing method R determines the reference using a run with a torque/force stop.

Preparation

1. Activate referencing method R by setting the following parameters to the specified values:
    I30 to 4: Torque/force stopper,
    I31 to 1: Negative,
    I35 to 0: Inactive.

2. I32, I33, I39, I44, I34:
    Define the set values necessary for referencing.

3. I28, I29:
    Define the torque/force limit. If the actual torque for the time stored in I29 is above the limit defined in I28 for an ongoing period, the torque/force limit is reached.

Information

In case of a selected value for the torque/force variable that is too big, the machine can be damaged. In case of a selected value that is too small, an incorrect reference position may be applied.

Referencing

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. The current actual position is set to the value of the reference position I34 when the torque/force stop is reached and the time stored in I29 has elapsed.

3. The set values are set to the value 0 with deceleration I39.

4. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.1.1.19   Referencing method S

Referencing method S determines the reference using a run with a torque/force stop and zero pulse. The run starts with a negative initial movement.
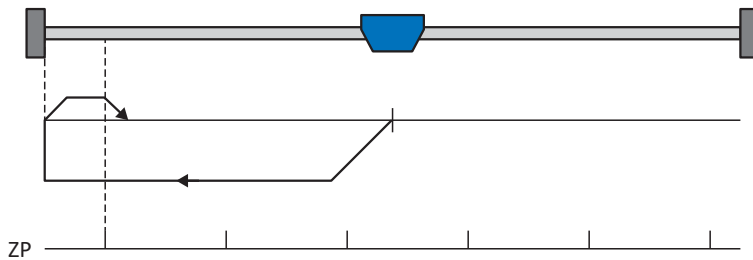
Preparation

1. Activate referencing method S by setting the following parameters to the specified values:
   I30 to 4: Torque/force stopper,
   I31 to 1: Negative,
   I35 to 1: Active.

2. I32, I33, I39, I44, I34:
   Define the set values necessary for referencing.

3. I28, I29:
   Define the torque/force limit. If the actual torque for the time stored in I29 is above the limit defined in I28 for an ongoing period, the torque/force limit is reached.

4. I53:
   Define the start of the search for the zero pulse search

Information

In case of a selected value for the torque/force variable that is too big, the machine can be damaged. In case of a selected value that is too small, an incorrect reference position may be applied.

Referencing

If the PLCopen command MC_Home is active, referencing takes places as follows:

1. The drive starts in the negative direction with acceleration I39 and velocity I32.

2. It changes its direction upon reaching the torque/force stop and after the time stored in I29 has passed, and continues its run with velocity I33 until it reaches the next zero pulse.

3. The current actual position is set to the value of reference position I34 upon reaching the zero pulse.

4. The set values are set to the value 0 with deceleration I39.

5. If I43 is set to 1: Active, the drive is positioned at reference position I34.

5.4.2   Reference position

Depending on the referencing type I30, the actual position I80 is replaced by the reference position I34 during the referencing event.

5.4.3   Reference retaining

STOBER offers a convenient drive-based referencing system. Depending on the encoder model used and the reference management, different types of reference retaining (I46) are offered.

5.5   Referencing in AC1 and AC4

In application classes 1 and 4, the controller is responsible for the position of the axes and is thus responsible for referencing the axes. Position-capable technology objects are controlled for referencing via the PLCopen block MC_Home.

Referencing	Positioning axis/ Synchronous axis with incremental encoder	Positioning axis/ Synchronous axis with absolute encoder	External incremental encoder	External absolute encoder
Active referencing (Mode = 3 or 5)	X	—	—	—
Passive referencing (Mode = 2, 8 or 10)	—	—	—	—
Setting the actual position (Mode = 0)	X	X	—	—
Relative displacement of the actual position (Mode = 1)	X	X	—	—
Absolute encoder adjustment (Mode = 6, 7)	—	X	—	—

Tab. 14: Referencing in AC1 and AC4

For more information about the control of the PLCopen blocks, see the documentation from Siemens or the online help in the TIA Portal.

5.6   Synchronization: Sign-of-Life

Sign-of-Life is a life counter that helps the application in the motion controller (block in the controller that controls the movement) and the application in the drive controller monitor each other. As soon as the application in the drive controller has synchronized to the clock of the controller, the drive controller starts sending drive controller Sign-of-Life signals (DO-LS). This consists of four bits in the status word ZSW2 and follows the specification of the Sign-of-Life of the controller (C-LS). If the drive controller no longer responds correctly and on time due to a synchronization error, an alarm is triggered in the controller. If the controller or technology object do not behave in a synchronized manner, the drive controller triggers fault 52: Communication with cause 16: PROFINET Sign-of-Life synchronisation failed.

Information

The Sign-of-Life mechanism is only active when synchronized operation is active in application class 4 (AC4).

5.7 Cycle times

Possible cycle times can be found in the following table.

Type	Cycle times	Relevant parameters
PROFINET RT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
PROFINET IRT fieldbus, cyclical communication	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150

Tab. 15: Cycle times

5.8 PROFIdrive device control

Device control is the central component of a drive. It defines the control channel from which set values are processed and where actual values are output.

The PROFIdrive device control is based on the internationally standardized device profile PROFIdrive for electric drives. This profile describes the control sequence of a drive controller based on a device state machine. Each device state here represents a certain behavior that can be changed only through defined processes. These processes are assigned to individual state transitions.

For example, device control regulates the device start-up when turning on the supply voltage, the enable state of the drive controller, the process of a quick stop, the behavior in case of fault and the restart after a fault.

For state transitions, the device state machine must receive certain bit combinations in the control word (STW) according to PROFIdrive. The bit combination in the status word (ZSW), however, indicates the current state of the drive controller.

5.9 General presets

The control signals are transmitted from the controller to the drive controller via fieldbus. For the start of a movement and for the jog function, which is defined in the PROFIdrive profile, the following presets are therefore implemented in the DriveControlSuite:

Parameter	Default value
I100 Source execute	2: Parameter
I104 Source jog enable	2: Parameter
I105 Source positive jog	2: Parameter
I106 Source negativ jog	2: Parameter

Tab. 16: Presets: Source digital signals (application)

5.10 General control

In addition to the signals of the device control, which are implemented via the control word 1 (STW1, parameter M515) and the status word 1 (ZSW1, parameter M516), a general control signal from STW1 is also used to influence the application. On the application level, a MC_Stop is executed if bit 0 is set to the value 0. To operate the application, bit 0 must be set to the value 1.

Bit	Designation	Comment
0	On	Switch on voltage: 0 = inactive; 1 = active

Tab. 17: General control: Bit 0 in control word 1

5.11   Jog

Jog is activated for all application classes and telegrams via control word 1 (M515). In control word 1, the following bits are assigned for the jog function:

Bit	Designation	Comment
8	Jog 1 ON	Positive jog (prerequisite: I104 = I105 = 2: Parameter): 0 = inactive; 1 = active
9	Jog 2 ON	Negative jog (prerequisite: I104 = I106 = 2: Parameter): 0 = inactive; 1 = active

Tab. 18: Jog: Bit 8 + 9 in control word 1

The jog profile is defined by the following parameters:

- I12 Jog velocity

- I13 Jog acceleration

- I18 Jog jerk

5.12   Application classes and telegrams in detail

The following chapters describe the application classes and telegrams in detail.

5.12.1   Telegrams and process data

Selecting a telegram determines the process data on the drive controller side that is to be transmitted. From the drive controller's point of view, the received process data represents the receive PZD and the process data to be transmitted represents the transmit PZD. This data consists of the following elements:

- Receive PZD: Control words (STW) or set values

- Transmit PZD: State words (ZSW) or actual values

The time-critical process data is exchanged cyclically.

The mapping of the process data via the telegram is specified by the controller to the drive controller in parameter M513 and displayed in parameter M512.

Standard telegrams

The standard telegrams correspond to the standardized profile PROFIdrive.

The following standard telegrams are available:

Standard telegram	Application class	Description
1	AC1	Set speed value 16 bit
2	AC1	Set speed value 32 bit
3	AC1, AC4	Set speed value 32 bit with 1 position encoder

Tab. 19: Standard telegrams of the PROFIdrive application

Manufacturer-specific telegrams

The following manufacturer-specific telegrams are available:

Siemens telegram	Application class	Description
111	AC3	Positioning (single positioner)

Tab. 20: Manufacturer-specific telegrams of the application PROFIdrive

5.12.2   Application class 1 (standard drive)

Application class 1 (AC1) is intended for speed-controlled axes and includes speed control with an integrated profile generator. The set values for the velocity are specified by the controller and read in the drive controller according to the cycle time. The complete speed control takes place in the drive controller.
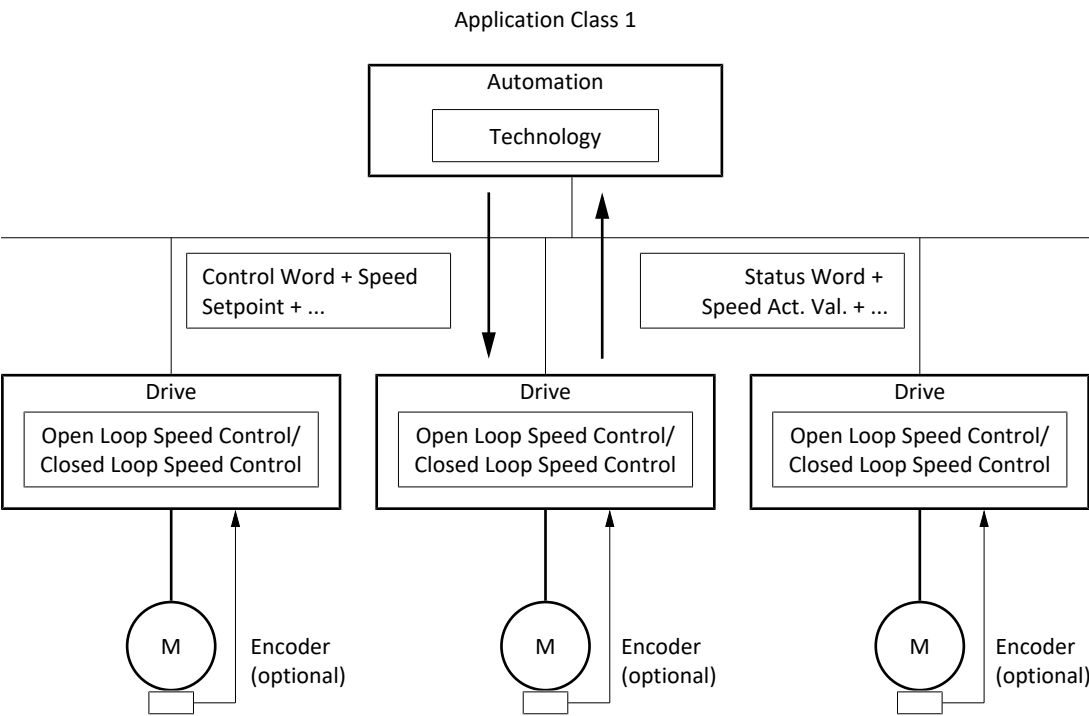
Fig. 27: PROFIdrive: Application class 1 (source: PROFIdrive profile)

To control application class 1, the three standard telegrams 1, 2 and 3 are defined for PROFIdrive and implemented in the application.

5.12.2.1   Standard telegram 1

The standard telegram 1 (set speed value 16 bit) is used in application class 1.

Structure

The mapping of the process data is specified by the controller (M512, M513).

The following tables show the structure of the telegram.

PZD	Data type	Name	Comment
1	WORD	Control word STW1 (STW1)	M515 Communication object PNU 967 in accordance with PROFIdrive
2	INT	Speed setpoint A (NSOLL_A)	M520 PNU 805

Tab. 21: Standard telegram 1: receive PZD

PZD	Data type	Name	Comment
1	WORD	Status word ZSW1 (ZSW1)	M516 Communication object PNU 968 in accordance with PROFIdrive
2	INT	Speed actual value A (NIST_A)	M522 PNU 806

Tab. 22: Standard telegram 1: transmit PZD
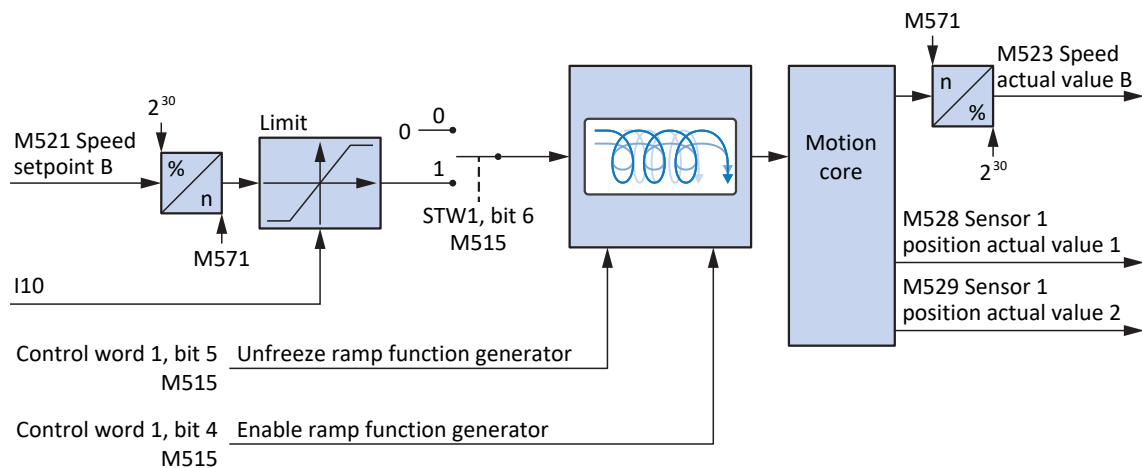
Input and output signals
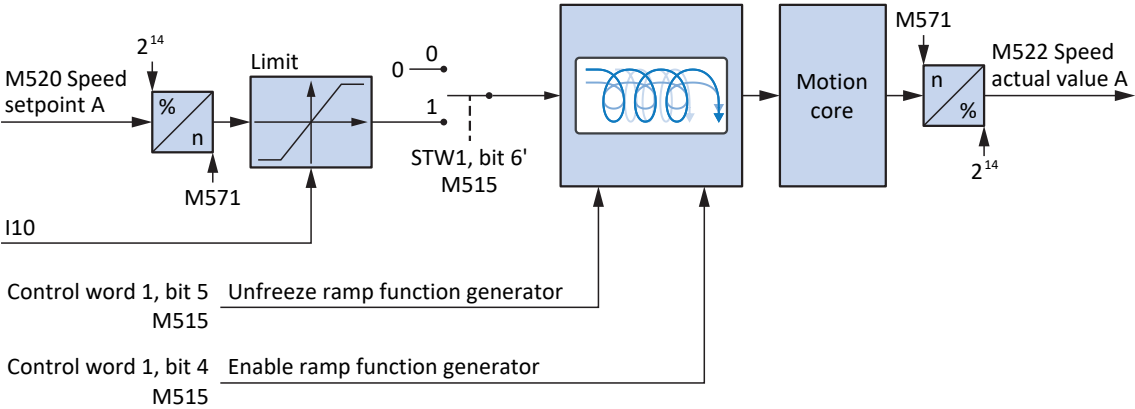
Fig. 28: Standard telegram 1: Input and output signals

Control and status information

The telegram is specified by the controller in parameter M513. The active telegram is output in parameter M512. If standard telegram 1 is active, the information 1: Standard telegram 1 is displayed there.

The following application-specific bits are assigned in control word 1 M515:

Bit	Designation	Comment
4	Enable ramp generator	Activate calculation of the motion profile: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M520)
5	Unfreeze ramp generator	Unfreeze motion profile calculation: 0 = velocity specification = last velocity specification before freeze; 1 = velocity specification by Speed setpoint (M520)
6	Enable setpoint	Deactivate set velocity: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M520)

Tab. 23: Standard telegram 1: Application-specific bit in control word 1

The following application-specific bits are assigned in status word 1 M516:

Bit	Designation	Comment
8	Error within tolerance range	Actual velocity within the permitted tolerance around the set velocity (source: M598): 0 = inactive; 1 = active
10	Target velocity reached	Target velocity reached (source: M596): 0 = inactive; 1 = active
13	Standstill	StndStill, standstill (source: I199): 0 = inactive; 1 = active
14	Accelerate	Accel, accelerated (source: I184): 0 = inactive; 1 = active
15	Decelerate	Decel, delayed (source: I185): 0 = inactive; 1 = active

Tab. 24: Standard telegram 1: Application-specific bit in status word 1

> **Information**
>
> Parameter M571 Velocity reference value provides the reference value for the set velocity and actual velocity and ensures the function of the application.

5.12.2.2 Standard telegram 2

The standard telegram 2 (set speed value 32 bit) is used in application class 1.

Structure

The mapping of the process data is specified by the controller (M512, M513).

The following tables show the structure of the telegram.

PZD	Data type	Name	Comment
1	WORD	Control word STW1 (STW1)	M515 Communication object PNU 967 in accordance with PROFIdrive
2 + 3	DINT	Speed setpoint B (NSOLL_B)	M521 PNU 807
4	WORD	Control word STW2 (STW2)	M517 PNU 803

Tab. 25: Standard telegram 2: receive PZD

PZD	Data type	Name	Comment
1	WORD	Status word ZSW1 (ZSW1)	M516 Communication object PNU 968 in accordance with PROFIdrive
2 + 3	DINT	Speed actual value B (NIST_B)	M523 PNU 808
4	WORD	Status word ZSW2 (ZSW2)	M518 PNU 804

Tab. 26: Standard telegram 2: transmit PZD

Input and output signals
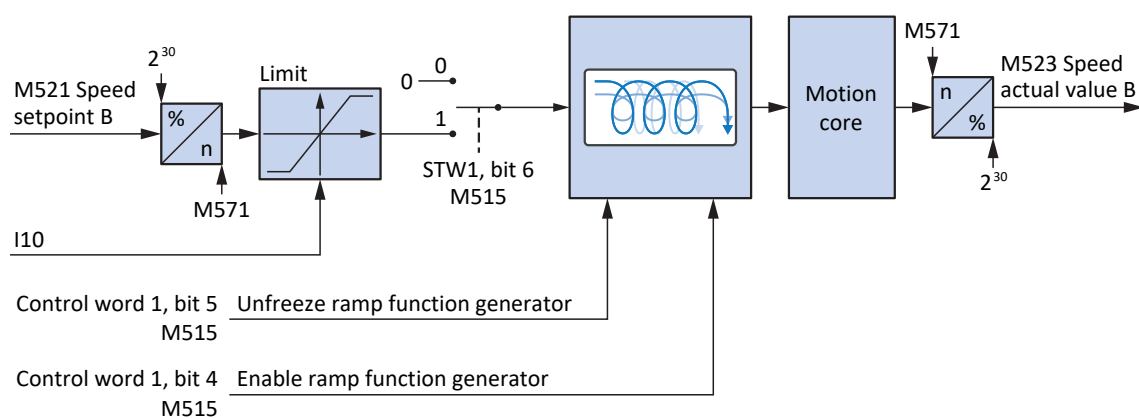
Fig. 29: Standard telegram 2: Input and output signals

Control and status information

The telegram is specified by the controller in parameter M513. The active telegram is output in parameter M512. If standard telegram 2 is active, the information 2: Standard telegram 2 is displayed there.

The following application-specific bits are assigned in control word 1 M515:

Bit	Designation	Comment
4	Enable ramp generator	Activate calculation of the motion profile: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)
5	Unfreeze ramp generator	Unfreeze motion profile calculation: 0 = velocity specification = last velocity specification before freeze; 1 = velocity specification by Speed setpoint (M521)
6	Enable setpoint	Deactivate set velocity: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)

Tab. 27: Standard telegram 2: Application-specific bit in control word 1

The following application-specific bits are assigned in status word 1 M516:

Bit	Designation	Comment
8	Error within tolerance range	Actual velocity within the permitted tolerance around the set velocity (source: M598): 0 = inactive; 1 = active
10	Target velocity reached	Target velocity reached (source: M596): 0 = inactive; 1 = active
13	Standstill	StndStill, standstill (source: I199): 0 = inactive; 1 = active
14	Accelerate	Accel, accelerated (source: I184): 0 = inactive; 1 = active
15	Decelerate	Decel, delayed (source: I185): 0 = inactive; 1 = active

Tab. 28: Standard telegram 2: Application-specific bit in status word 1

> **Information**
>
> Parameter M571 Velocity reference value provides the reference value for the set velocity and actual velocity and ensures the function of the application.

5.12.2.3   Standard telegram 3

The standard telegram 3 (set speed value 32 bit with 1 position encoder) is used in application class 1 and 4.

Structure

The mapping of the process data is specified by the controller (M512, M513).

The following tables show the structure of the telegram.

PZD	Data type	Name	Comment
1	WORD	Control word STW1 (STW1)	M515 Communication object PNU 967 in accordance with PROFIdrive
2 + 3	DINT	Speed setpoint B (NSOLL_B)	M521 PNU 807
4	WORD	Control word STW2 (STW2)	M517 PNU 803
5	WORD	Sensor 1 control word (G1_STW)	M526 PNU 809

Tab. 29: Standard telegram 3: receive PZD

PZD	Data type	Name	Comment
1	WORD	Status word ZSW1 (ZSW1)	M516 Communication object PNU 968 in accordance with PROFIdrive
2 + 3	DINT	Speed actual value B (NIST_B)	M523 PNU 808
4	WORD	Status word ZSW2 (ZSW2)	M518 PNU 804
5	WORD	Sensor 1 status word (G1_ZSW)	M527 PNU 810
6 +7	DINT	Sensor 1 position actual value 1 (G1_XIST1)	M528 PNU 811
8 + 9	DINT	Sensor 1 position actual value 2 (G1_XIST2)	M529 PNU 812

Tab. 30: Standard telegram 3: transmit PZD
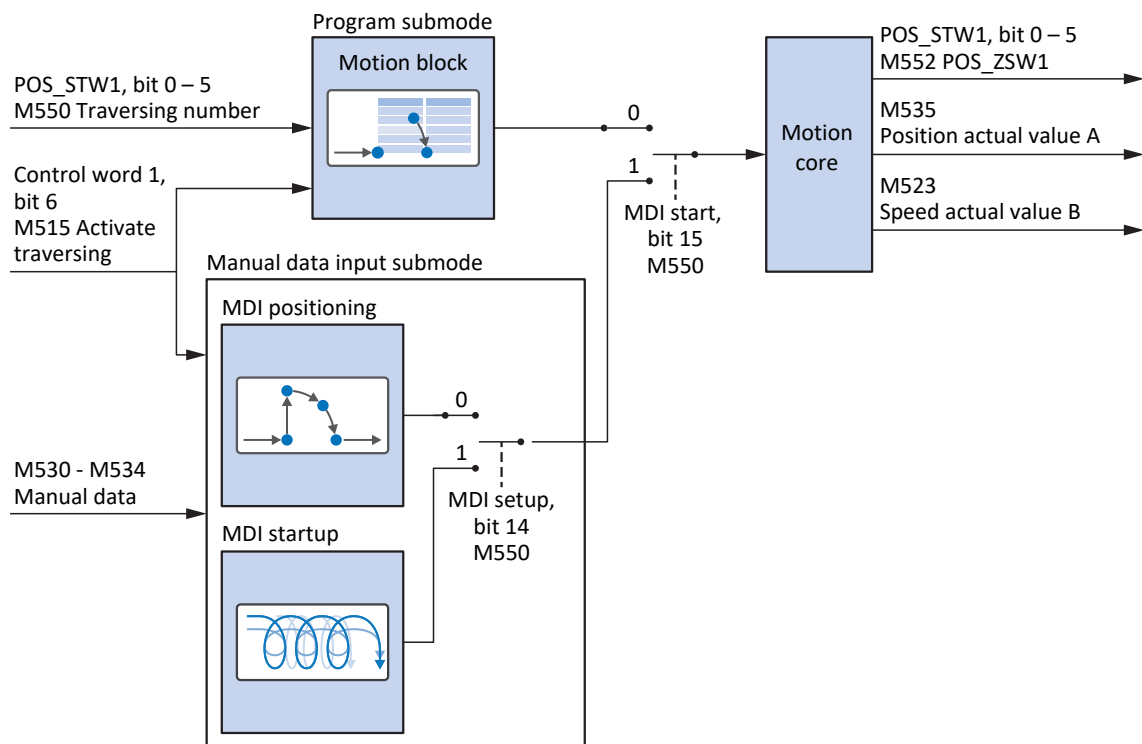
Input and output signals

Fig. 30: Standard telegram 3: Input and output signals

Control and status information

The telegram is specified by the controller in parameter M513. The active telegram is output in parameter M512. If standard telegram 3 is active, the information 3: Standard telegram 3 is displayed there.

The following application-specific bits are assigned in control word 1 M515:

Bit	Designation	Comment
4	Enable ramp generator	Activate calculation of the motion profile: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)
5	Unfreeze ramp generator	Unfreeze motion profile calculation: 0 = velocity specification = last velocity specification before freeze; 1 = velocity specification by Speed setpoint (M521)
6	Enable setpoint	Deactivate set velocity: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)

Tab. 31: Standard telegram 3: Application-specific bit in control word 1

The following application-specific bits are assigned in status word 1 M516:

Bit	Designation	Comment
8	Error within tolerance range	Actual velocity within the permitted tolerance around the set velocity (source: M598): 0 = inactive; 1 = active
10	Target velocity reached	Target velocity reached (source: M596): 0 = inactive; 1 = active
13	Standstill	StndStill, standstill (source: I199): 0 = inactive; 1 = active
14	Accelerate	Accel, accelerated (source: I184): 0 = inactive; 1 = active
15	Decelerate	Decel, delayed (source: I185): 0 = inactive; 1 = active

Tab. 32: Standard telegram 3: Application-specific bit in status word 1

> **Information**
>
> Parameter M571 Velocity reference value provides the reference value for the set velocity and actual velocity and ensures the function of the application.

5.12.2.4   Presets in AC1

For application class 1 with standard telegram 1, 2 or 3, the following presets are implemented in DriveControlSuite:

Parameter	Default value
K08 Selected operating mode	2: Velocity, torque/force
D01 Command	1: MC_MoveSpeed
D30 Source main reference value	1: Parameter G462
G461 Source external velocity	4: Parameter G460
D15 Control byte fixed acceleration value	15: Fixed acceleration value 15
D17 Control byte fixed deceleration value	15: Fixed deceleration value 15
D19 Control byte fixed jerk value	15: Fixed deceleration value 15

Tab. 33: Presets in AC1: Source digital signals (application)

The presets of the parameters D15, D17 and D19 cause the maximum values from the axis model (I11, I16) to be used for the profile definition for acceleration, deceleration and jerk.

5.12.3   Application class 3 (positioning mode)

Application class 3 (AC3) is intended for position-controlled axes. In application class 3, only the higher-level technological processes run on the controller. Interpolation, position control and speed control are implemented directly in the drive. The set value can be specified either in MDI mode (command operating mode) or in program mode (motion block operating mode).
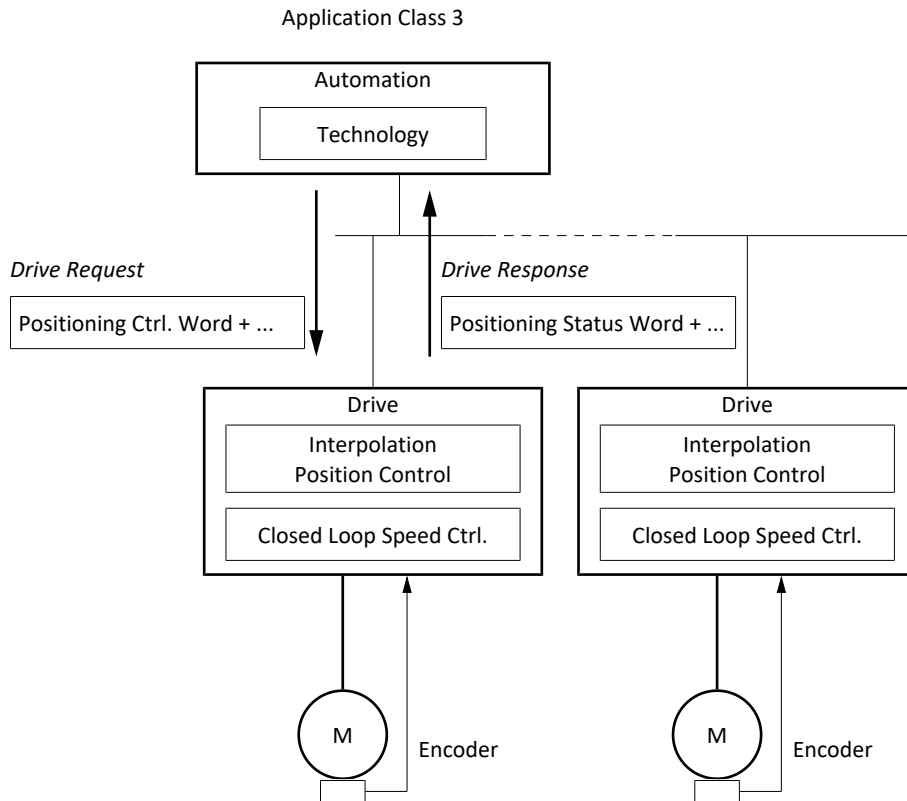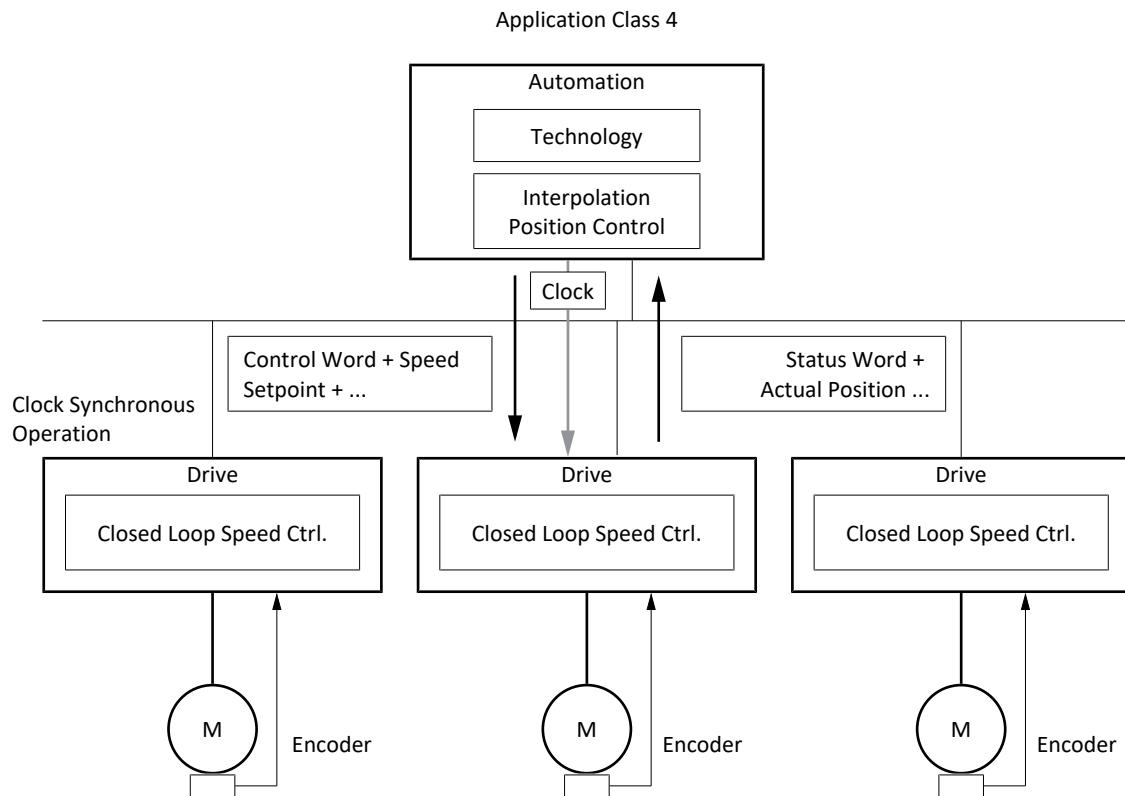
Fig. 31: PROFIdrive: Application class 3 (source: PROFIdrive profile)

To control application class 3, Siemens telegram 111 is defined for PROFIdrive and implemented in the application.

5.12.3.1 Siemens telegram 111

Siemens telegram 111 (single positioner) is used in application class 3.

Structure

With the exception of the user-defined user area, the mapping of the process data is specified by the controller (M512, M513).

The following tables show the structure of the telegram.

PZD	Data type	Name	Comment
1	WORD	Control word STW1 (STW1)	M515 Communication object PNU 967 in accordance with PROFIdrive
2	WORD	POS_STW1 (POS_STW1)	M550
3	WORD	POS_STW2 (POS_STW2)	M551
4	WORD	Control word STW2 (STW2)	M517 PNU 803
5	INT	Override (OVERRIDE)	M554
6 + 7	DINT	MDI target position (MDI_TARPOS)	M530 PNU 834
8 + 9	DINT	MDI velocity (MDI_VELOCITY)	M531 PNU 835
10	INT	MDI acceleration (MDI_ACC)	M532 PNU 836
11	INT	MDI deceleration (MDI_DEC)	M533 PNU 837
12	WORD/INT	User	—

Tab. 34: Siemens telegram 111: receive PZD

PZD	Data type	Name	Comment
1	WORD	Status word ZSW1 (ZSW1)	M516 Communication object PNU 968 in accordance with PROFIdrive
2	WORD	POS_ZSW1 (POS_ZSW1)	M552
3	WORD	POS_ZSW2 (POS_ZSW2)	M553
4	WORD	Status word ZSW2 (ZSW2)	M518 PNU 804
5	INT	MELDW (MELDW)	M557
6 + 7	DINT	Position actual value A (XIST_A)	M535
8 + 9	DINT	Speed actual value B (NIST_B)	M523 PNU 808
10	INT	FAULT_Code (FAULT_Code)	M555
11	INT	WARN_Code (WARN_Code)	M556
12	WORD/INT	User	Constant value 0

Tab. 35: Siemens telegram 111: transmit PZD

Input and output signals

Fig. 32: Siemens telegram 111: Input and output signals

Control and status information

The telegram is specified by the controller in parameter M513. The active telegram is output in parameter M512. If Siemens telegram 111 is active, there is the information 111: Telegram 111.

The following application-specific bits are assigned in control word 1 M515:

Bit	Designation	Comment
4	Do not reject traversing task	Program submode, Do not reject motion block: 0 = cancel active motion block with quick stop; 1 = active motion block is not canceled or a new motion block can be started
5	No intermediate stop	Program submode, No intermediate stop of motion block: 0 = inactive; 1 = active; 0 → 1 = interrupt active motion block by stop; 1 → 0 = continue interrupted motion block (MC_Halt; set deceleration: I11; set jerk: I16; prerequisite: J06 = J06); 0 → 1 = continue canceled motion block (Continue; prerequisite: J917 = 2: Parameter)
6	Activate traversing	Start movement (prerequisite: M515, bit 4 = 1, I100 = 2: Parameter): 0, 1 = inactive; 0 → 1 = active
11	Start homing procedure	Start referencing, referencing type I30

Tab. 36: Siemens telegram 111: Application-specific bit in control word 1

The following application-specific bits are assigned in status word 1 M516:

Bit	Designation	Comment
8	No follow error	NoFlwErr, lag within tolerance (source: M598): 0 = inactive; 1 = active
10	Target position reached	TargPos, target position reached (source: M596): 0 = inactive; 1 = active
11	Home position set	RefPSet, in reference (source: M595): 0 = inactive; 1 = active
12	Traversing task acknowledge	TrvTskAck, Execute signal is active and motion command is not finished (source: M594): 0 = inactive; 1 = active
13	Standstill	StndStill, standstill (source: I199): 0 = inactive; 1 = active
14	Accelerate	Accel, accelerated (source: I184): 0 = inactive; 1 = active
15	Decelerate	Decel, delayed (source: I185): 0 = inactive; 1 = active

Tab. 37: Standard telegram 111: Application-specific bit in status word 1

5.12.3.2 Operating modes in AC3

The set value in application class 3 with Siemens telegram 111 can be specified either in Program mode or in MDI mode.

The mode is specified by the controller in positioning control word 1 (POS_STW1) in parameter M550. If bit 15 is set to the value 0, the motion block operating mode is activated at the application level. Bit 15 must be set to the value 1 for command operating mode.

Bit	Designation	Comment
15	MDI start	MdiStart, Specification operating mode: 0 = Program mode (motion block operating mode); 1 = MDI mode (command operating mode)

Tab. 38: Specification operating mode: Bit 15 in positioning control word 1

The active operating mode is output in the parameter K09.

For more information on parameterizing the motion block and command operating modes in drive-based applications using DriveControlSuite, refer to the documentation for the Drive Based application (see Further information [▶ 108]).

5.12.3.3 Presets in AC3

For application class 3 with Siemens telegram 111, the following presets for the Program mode are implemented in DriveControlSuite:

Parameter	Default value
J03 Source motion block selection	1: Parameter J02

Tab. 39: Presets in AC3: Source selection motion block

5.12.4 Application class 4 (central motion control)

Application class 4 (AC4) is intended for speed-controlled axes. This application class defines a speed set value interface with a process of speed control on the drive and position control in the controller. The position control loop is closed via the bus. For optimal interaction, the controller and drives are synchronized via PROFINET IRT. This enables robotics and machine tool applications with coordinated motion sequences of multiple drives.

Fig. 33: PROFIdrive: Application class 4 (source: PROFIdrive profile)

To control application class 4, standard telegram 3 is defined for PROFIdrive and implemented in the application.

5.12.4.1   Standard telegram 3

The standard telegram 3 (set speed value 32 bit with 1 position encoder) is used in application class 1 and 4.

Structure

The mapping of the process data is specified by the controller (M512, M513).

The following tables show the structure of the telegram.

PZD	Data type	Name	Comment
1	WORD	Control word STW1 (STW1)	M515 Communication object PNU 967 in accordance with PROFIdrive
2 + 3	DINT	Speed setpoint B (NSOLL_B)	M521 PNU 807
4	WORD	Control word STW2 (STW2)	M517 PNU 803
5	WORD	Sensor 1 control word (G1_STW)	M526 PNU 809

Tab. 40: Standard telegram 3: receive PZD

PZD	Data type	Name	Comment
1	WORD	Status word ZSW1 (ZSW1)	M516 Communication object PNU 968 in accordance with PROFIdrive
2 + 3	DINT	Speed actual value B (NIST_B)	M523 PNU 808
4	WORD	Status word ZSW2 (ZSW2)	M518 PNU 804
5	WORD	Sensor 1 status word (G1_ZSW)	M527 PNU 810
6 +7	DINT	Sensor 1 position actual value 1 (G1_XIST1)	M528 PNU 811
8 + 9	DINT	Sensor 1 position actual value 2 (G1_XIST2)	M529 PNU 812

Tab. 41: Standard telegram 3: transmit PZD

Input and output signals

Fig. 34: Standard telegram 3: Input and output signals

Control and status information

The telegram is specified by the controller in parameter M513. The active telegram is output in parameter M512. If standard telegram 3 is active, the information 3: Standard telegram 3 is displayed there.

The following application-specific bits are assigned in control word 1 M515:

Bit	Designation	Comment
4	Enable ramp generator	Activate calculation of the motion profile: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)
5	Unfreeze ramp generator	Unfreeze motion profile calculation: 0 = velocity specification = last velocity specification before freeze; 1 = velocity specification by Speed setpoint (M521)
6	Enable setpoint	Deactivate set velocity: 0 = velocity specification = 0; 1 = velocity specification by Speed setpoint (M521)

Tab. 42: Standard telegram 3: Application-specific bit in control word 1

The following application-specific bits are assigned in status word 1 M516:

Bit	Designation	Comment
8	Error within tolerance range	Actual velocity within the permitted tolerance around the set velocity (source: M598): 0 = inactive; 1 = active
10	Target velocity reached	Target velocity reached (source: M596): 0 = inactive; 1 = active
13	Standstill	StndStill, standstill (source: I199): 0 = inactive; 1 = active
14	Accelerate	Accel, accelerated (source: I184): 0 = inactive; 1 = active
15	Decelerate	Decel, delayed (source: I185): 0 = inactive; 1 = active

Tab. 43: Standard telegram 3: Application-specific bit in status word 1

> **Information**
>
> Parameter M571 Velocity reference value provides the reference value for the set velocity and actual velocity and ensures the function of the application.

6 Appendix

6.1 Supported communication objects

6.1.1 PROFIdrive Device specific; parameter number (PNU): 0 – 899

The following table contains the supported device-specific communication objects of the standardized PROFIdrive profile and their mapping to the corresponding parameters of STOBER.

Parameter number (PNU)	Transmit PZD	Receive PZD	Name	Comment
110	—	—	Velocity tolerance range	M570
111	—	—	Velocity out of tolerance range time	M597
801	✓	✓	Control word STW1 (STW1)	M515
802	✓	—	Status word ZSW1 (ZSW1)	M516
803	✓	✓	Control word STW2 (STW2)	M517
804	✓	—	Status word ZSW2 (ZSW2)	M518
805	✓	✓	Speed setpoint A (NSOLL_A)	M520
806	✓	—	Speed actual value A (NIST_A)	M522
807	✓	✓	Speed setpoint B (NSOLL_B)	M521
808	✓	—	Speed actual value B (NIST_B)	M523
809	✓	✓	Sensor 1 control word (G1_STW)	M526
810	✓	—	Sensor 1 status word (G1_ZSW)	M527
811	✓	—	Sensor 1 position actual value 1 (G1_XIST1)	M528
812	✓	—	Sensor 1 position actual value 2 (G1_XIST2)	M529
834	✓	✓	MDI target position (MDI_TARPOS)	M530
835	✓	✓	MDI velocity (MDI_VELOCITY)	M531
836	✓	✓	MDI acceleration (MDI_ACC)	M532
837	✓	✓	MDI deceleration (MDI_DEC)	M533
850	✓	✓	POS_STW1	M550
851	✓	✓	POS_STW2	M551
852	✓	—	POS_ZSW1	M552
853	✓	—	POS_ZSW2	M553
854	✓	✓	Override	M554
855	✓	—	FAULT_Code	M555
856	✓	—	WARN_Code	M556
857	✓	—	MELDW	M557
	✓	—	Position actual value A (XIST_A)	M535

Tab. 44: PROFIdrive Device specific; PNU: 0 – 899

6.1.2 PROFIdrive Profile specific; parameter number (PNU): 900 – 999

The following table contains the supported profile-specific communication objects of the standardized PROFIdrive profile and their mapping to the corresponding parameters of STOBER.

Parameter number (PNU)	Transmit PZD	Receive PZD	Name	Comment
922	—	—	Telegram selection	M513
925	—	—	Number of controller Sign-of-Life failures which may be tolerated	M538
930	—	—	Operating mode	Constant value 1
944	—	—	Fault message counter	M540
947	—	—	Fault number	M543
950	—	—	Scaling of the fault buffer	Constant value 8
952	—	—	Fault situation counter	
964	—	—	Drive unit identification	
965	—	—	Profile identification number	
972	—	—	Drive reset	A09
977	—	—	Transfer to non-volatile memory	A00
979	—	—	Sensor format	M537
980	—	—	Number list of defined parameter	

Tab. 45: PROFIdrive Profile specific; PNU: 900 – 999

6.1.3 PROFIdrive Velocity reference value; parameter number (PNU): 60000

The following table contains the supported Velocity reference value communication object of the standardized PROFIdrive profile as well as its mapping to the corresponding parameter of STOBER.

Parameter number (PNU)	Transmit PZD	Receive PZD	Name	Comment
60000	—	—	Velocity reference value	M571

Tab. 46: PROFIdrive Velocity reference value; PNU: 60000

6.1.4   PROFIdrive Communication system interfaces; parameter number (PNU): 61000 – 61999

The following table contains the supported communication objects for the transmission of the standardized PROFIdrive profile as well as their mapping to the corresponding parameters of STOBER.

Parameter number (PNU)	Transmit PZD	Receive PZD	Name	Comment
61000	—	—	Name of station	A273
61001	—	—	IP of station	A274
61002	—	—	MAC of station	A279
61003	—	—	Default gateway of station	A276
61004	—	—	Subnet mask of station	A275

Tab. 47: PROFIdrive Communication system interfaces; PNU: 61000 – 61999

6.2   Further information

The documentation listed in the following table offers additional relevant information about the associated drive controllers.

Current document versions can be found at http://www.stoeber.de/en/downloads/.

Device/Software	Documentation	Contents	ID
SC6 drive controller	Manual	System design, technical data, project configuration, storage, installation, connection, commissioning, operation, service, diagnostics	442790
Multi-axis drive system with SI6 and PS6	Manual	System design, technical data, project configuration, storage, installation, connection, commissioning, operation, service, diagnostics	442728
PROFINET communication – SC6, SI6	Manual	Installation, electrical installation, data transfer, commissioning, detailed information	443039
SU6 safety technology – STO and SS1 via PROFIsafe	Manual	Technical data, installation, commissioning, diagnostics	443258
SR6 safety technology – STO via terminals	Manual	Technical data, installation, commissioning, diagnostics	442741
Drive Based (DB) application	Manual	Project planning, configuration, parameterization, function test, detailed information	442706

Additional information and sources that form the basis of this documentation or are referenced by the documentation:

PROFIBUS Nutzerorganisation e. V. (PNO), 2015. *Profile Drive Technology – PROFIdrive Profile*. Technical specification for PROFIBUS and PROFINET. Specification. Version 4.2, October 2015.

Information concerning the Siemens TIA Portal

The most important information about the Siemens TIA Portal and additional documents, links and training courses can be found at
http://www.industry.siemens.com/topics/global/en/tia-portal/pages/default.aspx.

SC6, SI6 – Device description

A GSD file for easily integrating the drive controllers of the SC6 and SI6 series into the respective system environment can be found in the STOBER download center http://www.stoeber.de/en/downloads/, search term GSD.

6.3   Formula symbols

Symbol	Unit	Explanation
F	N	Force
M	Nm	Torque
n	rpm	Speed

6.4   Abbreviations

Abbreviation	Meaning
AC	Application class
C-LS	Controller life counter
DO-LS	Drive controller life counter
FB	Function block
GSD	General Station Description data
GSDML	General Station Description Markup Language
IEC	International Electrotechnical Commission
IP	Internet Protocol
IRT	Isochronous Real-Time
LS	Limit Switch
LSB	Least Significant Bit
M	Motor
M/F	Torque or force
MAC	Media Access Control
MDI	Manual data input
MEnc	Motor encoder
MT	Multi-turn
PEnc	Position encoder
PNU	Parameter number
PROFIBUS	Process Field Bus
PROFINET	Process Field Network
PZD	Process Data
RS	Reference Switch
RxPZD	Receive PZD (receive process data)
S	Switch
ST	Single-turn
STW	Control word
TIA	Totally Integrated Automation
TO	Technology object
TxPZD	Transmit PZD (transmit process data)
ZP	Zero Pulse
ZSW	Status word

7   Contact

7.1   Consultation, service and address

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List of figures

03/2022 | ID 443270.01

List of tables

Glossary

Application class (AC)

Standardized drive functions according to the PROFIdrive device profile. In view of its wide range of possible applications, six classes specified according to functionality have been defined for PROFIdrive. A drive can cover one or more classes.

Broadcast domain

Logical grouping of network devices within a local network that reaches all nodes via broadcast.

Command

Operating mode in the Drive Based and Drive Based Synchronous applications. This enables configurable movements to be shut down. The associated motion commands correspond to the PLCopen standard. An absolutely necessary, higher-level controller coordinates the associated time-dependent sequences.

Function block

Functional software unit that includes a named copy of a data structure and associated operations defined by a corresponding function block type.

GSD file

Includes the technical features of a PROFINET IO device (type, configuration data, parameters, diagnostic information, etc.) in XML format in accordance with the GSDML specification. A GSD file serves as the configuration basis for project configuration systems and is generally provided by the respective device manufacturer.

IO controller

Generally, a programmable logic controller that controls automation tasks and regulates data communication.

IO device

A decentralized field device that is assigned logically to a PROFINET IO controller that manages and controls it. An IO device consists of multiple modules and submodules.

IPv4 limited broadcast

Type of broadcast in a network with IPv4 (Internet Protocol version 4). The IP address 255.255.255.255 is entered as the destination. The content of the broadcast is not forwarded by a router, which limits it to the local network.

Jog

Step-by-step movement that can be used to move the drive incrementally and independently of the controller, such as during commissioning, in emergency operation or during setup and repair work. Also: Name of a CiA 402 application operating mode.

MAC address

Hardware address for unique identification of a device in an Ethernet network. The MAC address is assigned by the manufacturer and consists of a 3-byte manufacturer ID and 3-byte device ID.

Motion block

Operating mode in the Drive Based and Drive Based Synchronous applications. Summarizes the properties of movements in the form of pre-defined motion blocks. Linking these enables the definition of complete motion sequences, which makes it possible to execute sequences quickly – regardless of whether the motion sequences are specified by a controller or executed through binary signals.

Process data (PZD)

Control and status information that is time-critical and transmitted in the PROFINET network cyclically using telegrams. Depending on the view of the respective node, a distinction is made between receive PZD (RxPZD) and transmit PZD (TxPZD).

PROFIdrive

Standardized drive interface for PROFIBUS and PROFINET open standard buses. It defines the device behavior and the procedure for accessing internal device data for electrical drives on PROFINET and PROFIBUS. The interface is specified by PROFIBUS and PROFINET International (PI) user organizations, and is specified as the future-proof standard by standard IEC 61800-7-303.

PROFINET

Open Ethernet standard of PROFIBUS Nutzerorganisation e. V. (PNO) for automation.

PROFINET IO system

Bus system for industrial automation over Industrial Ethernet. The system generally consists of at least one IO controller that controls the exchange of data with at least one IO device in a decentralized location. Within a configurable update time, an IO controller supplies an IO device with data; the device sends data back to the IO controller in turn. Multiple PROFINET IO systems can be operated on an Industrial Ethernet subnet simultaneously. Two performance levels of real-time support are available with the RT transmission method for time-critical process data and the IRT transmission method for high-precision as well as synchronized processes.

PROFINET IRT

Transmission method for high-precision as well as synchronized processes in a PROFINET IO system.

PROFINET RT

Transmission method for time-critical process data in a PROFINET IO system.

PROFIsafe

Communication standard for safety standard IEC 61508 that includes both standard as well as fail-safe communication. The standard enables reliable communication for PROFIBUS and PROFINET open standard buses based on standard network components, and is defined as the international standard in standard IEC 61784-3-3.

Receive PZD (RxPZD)

Process data received by a node in the PROFINET network.

Referencing

When commissioning a system with a position measurement system, the relation of a measured axis to an actual axis position must be determined. Usually, a defined initial position is identified either by a reference search or by a reference setting. The associated process is referred to as referencing. Absolute movements can be performed only in a referenced state.

Siemens telegram

Data with specified sequence and standardized contents that is exchanged cyclically between the controller and drive controller during PROFIdrive communication. The standard telegram is structured according to the manufacturer-specific specifications from Siemens.

Standard telegram

Data with specified sequence and standardized contents that is exchanged cyclically between the controller and drive controller during PROFIdrive communication. The standard telegram is structured according to the PROFIdrive device profile.

Technology object

Software object in a Siemens controller that represents a mechanical component. It encapsulates the technological functionality and allows uniform configuration and parameterization.

Transmit PZD (TxPZD)

Process data sent by a node in the PROFINET network.

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