

SIEMENS

SIMATIC

S7-1500 S7-1500 Motion Control V13 Update 3




Function Manual

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Legal information

Warning notice system

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

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.


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Disclaimer of Liability

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

Preface

Purpose of the documentation

This documentation provides important information that you need to configure and commission the integrated Motion Control functionality of the S7-1500 Automation systems.

Required basic knowledge

In order to understand this documentation, the following knowledge is required:

- General knowledge in the field of automation
- General knowledge in the field of drive engineering and motion control

Validity of the documentation

This documentation is valid for the S7-1500 product range.

Conventions

- For the path settings in the project navigation it is presumed that the "Technology objects" object is opened in the CPU subtree. The "Technology object" placeholder represents the name of the technology object.

Example: "Technology object > Configuration > Basic parameters".

- The <TO> placeholder represents the name set in tags for the respective technology object.

Example: <TO>.Actor.Type

- This documentation contains pictures of the devices described. The pictures may differ in minor details from the devices supplied.

You should also observe the notes that are marked as follows:

Note

A note contains important information about the product described in the documentation, about the handling of the product, and about sections in this documentation demanding your particular attention.

Further support

- The range of technical documentation for the individual SIMATIC products and systems is available on the Internet (<http://www.siemens.com/simatic-tech-doku-portal>).
- The online catalog and the online ordering system is available on the Internet (<http://mall.automation.siemens.com>).

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You can find more information about industrial security on the Internet (<http://www.siemens.com/industrialsecurity>).

To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (<http://support.automation.siemens.com>).

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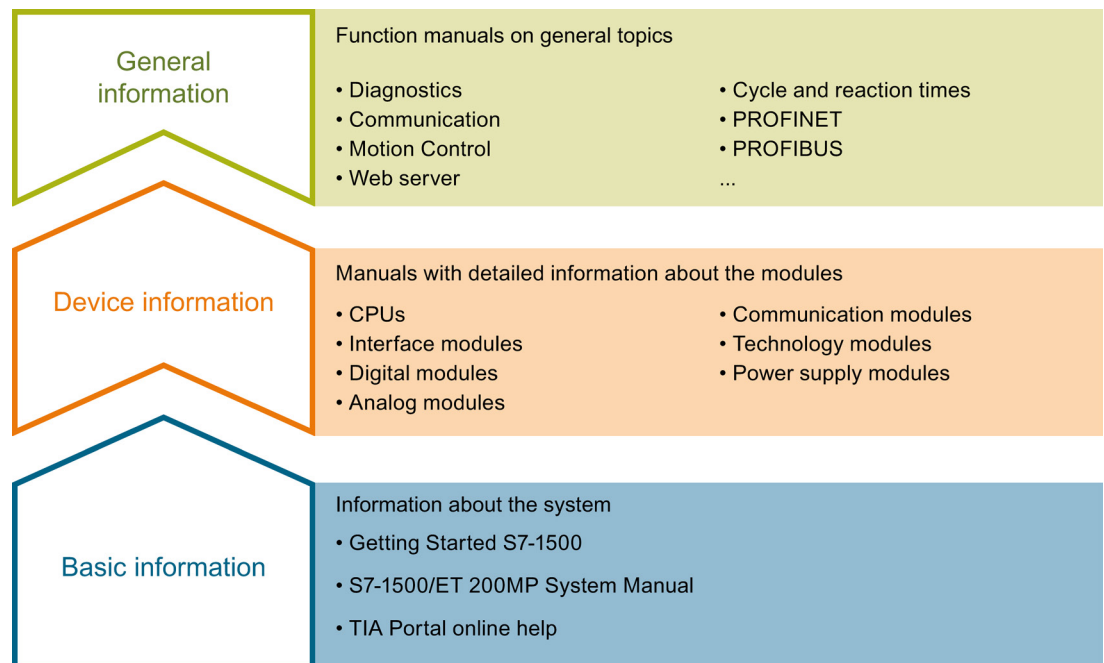
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Guide to documentation S7-1500 / ET 200MP

The documentation for the SIMATIC S7-1500 automation system and the SIMATIC ET 200MP distributed I/O system is arranged into three areas. This arrangement enables you to access the specific content you require.



Basic information

System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems. The STEP 7 online help supports you in the configuration and programming.

Device information

Manuals contain a compact description of the module-specific information, such as properties, terminal diagrams, characteristics, technical specifications.

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC S7-1500 and ET 200MP systems, e.g. diagnostics, communication, Motion Control, Web server.

You can download the documentation free of charge from the Internet (<http://www.automation.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/tech-doc-controllers/Pages/Default.aspx>).

Changes and supplements to the manuals are documented in a Product Information.

Manual Collection S7-1500 / ET 200MP

The Manual Collection contains the complete documentation on the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (<http://support.automation.siemens.com/WW/view/en/86140384>).

My Documentation Manager

The My Documentation Manager is used to combine entire manuals or only parts of these to your own manual.

You can export the manual as PDF file or in a format that can be edited later.

You can find the My Documentation Manager on the Internet (<http://support.automation.siemens.com/WW/view/en/38715968>).

Applications & Tools

Applications & Tools supports you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus in individual products.

You can find Applications & Tools on the Internet (<http://support.automation.siemens.com/WW/view/en/20208582>).

CAX Download Manager

The CAX Download Manager is used to access the current product data for your CAX or CAE systems.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find the CAX Download Manager on the Internet (<http://support.automation.siemens.com/WW/view/en/42455541>).

Introduction

2.1 Integrated Motion Control Functionality of the CPU S7-1500

S7-1500 Motion Control supports controlled positioning and moving of axes and is an integral part of every CPU S7-1500 as well as every CPU S7-1500SP. The Motion Control functionality supports the technology objects rotation axis, positioning axis, synchronous axis and external encoders.

Drives with PROFIdrive capability and drives with analog setpoint interface are controlled by means of standardized Motion Control instructions according to PLCopen.

The axis control panel and comprehensive online and diagnostic functions support easy commissioning and optimization of drives.

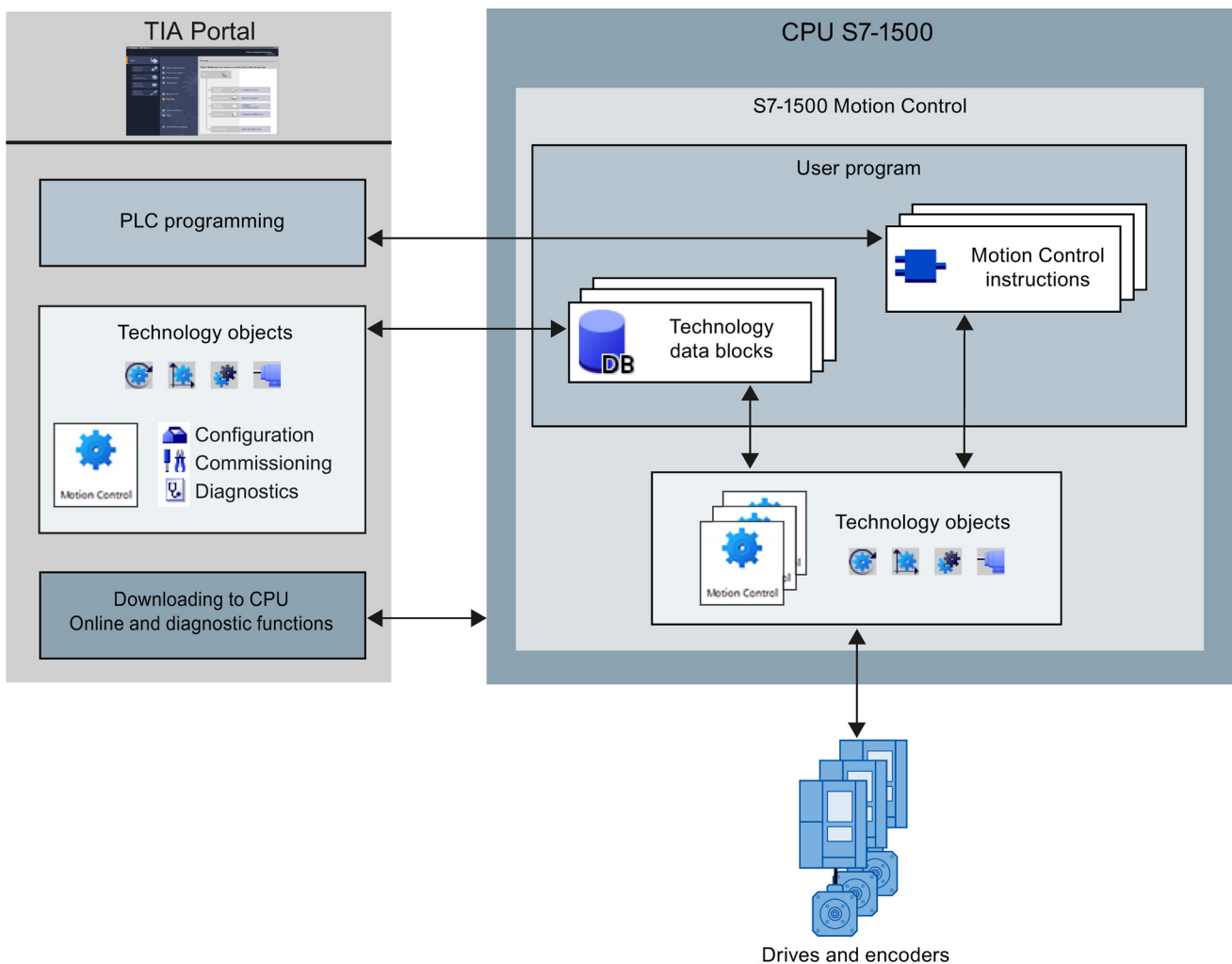
S7-1500 Motion Control is constantly integrated into the CPU S7-1500 system diagnostics.

2.2 Principle of operation of S7-1500 Motion Control

Overview

You create a project, configure technology objects, and load the configuration into the CPU using the TIA Portal. The Motion Control functionality is processed in the CPU. You control the technology objects with the Motion Control instructions in your user program. The TIA Portal provides additional functions for commissioning, optimization (Page 199) and diagnostics (Page 214).

The following figure shows schematically the user interfaces and the integration of Motion Control into the CPU S7-1500. The concepts are then briefly explained:



TIA Portal

The TIA Portal supports you in the planning and commissioning of Motion Control functionality:

- Integrating and configuring hardware
- Creating and configuring technology objects
- Creating the user program
- Downloading to CPU
- Commissioning of axes
- Optimization of drives
- Diagnostics

You use the TIA Portal to configure the hardware, the technology objects as well as your user program. You download the program you created to the CPU. You test your user program and diagnose the hardware with the online and diagnostic functions of the TIA Portal.

Technology objects



Technology objects represent real objects (e.g., a drive) in the controller. You can call the functions of the technology objects by means of Motion Control instructions in your user program. The technology objects provide open- and closed-loop control of the movement of the real objects, and report status information (e.g. the current position).

The configuration of the technology objects represents the properties of the real object. The configuration data are stored in a technology data block.



The following technology objects are available for Motion Control:

-  **Speed axis technology object**

The speed axis technology object ("TO_SpeedAxis") permits the specification of the speed for a drive. You program the movement of the axis with Motion Control instructions.

-  **Positioning axis technology object**

The positioning axis technology object ("TO_PositioningAxis") permits the position-controlled positioning of a drive. You assign positioning jobs to the axis with Motion Control instructions in your user program.

-  **Synchronous axis technology object**
The synchronous axis technology object ("TO_SynchronousAxis") includes all functions of the positioning axis technology object. You can also interconnect the axis with a master value so that the axis follows the position change of a leading axis in synchronous operation.
-  **External encoder technology object**
The external encoder technology object ("TO_ExternalEncoder") detects a position, and makes it available to the controller. The detected position can be evaluated in the user program.

Technology data block



The properties of real objects are configured by means of the technology objects and saved in a technology data block. The technology data block contains all configuration data, setpoint and actual values, and status information of the technology object. The TIA Portal automatically creates the technology data block when the technology object is created. You access the data of the technology data block with your user program.

Motion Control instructions



With the Motion Control instructions you perform the desired functionality in the technology objects. The Motion Control instructions are available in the TIA Portal under "Instructions > Technology > Motion Control > S7-1500 Motion Control".



The Motion Control instructions conform to PLCopen (version 2.0).

User program

The Motion Control instructions and the technology data block represent the programming interfaces for the technology objects. Use the Motion Control instructions to start Motion Control jobs at technology objects in your user program. You track the status of running jobs with the output parameters of the Motion Control instructions. You access status information of the technology object with the technology data block and change specific configuration parameters during runtime.

Drives and encoders

Drives permit the movement of the axis. They are integrated into the hardware configuration.

When you perform a Motion Control job in your user program, the technology object takes over the control of the drive and the reading in of values from position encoders.

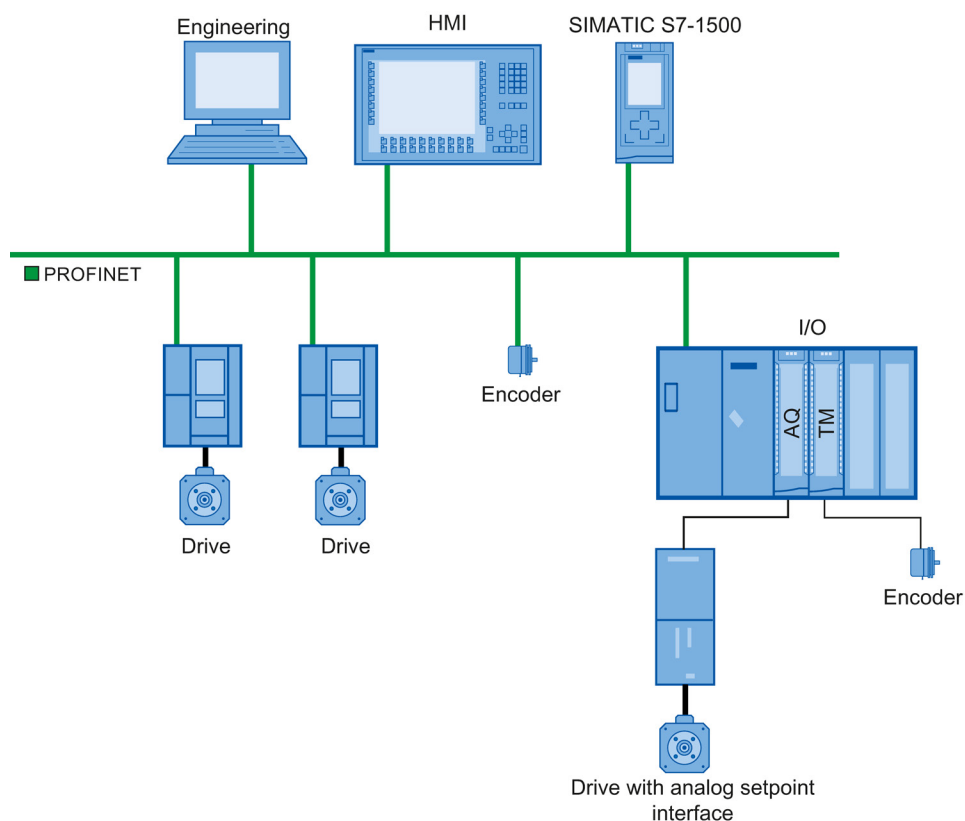
Drives and encoders with PROFIdrive capability are connected by means of PROFIdrive frames. The following connections are possible:

- PROFINET IO
- PROFIBUS DP
- Technology module (TM)

Drives with analog setpoint interfaces are connected using an analog output (AQ) and an optional enable signal. Analog inputs and outputs are made available by means of corresponding IO modules.

A drive is also called an actuator, and an encoder is also called a sensor.

The figure below shows an example configuration in which all components are connected to the CPU by means of PROFINET IO:



Basics

3.1 Functions

You can perform the Motion Control function by means of Motion Control instructions in your user program or the TIA Portal (under Commissioning).

The following table shows the functions that are supported by technology objects:

Function	Speed axis	Positioning axis	Synchronous axis	External encoder
Motion Control instructions (user program)				
"MC_Power (Page 234)" Enable, disable technology objects	X	X	X	X
"MC_Home (Page 239)" Homing technology objects, setting home position	-	X	X	X
"MC_MoveJog (Page 244)" Moving axes in jog mode	X	X	X	-
"MC_MoveVelocity (Page 249)" Moving axes with the specified speed	X	X	X	-
"MC_MoveRelative (Page 255)" Position axis relatively	-	X	X	-
"MC_MoveAbsolute (Page 260)" Position axis absolutely	-	X	X	-
"MC_MoveSuperimposed (Page 265)" Superimposed positioning of axes	-	X	X	-
"MC_GearIn (Page 270)" Start gearing	-	-	X	-
"MC_Halt (Page 275)" Stop axis	X	X	X	-
"MC_Reset (Page 279)" Acknowledging alarms, restarting technology objects	X	X	X	X
TIA Portal				
"Axis control panel (Page 202)" Moving and homing axes using the TIA Portal	X	X	X	-
"Optimization (Page 207)" Optimization of position control ("Kv" factor)	-	X	X	-

3.2 Scale

For information on the number of technology objects that may be used, refer to the technical specifications of the utilized CPU.

A synchronous axis requires twice as many resources as a speed-controlled axis or positioning axis. You can configure two fewer speed or positioning axes for every synchronous axis you use.

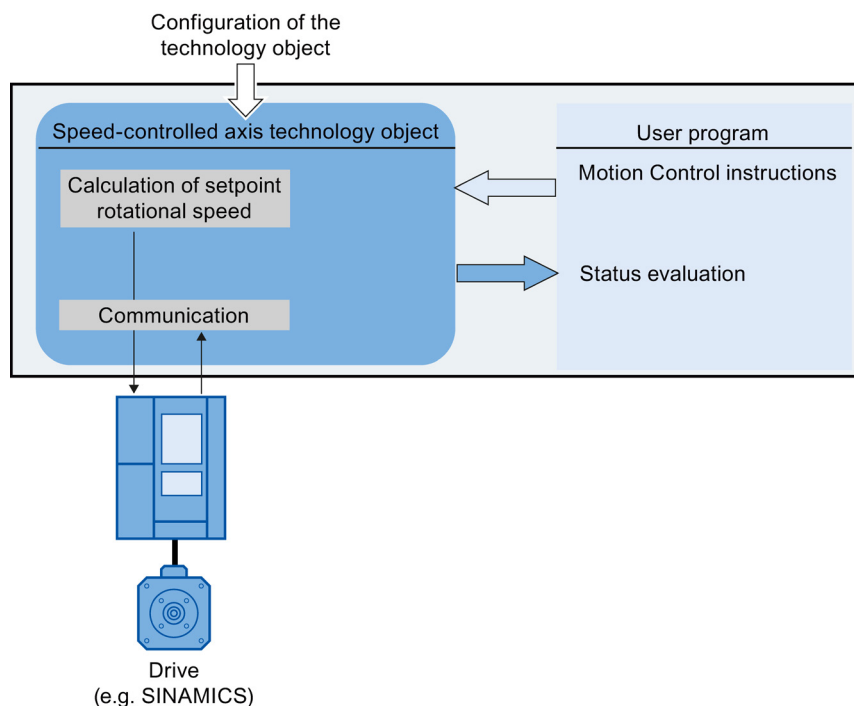
3.3 Speed-controlled axis technology object

The speed axis technology object calculates speed setpoints, taking account of the specified dynamics, and outputs them to the drive. All movements of the speed axis occur under speed control. The system takes account of an existing load gear.

A drive is assigned to each speed axis by means of a PROFIdrive frame, or by means of an analog setpoint interface.

The speed is specified in revolutions per unit of time.

The following figure shows the basic principle of operation of the speed axis technology object:



3.4 Positioning axis technology object

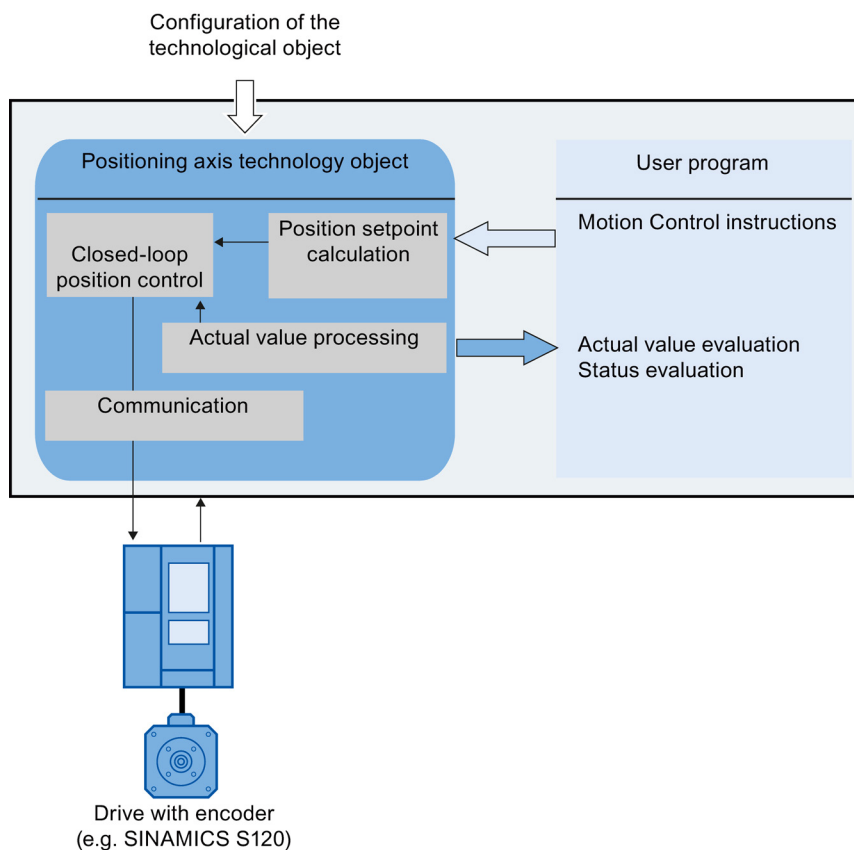
The positioning axis technology object calculates position setpoints, taking account of the specified dynamics, and outputs corresponding speed control setpoints to the drive. All movements of the positioning axis occur under position control. For absolute positioning, the physical position must be known to the positioning axis technology object.

Each positioning axis is assigned a drive by means of a PROFIdrive frame or by means of an analog setpoint interface, and an encoder by means of a PROFIdrive frame.

The relationship between the encoder values and a defined position is created by assigning parameters to the mechanical properties and the encoder settings, as well as to a homing process. The technology object can also perform movements without a position relationship, and relative position movements, even without being in a homed status.

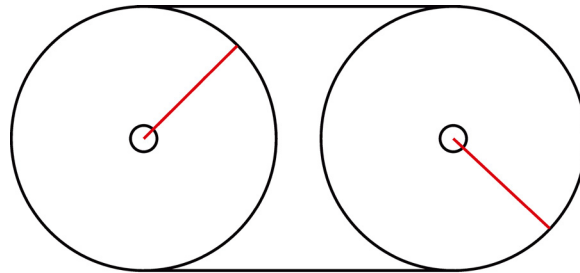
Depending on the execution of the mechanics, a positioning axis is implemented as linear axis or rotary axis (Page 26).

The figure below shows the basic principle of operation of the positioning axis technology object:



3.5 Synchronous axis technology object

The synchronous axis technology object follows the position change of a leading axis in relative synchronous operation. A relative gearing exists, for example, when two mechanically coupled rollers are driven by the same motor:



A

B

A Leading axis (driven axis)

B Following axis

— Relative position relationship

The change of the leading axis position setpoint is multiplied by a specified gear ratio and passed on to the following axis as setpoint. The synchronous axis technology object outputs this setpoint as speed setpoint to the drive limited to the maximum speed of the drive (<TO>.Actor.DriveParameter.MaxSpeed).

The synchronous axis technology object includes all functions of the positioning axis technology object. All movements of the synchronous axis occur under position control.

If the synchronous axis is operated without synchronous operation, the dynamic limits configured at the technology object apply.

If the synchronous axis is operated as following axis in synchronous operation, the following dynamic limits apply depending on the status of the synchronous operation.

- **Synchronization**

During synchronization, dynamic limits configured at the technology object apply to the lead axis and the following axis respectively.

- **Travel synchronous** ("MC_GearIn.InGear" = TRUE)

If the synchronous axis is operated as following axis, the dynamic limits of the leading axis are multiplied by the gear ratio apply. The configured dynamic limits of the following axis are ignored. The dynamic of the following axis is limited to the maximum speed of the drive.

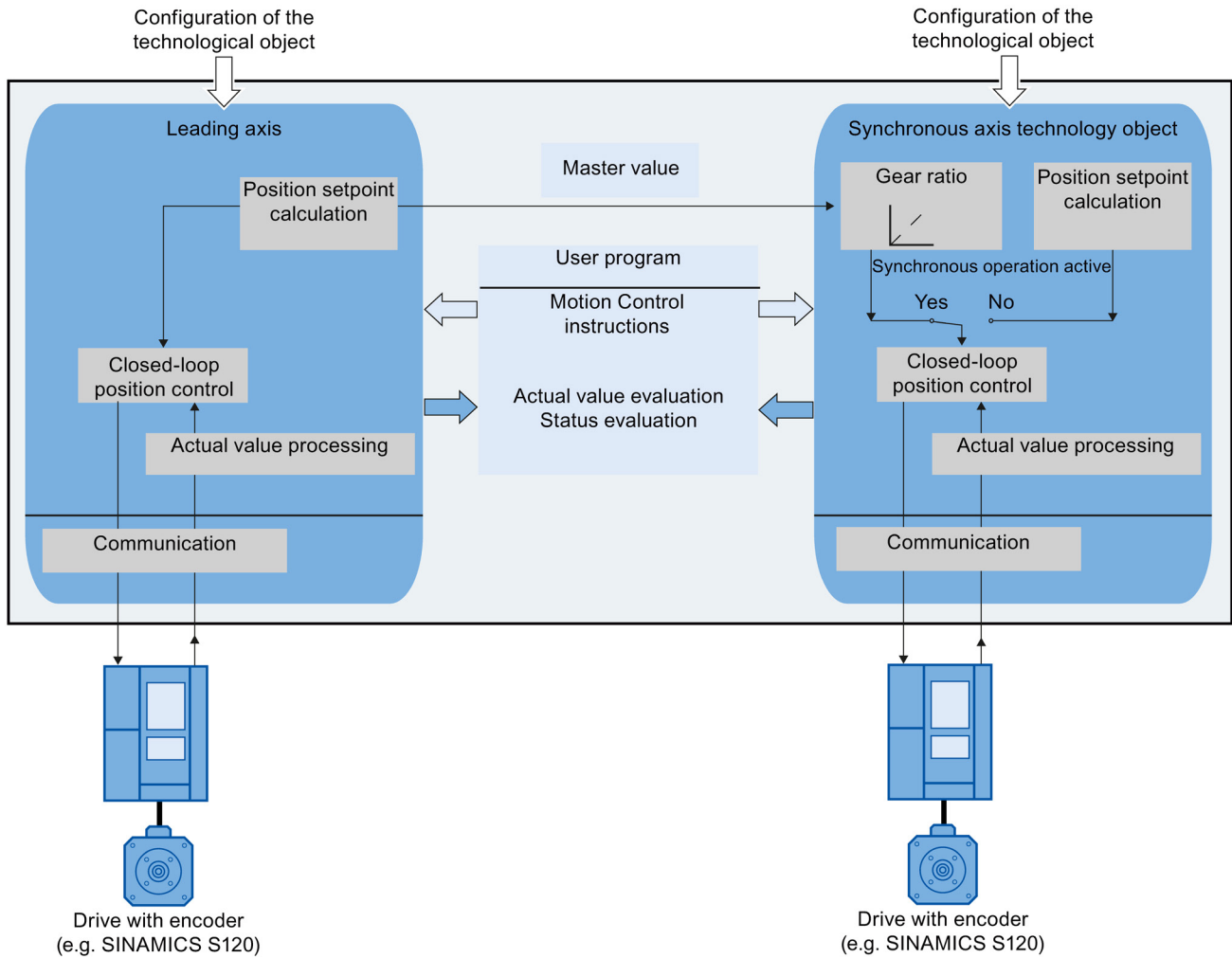
The following hardware components are assigned to each synchronous axis:

- A drive by means of a PROFIdrive frame or by means of an analog setpoint interface
- An encoder by means of a PROFIdrive frame

Depending on the execution of the mechanics, a synchronous axis is implemented as linear axis or rotary axis (Page 26).

3.5 Synchronous axis technology object

The figure below shows the basic principle of operation of the synchronous axis technology object:

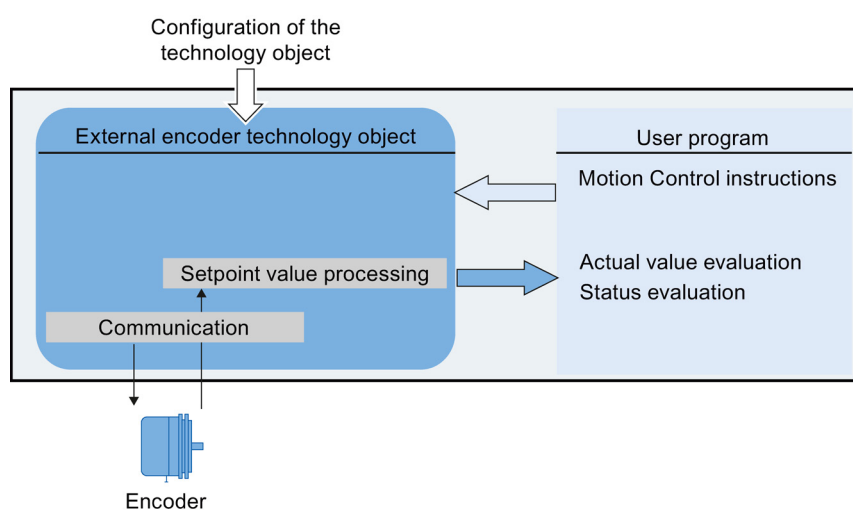


3.6 External encoder technology object

The external encoder technology object detects a position, and makes it available to the controller.

The relationship between the encoder values and a defined position is created by assigning parameters to the mechanical properties and the encoder settings, as well as to a homing process.

The following figure shows the basic principle of operation of the external encoder technology object:



Specification of the position occurs according to the selected system of units:

- **Linear system of units**

The position is specified as a linear measure, e.g. millimeters (mm).

- **Rotary system of units**

The position is specified as an angular measure, e.g. degrees ($^{\circ}$).

Note

The positioning axis/synchronous axis technology objects and external encoder are independent of each other, and cannot be coupled to each other. The actual position of an external encoder cannot be used for position control of a positioning axis or synchronous axis.

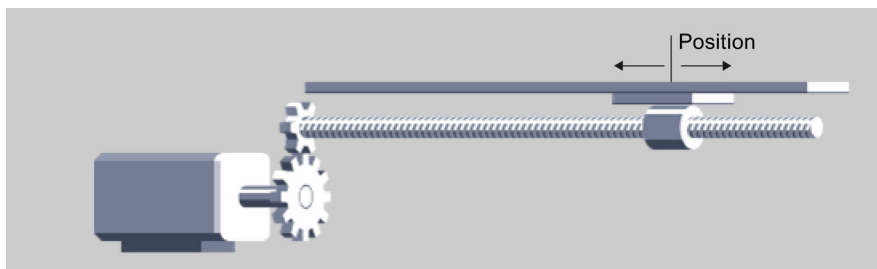
3.7 Axis types

Axes can be configured with different axis types:

- Positioning and synchronous axes can be configured as rotary or linear axis.
- Speed axes are always rotary axes.

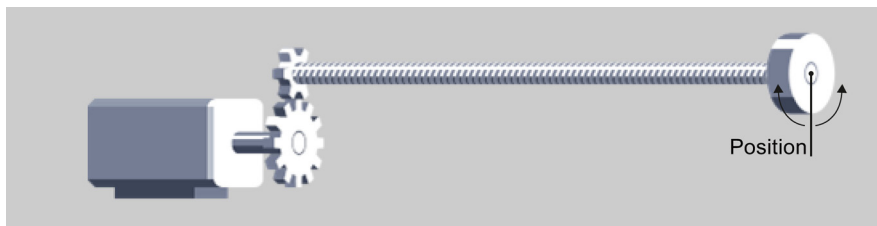
Depending on the execution of the mechanics, an axis is implemented as a linear axis or rotary axis:

- **Linear axis**



For linear axes, the position of the axis is specified as a linear measure, e.g. millimeters (mm).

- **Rotary axis**



For rotary axes, the position of the axis is specified as an angular measure, e.g. degrees (°).

3.8 Modulo setting

The positioning axis, synchronous axis and external encoder technology objects can be enabled with the "Modulo" setting.

If an axis is moved in only one direction, the position value continually increases. To limit the position value to a recurring reference system, you can enable the "Modulo" setting.

When "modulo" is enabled, the position value of the technology object is represented by means of a recurring modulo range. The modulo range is defined by the start value and the length.

For example, to limit the position value of a rotary axis to a full rotation, the modulo range can be defined with start value = 0° and length = 360°. With an encoder resolution of 0.1°/encoder step, the position value is represented in the modulo range 0° to 359.9°.

3.9 Units of measure

The table below shows the supported units of measure for position and velocity:

Position	Velocity
nm, μm , mm, m, km	mm/s, mm/min, mm/h, m/s, m/min, m/h, km/min, km/h
in, ft, mi	in/s, in/min, ft/s, ft/min, mi/h
$^{\circ}$, rad	$^{\circ}/\text{s}$, $^{\circ}/\text{min}$, rad/s, rad/min

The acceleration is configured accordingly as unit of measure of the position/s².

The jerk is configured accordingly as unit of measure of the position/s³.

The speed is configured as revolutions per unit of time: 1/s, 1/min, 1/h

Note

When setting or changing the units of measurement, note the effect on the depiction and the user program:

- Depiction in the technology data block
- Supply to the parameters in the user program
- Input and display of the position and speed in the TIA Portal
- Setpoint settings by leading axes in synchronous operation

All information and displays are output in the selected unit of measure.

3.10 Drive and encoder connection

3.10.1 Brief description

A speed axis is assigned a drive.

A positioning axis/synchronous axis is assigned a drive and an encoder.

An external encoder is assigned an encoder.

The setpoint value at the drive is specified either with PROFIdrive message frames, or with an analog output.

The following connection options are available for an encoder:

- Encoder to drive
- Encoder on technology module
- PROFIdrive encoder directly to PROFIBUS DP / PROFINET IO

The encoder value is transmitted exclusively via PROFIdrive message frames.

PROFIdrive

PROFIdrive is the standardized standard profile for drive technology in the connection of drives and encoders via PROFIBUS DP and PROFINET IO.

Drives that support the PROFIdrive profile are connected according to the PROFIdrive standard.

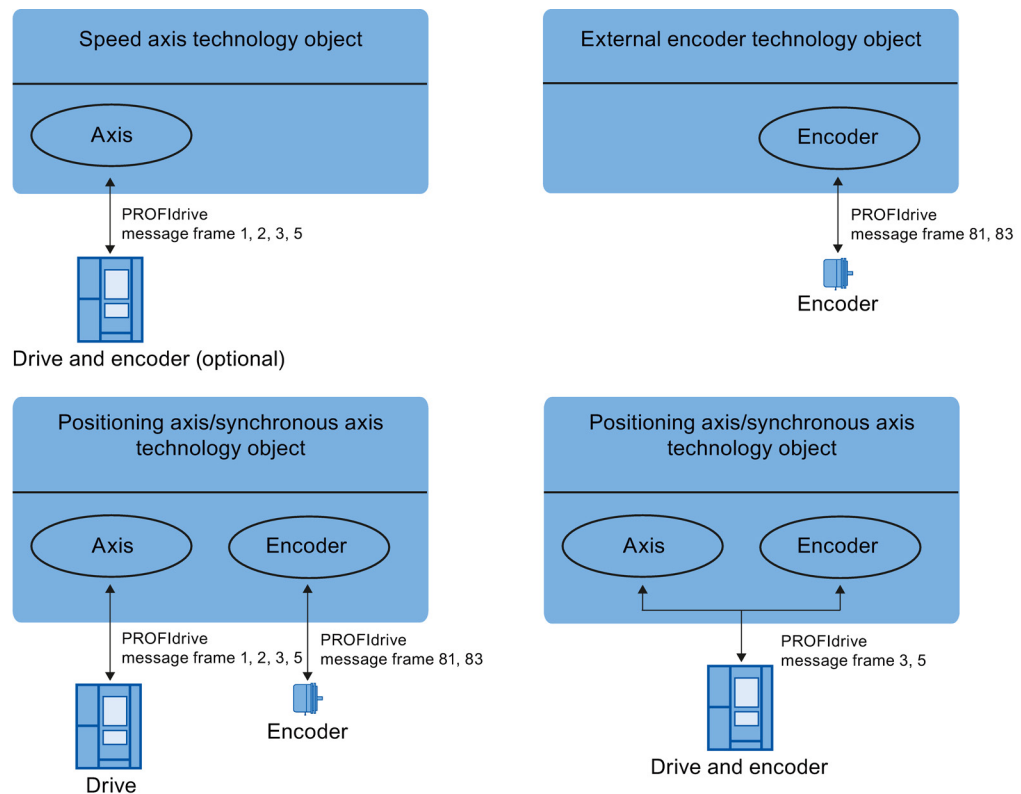
Communication between controller and drive/encoder is by means of various PROFIdrive message frames. Each of the message frames has a standardized structure. Depending on the application, you can select the applicable message frame. Control words and status words as well as setpoints and actual values are transmitted in the PROFIdrive message frames.

The PROFIdrive profile likewise supports the "Dynamic Servo Control" (DSC) control concept. DSC uses rapid position control in the drive. This can be used to solve highly dynamic positioning jobs.

3.10.2 Frames

The transmission of the encoder value occurs either in a frame together with the setpoint (frame 3 or frame 5), or in a separate encoder frame (frame 81 or frame 83).

The following figure represents the relationship between the technology objects and the drives / encoders:



Explanation of the figure:

- The setpoint of a speed axis is transmitted to a drive via PROFIdrive frame 1, 2, 3 or 5.
- The encoder value of an external encoder is transmitted via PROFIdrive frame 81 or 83.
- The setpoint of a positioning axis/synchronous axis is transmitted to a drive via PROFIdrive frame 1, 2, 3 or 5
- Encoder value of the positioning axis/synchronous axis

The encoder value can be transmitted in the following PROFIdrive frames:

- Transmission in the same PROFIdrive frame, in which the setpoint is also transmitted. For example, with PROFIdrive frame 3 or 5
- Transmission in PROFIdrive frame 81 or 83.

Frame types

The following table shows the supported PROFIdrive frame types for the assignment of drives and encoders:

Frame	Brief description
Standard frames	
1	<ul style="list-style-type: none"> • 16 bit speed setpoint (NSET) • 16 bit actual speed value (NACT),
2	<ul style="list-style-type: none"> • 32 bit speed setpoint (NSET) • 32 bit actual speed (NACT) • Signs of life
3	<ul style="list-style-type: none"> • 32 bit speed setpoint (NSET) • 32 bit actual speed (NACT) • Encoder actual value • Signs of life
5	<ul style="list-style-type: none"> • 32 bit speed setpoint (NSET) • 32 bit actual speed (NACT) • Dynamic Servo Control (DSC) • Encoder actual value • Signs of life
Standard frames encoder	
81	<ul style="list-style-type: none"> • Encoder actual value • Signs of life
83	<ul style="list-style-type: none"> • 32 bit actual speed (NACT) • Encoder actual value • Signs of life

When connecting by means of a PROFIdrive frame, the drives and encoders are handled and switched on in accordance with the PROFIdrive profile.

3.10.3 Setting reference values

The reference values for the drive connection and encoder connection must be set identically in the controller, and in the drive or encoder.

The setpoint speed setpoint NSET and the actual speed value NACT are transmitted in the PROFIdrive frame as a percentage value relative to the reference speed. The reference value for the speed must be set identically in the controller and in the drive.

The resolution of the actual value in the PROFIdrive frame must likewise be set identically in the controller and in the drive or encoder.

Frame settings

The controller settings are made in the TIA Portal under "Technology object > Configuration > Hardware interface > Data transmission".

The settings for drive and encoder are set in the configuration for the respective hardware.

The following table contrasts the controller settings and corresponding PROFIdrive parameters (<TO> stands for the applicable technology object):

Setting in the TIA Portal	Controller tag in the technology data block	PROFIdrive parameter
Frame	<TO>.Actor.Interface.Telegram	P922
Reference speed in [rpm]	<TO>.Actor.DriveParameter.ReferenceSpeed	(SINAMICS drives: P2000)
Maximum speed of the motor in [rpm]	<TO>.Actor.DriveParameter.MaxSpeed	(SINAMICS drives: P1082)
Encoder message frame	<TO>.Sensor[n].Interface.Telegram	P922
Encoder system (linear or rotary encoder)	<TO>.Sensor[n].System	P979[1] Bit0
Encoder type 0: incremental 1: absolute 2: cyclic absolute	<TO>.Sensor[n].Type	P979[5]
Resolution (linear encoder) The grid spacing is specified on the nameplate of the sensor as a separation distance of the marks on the linear measuring system.	<TO>.Sensor[n].Parameter.Resolution	P979[2]
Increments per revolution (rotary encoder)	<TO>.Sensor[n].Parameter.StepsPerRevolution	P979[2]
Number of bits for fine resolution XIST1 (cyclic actual encoder value, linear or rotary encoder)	<TO>.Sensor[n].Parameter.FineResolutionXist1	P979[3]
Number of bits for fine resolution XIST2 (absolute encoder value, linear or rotary encoder)	<TO>.Sensor[n].Parameter.FineResolutionXist2	P979[4]
Differentiable encoder revolutions (rotary absolute value encoder)	<TO>.Sensor[n].Parameter.DeterminableRevolutions	P979[5]

3.10.4 Tags

The following technology object tags are relevant for the connection of drives and encoders:

Drive frame	
<TO>.Actor.Interface.Telegram	Frame number
<TO>.Actor.DriveParameter.ReferenceSpeed	Reference velocity / reference speed for the velocity / speed (NSET), which is transmitted as a percentage value
<TO>.Actor.DriveParameter.MaxSpeed	Maximum value for the setpoint speed of the drive (NSET) (PROFIdrive: $MaxSpeed \leq 2 \times ReferenceSpeed$ Analog setpoint: $MaxSpeed \leq 1.17 \times ReferenceSpeed$)
Encoder frame	
<TO>.Sensor[n].Interface.Telegram	Frame number
<TO>.Sensor[n].System	Encoder system linear or rotary
<TO>.Sensor[n].Type	Encoder type, incremental, absolute or cyclically absolute
<TO>.Sensor[n].Parameter.StepsPerRevolution	Increments per revolution for rotary encoder
<TO>.Sensor[n].Parameter.DeterminableRevolutions	Number of differentiable encoder revolutions for a multi-turn absolute value encoder
<TO>.Sensor[n].Parameter.Resolution	Resolution for linear encoder The grid spacing corresponds to the interval between two marks.
Fine resolution	
<TO>.Sensor[n].Parameter.FineResolutionXist1	Number of bits for fine resolution XIST1 (cyclic actual encoder value)
<TO>.Sensor[n].Parameter.FineResolutionXist2	Number of bits for fine resolution XIST2 (absolute value of the encoder)

3.11 Safety functions in the drive

3.11.1 Brief description

The safety functions are internal drive functions and are described in detail in the relevant drive documentation.

The following section describes the reactions to the supported safety functions at the controller end .

The safety features are only supported for the drive connection via PROFIdrive.

The following safety features are supported by S7-1500 Motion Control:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1)
- Safe Stop 2 (SS2)

The active safety functions can also be evaluated via Safety Info Channel (SIC). Since the SIC is not a component of S7-1500 Motion Control, you must evaluate it separately in the user program.

3.11.2 Safe Torque Off (STO)

The Safe Torque Off (STO) safety function is the most common and basic internal safety function in the drive. STO ensures that no torque generating energy acts on a drive. This prevents an unintended startup of the controller. The pulses of the drive are eliminated. The drive is reliably torque-free. This state is monitored internally in the drive.

You can use STO when the drive comes to a standstill in a sufficiently short time due to the load torque or friction. Other areas of use are where "coasting" of the drive has no relevance for safety.

Behavior with S7-1500 Motion Control

When STO is triggered in the drive, technology alarm 421 is output, and the technology object is disabled (alarm reaction: Remove enable).

When the STO signal is no longer present in the drive, you can enable the technology object again after acknowledgment of the alarm.

3.11.3 Safe Stop 1 (SS1)

The Safe Stop 1 (SS1) safety function brings a drive to standstill quickly and safely via a drive-internal rapid stop ramp. Safe Torque Off (STO) is activated after standstill. STO ensures that no torque generating energy acts on a drive. This prevents an unintended startup of the controller.

You can use the SS1 safety function when a fast stop of the drive with a subsequent transition to STO is required. SS1 is used, for example, to quickly stop high inertia or brake drives quickly and safely at high speeds

Behavior with S7-1500 Motion Control

When SS1 is triggered, the drive decelerates at a drive-internal rapid stop ramp and automatically triggers the Safe Torque Off (STO) safety function.

When SS1 is triggered in the drive, the technology alarm 550 (alarm reaction: Follow-up setpoint) is output and the actual values supplied by the drive are automatically tracked as setpoints. The actual values are not monitored at the controller end. When standstill is achieved, technology alarm 421 is output, and the technology object is disabled (alarm reaction: Remove enable).

When the SS1 signal is no longer present in the drive, you can enable the technology object again after the acknowledgment of the alarm.

3.11.4 Safe Stop 2 (SS2)

The Safe Stop 2 (SS2) safety function brings a drive to standstill quickly and safely via a drive-internal rapid stop ramp. When standstill is achieved, the standstill position is monitored at the drive end. The drive can deliver full torque to maintain the standstill.

SS2, for example, is used for machine tools.

Behavior with S7-1500 Motion Control

When SS2 is triggered, the drive decelerates at a drive-internal rapid stop ramp. The drive control monitors the standstill.

When SS2 is triggered in the drive, the technology alarm 550 (alarm reaction: Follow-up setpoint) is output and the actual values supplied by the drive are automatically tracked as setpoints. The actual values are not monitored at the controller end.

When the SS2 signal is no longer present in the drive, the drive goes automatically into "read for operation" mode. The operational readiness of the drive is indicated in the technology object tags <TO>.StatusDrive.InOperation with TRUE. The technology object is automatically enabled again after acknowledging the alarm.

3.12 Actual values

3.12.1 Brief description

For position-controlled motion and positioning, the controller must know the actual position value.

The actual position value is provided by a PROFIdrive frame. The actual value is updated after a one-off transition of the operating mode from STOP to RUN.

The actual values are represented incrementally or absolutely in the PROFIdrive frame, and standardized in the controller to the technological unit. Homing is used to convert the actual value to the physical position of the axis, or of the external encoder.

The controller supports the following types of actual values:

- Incremental actual value
- Absolute actual value with the setting absolute (measuring range > traversing range of the axis)
- Absolute actual value with the setting absolute (measuring range < traversing range of the axis)

3.12.2 Incremental actual value

The actual value in the PROFIdrive frame is based on an incremental value.

After POWER ON, position zero is displayed. The actual value is updated after a one-time transition of the operating mode from STOP to RUN in the STOP and RUN operating modes. The relationship between the technology object and the mechanical position must be recreated by means of homing (Page 39).

3.12.3 Absolute actual value

The actual value in the PROFIdrive frame is based on an absolute value.

After POWER ON, position zero is displayed. The actual value is updated after a one-off transition of the operating mode from STOP to RUN. The supplied absolute value is assigned to the associated mechanical axis position by means of absolute value adjustment (Page 56). The absolute value adjustment must be performed once. The absolute value offset is retentively saved beyond the switching on/off of the controller.

Differentiation of absolute values:

- The measuring range of the encoder is larger than the traversing range of the axis:
Absolute value with absolute setting
- The measuring range of the encoder is smaller than the traversing range of the axis:
Absolute value with cyclically absolute setting

Absolute actual value with the setting absolute (measuring range > traversing range)

The axis position results directly from the actual encoder value. The traversing range must be within an encoder measuring range. This means that the zero point of the encoder must not be located in the traversing range.

When the controller is switched on, the axis position is determined from the absolute encoder value.

Absolute actual value with the setting absolute (measuring range < traversing range)

The encoder supplies an absolute value within its measuring range. The controller includes the traversed measuring ranges and thus determines the correct axis position beyond the measuring range.

When the controller is switched off, the traversed measuring ranges are saved in the retentive memory area of the controller.

At the next power-on, the stored overflows are taken into account in the calculation of the actual position value.

NOTICE
Movements of the axis while the controller is switched off can skew the actual value
If the axis or the encoder is moved by more than half of the encoder measuring range while the controller is switched off, then the actual value in the controller is no longer in accord with the mechanical axis position.

3.12.4 Tags

The tags named in the Homing (Page 58) section are relevant for adapting actual values.

3.13 Mechanics

3.13.1 Brief description

For the display and processing of the technology object's position, the decisive factor is whether the position is represented as a unit of length (linear axis) or as a rotary unit (rotary axis).

Examples of units of length: mm, m, km

Examples of rotary units: °, rad

For the determination of the physical position from an actual encoder value, the system must know the various properties and configurations of the mechanics.

Positioning axis/synchronous axis

The following configuration options for mechanics are supported:

- Load gear
- Leadscrew pitch (linear axes only)
- Type of encoder mounting:
 - On the motor side (before the load gear)
 - On the load side (after the load gear and as applicable the leadscrew)
 - External (e.g. odometer)
- Inversion of the setpoint
- Inversion of the setpoint

External encoder

The following configuration options for mechanics are supported:

- Measuring gearbox (for rotary encoders)
- Leadscrew (only with linear system of units and rotatory encoders)
- Inversion of the setpoint

Speed axis

The following configuration options for mechanics are supported:

- Load gear
- Inversion of the setpoint

3.13.2 Tags

The following technology object tags are relevant for the setting of the mechanics:

Type of motion	
<TO>.Properties.MotionType	Indication of linear or rotary motion 0: Linear motion 1: Rotary motion
Load gear	
<TO>.LoadGear.Numerator	Load gear counter
<TO>.LoadGear.Denominator	Load gear denominator
Leadscrew pitch	
<TO>.Mechanics.LeadScrew	Leadscrew pitch
Type of encoder mounting	
<TO>.Sensor[n].MountingMode	Type of encoder mounting
<TO>.Sensor[n].Parameter.Distance PerRevolution	Load distance per encoder revolution with an externally mounted encoder
Inversion	
<TO>.Actor.InverseDirection	Setpoint inversion
<TO>.Sensor[n].InverseDirection	Actual value inversion
Modulo	
<TO>.Modulo.Enable	Enable modulo
<TO>.Modulo.Length	Modulo length
<TO>.Modulo.StartValue	Modulo start value

3.14 Homing

3.14.1 Brief description

With homing, you create the relationship between the position in the technology object and the mechanical position. The position value in the technology object is assigned to a homing mark at the same time. This homing mark represents a known mechanical position.

With incremental actual values this process is called homing; with absolute actual values it is called absolute value adjustment.

Homing is a requirement for the indication of the correct position in the technology object, and for absolute positioning.

Homing is enabled with the Motion Control instruction "MC_Home", and is enabled for a single homing process each time.

Homing status

The technology object tag <TO>.StatusWord.X5 (HomingDone) indicates whether the technology object has been homed to an axis or external encoder.

Type of homing

Homing can occur by means of an independent movement for homing (active homing), by means of a homing mark during an application-initiated movement (passive homing), or by means of direct position assignment.

A distinction is made between the following types of homing:

- **Active homing**

Active homing initiates a homing movement and performs the necessary approach to the homing mark. When the homing mark is detected, the actual position is set to the configured value. It is possible to specify an offset from the home position.

When active homing starts, current traversing movements are aborted. The offset is automatically traversed after the approach to home position.

- **Passive homing**

The homing job does not perform its own homing motion. When the homing mark is detected during an application-initiated motion, the actual position is set to the configured value.

Passive homing is also called homing on the fly.

- **Direct homing**

The homing job directly sets the actual position to the configured value, or offsets it by this amount.

- **Absolute value adjustment**

Absolute value adjustment adjusts the position of the technology object to the existing absolute actual value.

Homing mode

Depending on the type of homing mark and of the homing mark search, a distinction is made among the following homing modes (Page 41):

- **Homing with zero mark via PROFIdrive frame and proximity switch**
- **Homing with zero mark via PROFIdrive frame**
- **Homing with digital input**

3.14.2 Terms

Homing mark

A homing mark is an input signal, on whose occurrence a known mechanical position can be assigned to the actual values.

A homing mark can be:

- **A zero mark**

The zero mark of an incremental encoder or an external zero mark is used as a homing mark.

The zero mark is detected at the drive module or encoder module, and transmitted in the PROFIdrive frame. Perform the setting and evaluation as an encoder zero mark or external zero mark at the drive module and sensor module.

- **An edge at the digital input**

The falling or rising edge at a digital input is used as a homing mark.

Proximity switch

If there are several zero marks in the traversing range, the proximity switch permits the selection of a specific zero mark before or after the proximity switch.

Homing mark position

This is the position assigned to the homing mark.

The homing mark position corresponds to the home position minus the home position offset.

Home position

At the end of the active homing motion, the axis arrives at the home position.

Home position offset

The difference between the homing mark position and the home position is the home position offset.

An offset between homing mark position and home position only has an effect during active homing. The offset is traversed after the synchronization of the axis via the Motion Control instruction "MC_Home". For axes with the modulo setting, the home position offset is always traversed using the direction setting for the shortest path.

Direction reversal at the hardware limit switch (reversing cam)

Hardware limit switches can be used as reversing cams in active homing. If the homing mark is not detected or was approached from the wrong side, then the motion continues after the reversing cam in the opposite direction.

3.14.3 Homing mode

Various homing modes are available for the positioning axis/synchronous axis and external encoder technology objects with incremental encoders. The homing mode is set in the configuration.

Homing with zero mark via PROFIdrive frame and proximity switch

The system checks for when the proximity switch is reached. After the proximity switch is reached and is left again in the assigned homing direction, zero mark detection is enabled via the PROFIdrive message frame.

When the zero mark is reached in the pre-selected direction, then the actual position of the technology object is set to the homing mark position.

Homing with zero mark via PROFIdrive frame

The system enables zero mark detection, as soon as the actual value of the technology object moves in the assigned homing direction.

When the zero mark is reached in the specified homing direction, the actual position of the technology object is set to the homing mark position.

Homing with digital input

The system checks the state of the digital input, as soon as the actual value of the axis or encoder moves in the assigned homing direction.

When the homing mark is reached (setting of the digital input) in the specified homing direction, the actual position of the technology object is set to the homing mark position.

Note

The digital inputs must be placed into the process image partition "PIP OB Servo".

The filter time of the digital inputs must be set smaller than the duration of the input signal at the reference point switch.

See also

Homing SINAMICS drives with external zero marks (Page 396)

3.14.4 Active homing with zero mark and proximity switch

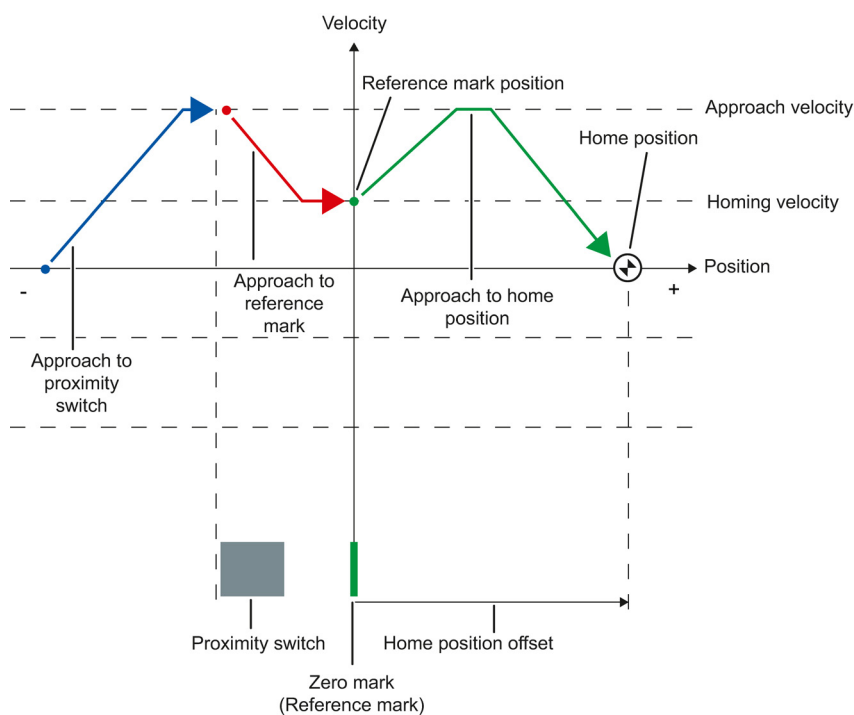
The following examples show homing motions in the positive and negative directions.

Example of homing in the positive direction

The approach to the homing mark and the home position occurs in the positive direction.

The following figure shows the homing motion with the following settings:

- Active homing with zero mark and proximity switch
- Approach in the positive direction
- Homing in the positive direction
- Positive home position offset

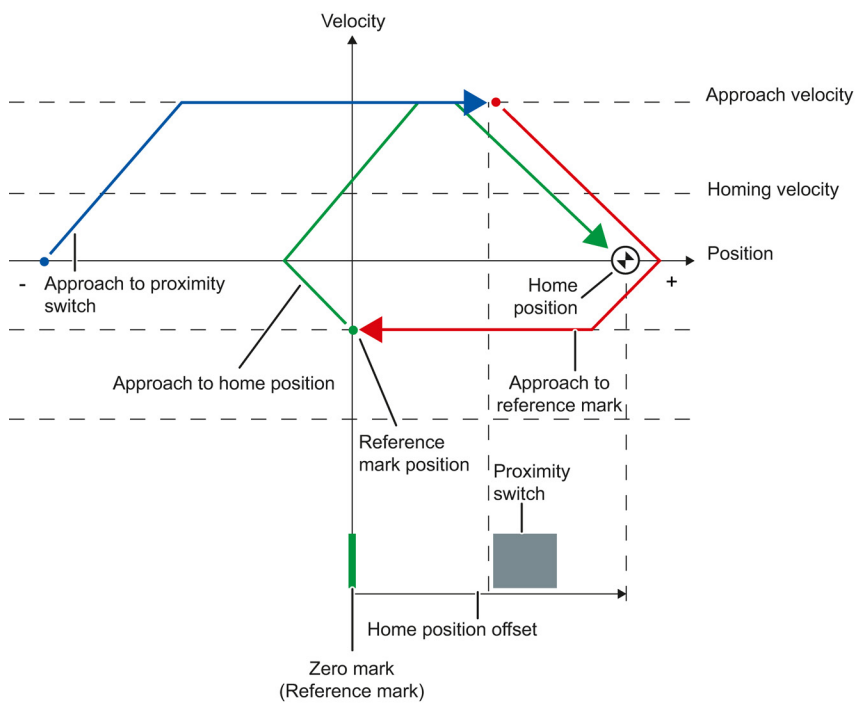


Example of homing in the negative direction

The move to the homing mark occurs in the negative direction by means of a direction reversal during the homing process. The move to the home position causes another direction reversal and occurs in the positive direction.

The following figure shows the homing motion with the following settings:

- Active homing with zero mark and proximity switch
- Approach in the positive direction
- Homing in the negative direction
- Positive home position offset



Motion sequence

The motion occurs in the following sequence:

1. **Start of active homing via the Motion Control instruction "MC_Home"**
2. **Approach to the proximity switch**
3. **Detection of the proximity switch in the homing direction, while moving at homing velocity**
4. **Departure from the proximity switch, and approach to the homing mark**

With the departure from the proximity switch, the detection of the homing mark is enabled.

5. **Detection of the homing mark**

When the homing mark is detected, the position of the technology object is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 3
Position = value in parameter "Position" minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset
- Parameter "Mode" to "MC_Home" = 5
Position = value in the tag <TO>.Homing.HomePosition minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

6. **Approach to the home position**

- Parameter "Mode" to "MC_Home" = 3
The axis moves to the position that is specified in the "Position" parameter.
- Parameter "Mode" to "MC_Home" = 5
The axis moves to the position that is specified in the <TO>.Homing.HomePosition tag.

Note

If the velocity on the span from the detection of the proximity switch to the zero mark cannot be reduced to the homing velocity, then homing occurs at the velocity that exists when the zero mark is traversed.

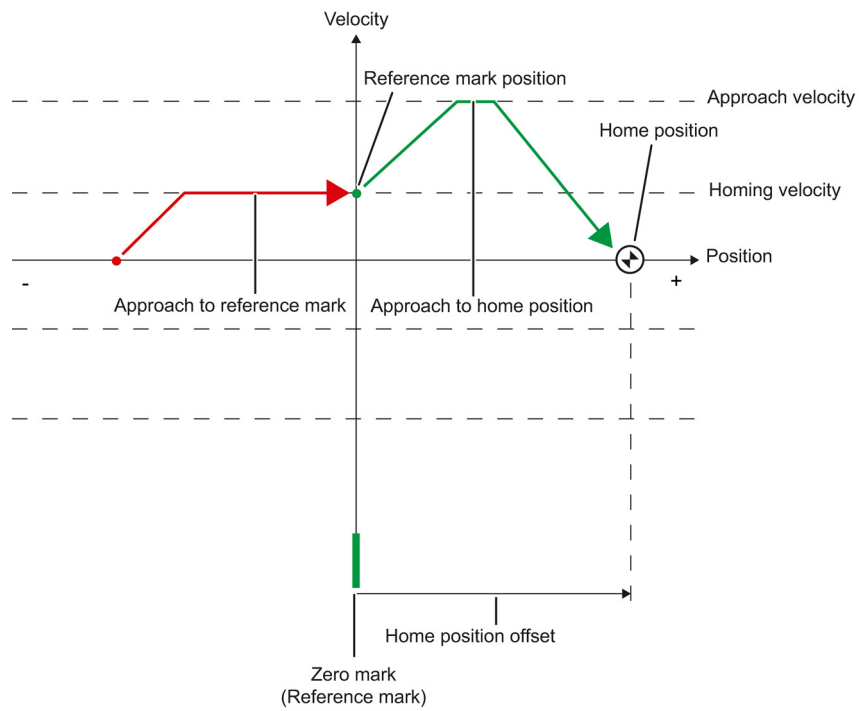
See also

Homing SINAMICS drives with external zero marks (Page 396)

3.14.5 Active homing with zero mark

The following figure shows an example of the homing motion with the following settings:

- Active homing with zero mark
- Homing in the positive direction
- Positive home position offset



Motion sequence

The motion occurs in the following sequence:

1. **Start of active homing via the Motion Control instruction "MC_Home"**
2. **Move to the homing mark in the homing direction with the homing velocity**
3. **Detection of the homing mark**

When the homing mark is detected, the position of the axis or encoder is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 3
Position = value in parameter "Position" minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset
 - Parameter "Mode" to "MC_Home" = 5
Position = value in the tag <TO>.Homing.HomePosition minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset
-

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

4. **Approach to the home position**

- Parameter "Mode" to "MC_Home" = 3
The axis moves to the position that is specified in the "Position" parameter.
- Parameter "Mode" to "MC_Home" = 5
The axis moves to the position that is specified in the <TO>.Homing.HomePosition tag.

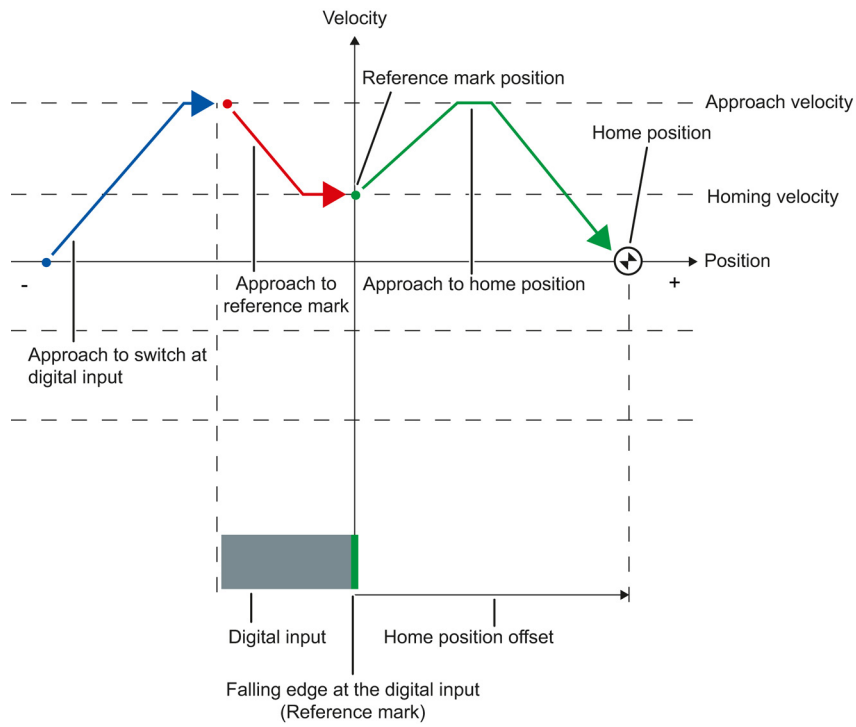
See also

Homing SINAMICS drives with external zero marks (Page 396)

3.14.6 Active homing with digital input

The following figure shows an example of the homing motion with the following settings:

- Active homing with digital input
- Approach in the positive direction
- Homing mark on the positive side of the digital input
- Positive home position offset



Motion sequence

The motion occurs in the following sequence:

1. **Start of active homing via the Motion Control instruction "MC_Home"**
2. **Detection of the rising edge at the digital input, while moving at homing velocity**
3. **Approach to the homing mark**
4. **Detection of the homing mark**

In the example, the falling edge of the switch at the digital input represents the homing mark.

When the homing mark is detected, the position of the axis or encoder is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 3
Position = value in parameter "Position" minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset
 - Parameter "Mode" to "MC_Home" = 5
Position = value in the tag <TO>.Homing.HomePosition minus
<TO>.Sensor[n].ActiveHoming.HomePositionOffset
-

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

5. **Approach to the home position**

- Parameter "Mode" to "MC_Home" = 3
The axis moves to the position that is specified in the "Position" parameter.
 - Parameter "Mode" to "MC_Home" = 5
The axis moves to the position that is specified in the <TO>.Homing.HomePosition tag.
-

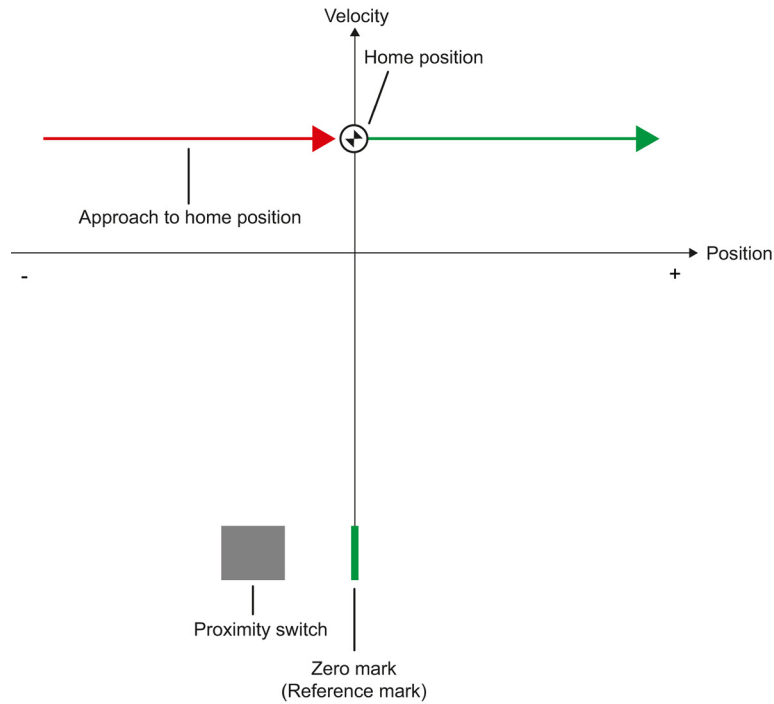
Note

If the velocity on the span from the detection of the rising edge to the falling edge cannot be reduced to the homing velocity, then homing occurs at the velocity that exists when the homing mark is traversed.

3.14.7 Passive homing with zero mark and proximity switch

The following figure shows an example of the homing motion with the following settings:

- Passive homing with zero mark and proximity switch
- Homing in the positive direction



Motion sequence

The motion occurs in the following sequence:

1. **Enablement of passive homing via the Motion Control instruction "MC_Home".**
2. **Motion due to a Motion Control job from the application**

The detection of the proximity switch and of the homing mark is enabled when the actual position value of the axis or encoder moves in the assigned homing direction.

3. **Detection of the proximity switch**
4. **Departure from the proximity switch**

The departure from the proximity switch enables the detection of the homing mark.

5. **Detection of the homing mark**

When the homing mark is detected, the position of the axis or encoder is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 2, 8
Position = value in parameter "Position"
 - Parameter "Mode" to "MC_Home" = 10
Position = value in tag <TO>.Homing.HomePosition
-

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

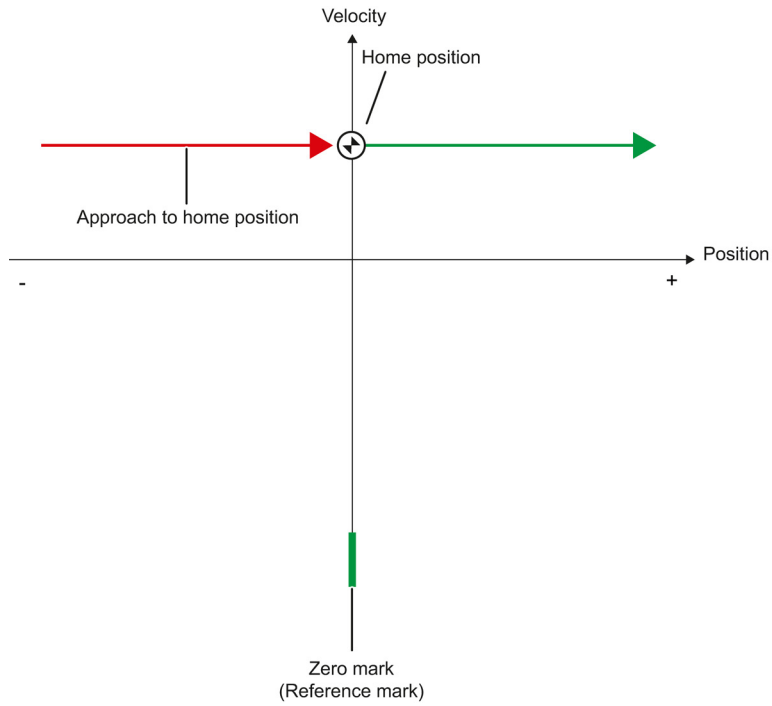
Note

If the direction of motion changes after departure from the proximity switch and before detection of the homing mark, then the proximity switch must be detected again. The Motion Control instruction "MC_Home" remains enabled.

3.14.8 Passive homing with zero mark

The following figure shows an example of the homing motion with the following settings:

- Passive homing with zero mark
- Homing in the positive direction



Motion sequence

The motion occurs in the following sequence:

1. **Enablement of passive homing via the Motion Control instruction "MC_Home".**
2. **Motion due to a Motion Control job from the application**

The detection of the homing mark is enabled when the actual position value of the axis or encoder moves in the assigned homing direction.

3. **Detection of the homing mark**

When the homing mark is detected, the position of the axis or encoder is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 2, 8
Position = value in parameter "Position"
- Parameter "Mode" to "MC_Home" = 10
Position = value in tag <TO>.Homing.HomePosition

Note

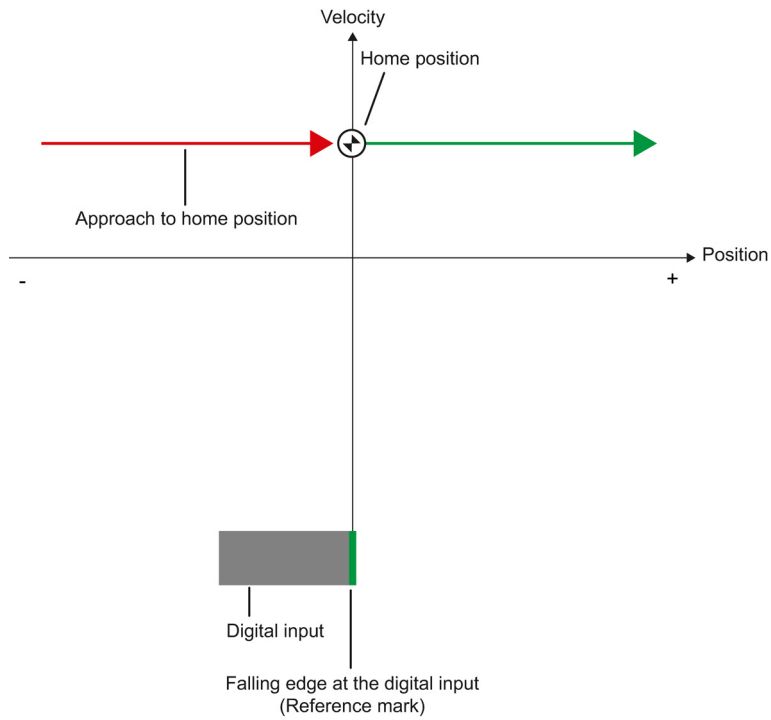
Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

3.14.9 Passive homing with digital input

The following figure shows an example of the homing motion with the following settings:

- Passive homing with digital input
- Homing in the positive direction
- Homing mark on the positive side of the digital input



Motion sequence

The motion occurs in the following sequence:

1. **Enablement of passive homing via the Motion Control instruction "MC_Home".**
2. **Motion due to a Motion Control job from the application**

The detection of the homing mark at the digital input is enabled when the actual position value of the axis or encoder moves in the assigned homing direction.

3. **Detection of the homing mark**

In the example, the falling edge of the switch at the digital input represents the homing mark.

When the homing mark is detected, the position of the axis or encoder is set depending on the configured mode:

- Parameter "Mode" to "MC_Home" = 2, 8
Position = value in parameter "Position"
- Parameter "Mode" to "MC_Home" = 10
Position = value in tag <TO>.Homing.HomePosition

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

3.14.10 Direction reversal at the hardware limit switch (reversing cam)

During active homing, the hardware limit switch can optionally be used as a reversing cam. If the homing mark is not detected or the motion was not in the homing direction, then the motion continues after the reversing cam in the opposite direction with the approach velocity.

When the hardware limit switch is reached, the dynamic defaults become effective. Deceleration with the emergency stop deceleration does not occur.

NOTICE
<p>Avoid moving to a mechanical endstop</p> <p>Ensure by one of the following measures, that in a direction reversal the machine does not move to a mechanical endstop.</p> <ul style="list-style-type: none"> • Keep the approach velocity low. • Increase the configured acceleration / deceleration. • Increase the offset between the hardware limit switch and the mechanical endstop.

3.14.11 Direct homing

Depending on the configured mode, the position of the positioning axis/synchronous axis or external encoder technology objects can be absolutely or relatively set with "MC_Home".

Set position absolutely

Proceed as follows to set the position absolutely:

1. In the Motion Control instruction "MC_Home", enter the absolute position in the "Position" parameter.
2. Call the Motion Control instruction "MC_Home" with parameter "Mode" = 0.

The position is set to the value specified in the "Position" parameter.

Set position relatively

Proceed as follows to set the position relatively:

1. In the Motion Control instruction "MC_Home", enter the relative position in the "Position" parameter.
2. Call the Motion Control instruction "MC_Home" with parameter "Mode" = 1.

The position is set to the current position plus the value specified in the "Position" parameter.

3.14.12 Absolute value adjustment

In absolute value adjustment, Motion Control determines an absolute value offset, that is retentively stored on the CPU.

Depending on the configured mode, the position of the axis or the encoder is absolutely or relatively set in the "MC_Home" Motion Control instruction.

- Parameter "Mode" = 7 (absolute specification of position)
Position = value in parameter "Position"
- Parameter "Mode" = 6 (relative specification of position)
Position = current position + value in parameter "Position"

3.14.13 Resetting the "Homed" status

Incremental encoder

In the following cases, the "Homed" status is reset, and the technology object must be rehomed.

- Errors in the sensor system / encoder failure
- Initiation of active homing with the Motion Control instruction "MC_Home" with "Mode" = 3, 5 (after successful completion of the homing process, the status "Homed" is set again.)

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

- Initiation of passive homing with the Motion Control instruction "MC_Home" with "Mode" = 2, 8, 10 (after successful completion of the homing process, the status "Homed" is set again.)
- Replacement of the CPU
- Replacement of the SIMATIC Memory Card
- POWER OFF
- Memory reset
- Modification of the encoder configuration
- Restart of the technology object
- Restoration of the CPU factory settings
- Transfer of a different project into the controller

Absolute value encoder

In the following cases, the "Homed" status is reset, and the technology object must be rehomed.

- Errors in the sensor system / encoder failure
- Replacement of the CPU
- Modification of the encoder configuration
- Restoration of the CPU factory settings
- Transfer of a different project into the controller

Resetting the memory of the CPU or upgrading a project does not require another absolute value adjustment.

3.14.14 Tags

The following technology object tags are relevant for homing:

Status indicators	
<TO>StatusWord.X11 (HomingCommand)	Homing command active
<TO>StatusWord.X5 (HomingDone)	Technology object is homed
<TO>ErrorWord.X10 (HomingFault)	Error occurred during homing
Approach to the proximity switch	
<TO>.Homing.ApproachDirection	Start direction or approach direction for the approach to the proximity switch
<TO>.Homing.ApproachVelocity	Velocity for the approach to the proximity switch
Approach to the homing mark	
<TO>.Sensor[n].ActiveHoming.Direction	Homing direction
<TO>.Homing.ReferencingVelocity	Velocity for the approach to the homing mark
Approach to home position	
<TO>.Homing.ApproachVelocity	Velocity for the approach to the home position
Positions	
<TO>.Homing.AutoReversal	Reversal at the hardware limit switches
<TO>.Homing.HomePosition	Home position
<TO>.StatusSensor[n].AbsEncoderOffset	Calculated offset after the absolute value adjustment
Parameters for active homing	
<TO>.Sensor[n].ActiveHoming.Mode	Homing mode
<TO>.Sensor[n].ActiveHoming.SideInput	Side of the digital input
<TO>.Sensor[n].ActiveHoming.Direction	Homing direction or approach direction
<TO>.Sensor[n].ActiveHoming.DigitalInputAddress	Byte number of the I/O address of the digital input
<TO>.Sensor[n].ActiveHoming.DigitalInputBitNumber	Bit number of the I/O address of the digital input
<TO>.Sensor[n].ActiveHoming.HomePositionOffset	Offset of the homing mark from the home position
Parameters for passive homing	
<TO>.Sensor[n].PassiveHoming.Mode	Homing mode
<TO>.Sensor[n].PassiveHoming.SideInput	Side of the digital input
<TO>.Sensor[n].PassiveHoming.Direction	Homing direction or approach direction
<TO>.Sensor[n].PassiveHoming.DigitalInputAddress	Byte number of the I/O address of the digital input
<TO>.Sensor[n].PassiveHoming.DigitalInputBitNumber	Bit number of the I/O address of the digital input

Note

Evaluation of the bits in StatusWord, ErrorWord and WarningWord

Read the information provided in section Evaluate StatusWord, ErrorWord and WarningWord (Page 175).

3.15 Control

3.15.1 Brief description

The position controller of the positioning axis/synchronous axis is a closed-loop P controller with pre-control of velocity.

If the drive supports Dynamic Servo Control (DSC), then a closed-loop position controller in the drive can optionally be used.

Dynamic Servo Control (DSC)

In drives that support Dynamic Servo Control (DSC), you can optionally use the closed-loop position controller in the drive. The position controller in the drive is usually implemented with a rapid speed-control cycle. This improves the control performance for digitally coupled drives. The communication times between controller and drive are automatically taken into account.

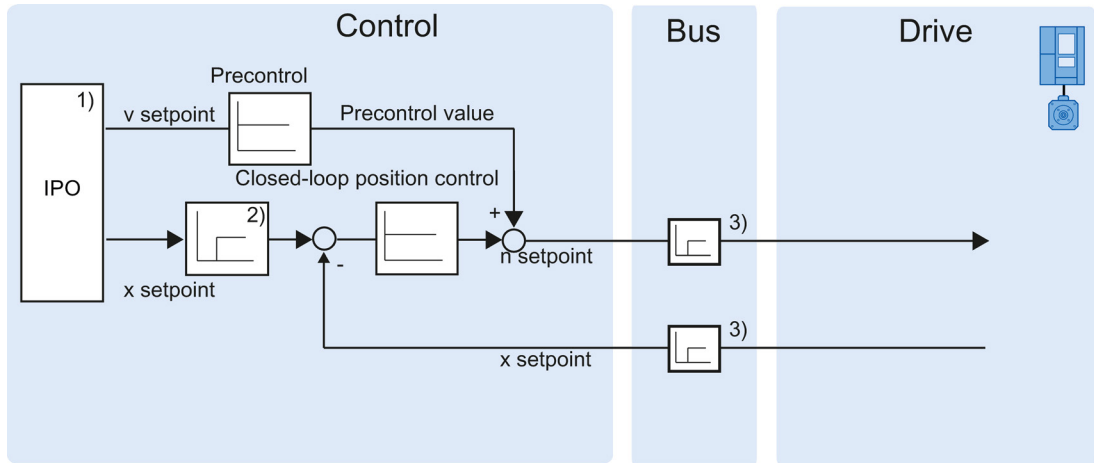
For DSC, the drive's encoder must be used and standard message frame 5 must be set on the drive.

See also

Frames (Page 29)

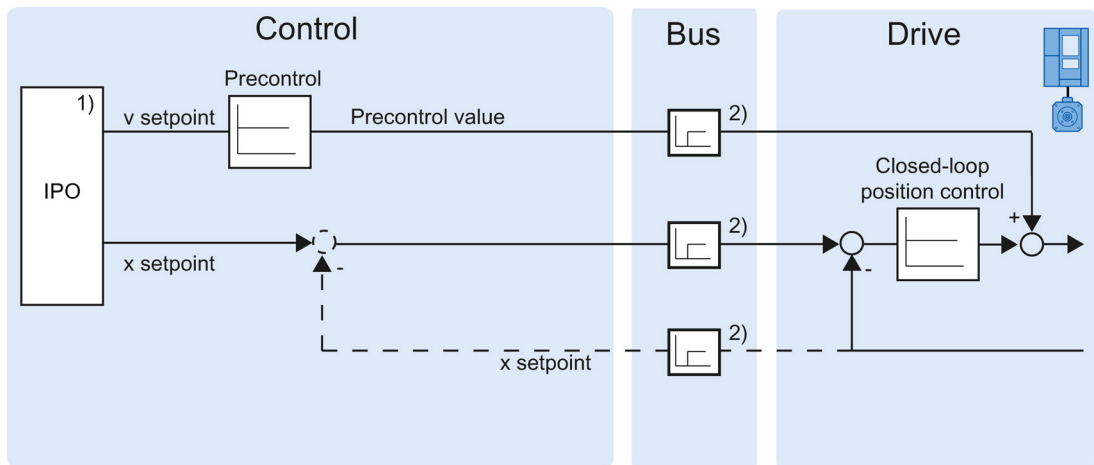
3.15.2 Control structure

The following figure shows the effective control structure without DSC:



- 1) Interpolator with motion control
- 2) Internal accounting of the signal delay times
- 3) Communication control drive

The following figure shows the effective control structure with DSC:



- 1) Interpolator with motion control
- 2) Communication control drive

3.15.3 Tags

The following technology object tags are relevant for control:

Parameter	
<TO>.PositionControl.Kv	Proportional gain in the position control
<TO>.PositionControl.Kpc	Velocity pre-control in the position control (in %)
<TO>.PositionControl.EnableDSC	Enabling DSC

3.16 Position-related monitoring

3.16.1 Brief description

The following functions are available in the positioning axis/synchronous axis technology object for monitoring positioning and motion:

- Positioning monitoring (Page 62)

The actual position value must reach a positioning window within a specified time, and remain in this positioning window for a minimum dwell time.

- Following error monitoring (Page 63)

The following error is monitored based on a velocity-dependent following error limit. The permissible maximum following error depends on the setpoint velocity.

If monitored conditions are violated, then technology alarms are output. The technology object responds in accordance with the alarm response.

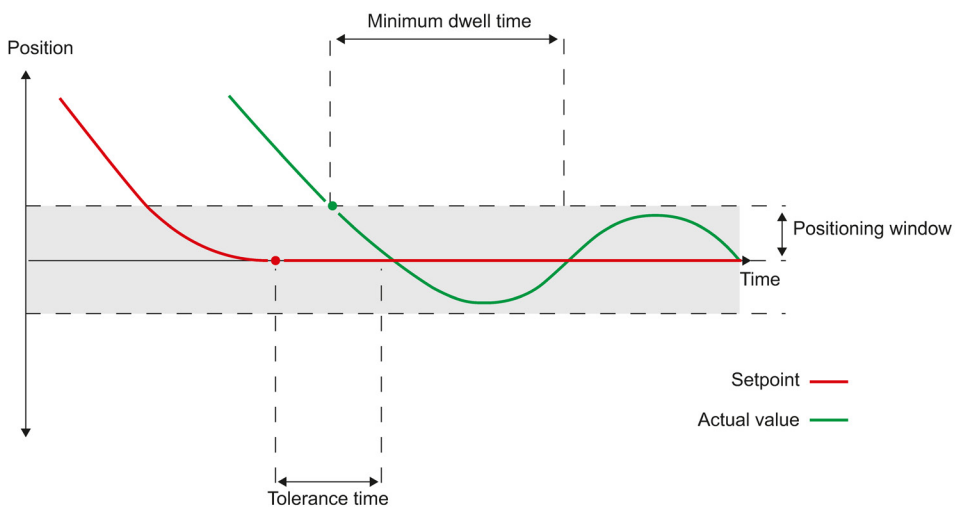
3.16.2 Positioning monitoring

Positioning monitoring monitors the behavior of the actual position at the end of the setpoint calculation.

As soon as the setpoint velocity reaches the value zero, the actual position value must be located within a tolerance time in the positioning window. The setpoint must not exit the positioning window during the minimum dwell time.

If the actual position value at the end of a positioning motion is reached within the tolerance time and remains in the positioning window for the minimum dwell time, then <TO>.StatusWord.X6 (Done) is set in the technology data block. This completes a Motion Control job.

The following figure shows the chronological sequence and the positioning window:



Positioning monitoring does not make any distinction between how the setpoint interpolation was completed. The end of setpoint interpolation can for example be reached as follows:

- by the setpoint reaching the target position
- by position controlled stopping during the motion, via the Motion Control instruction "MC_Halt"

Violation of positioning monitoring

In the following cases, technology alarm 541 is output by the positioning monitoring, and the technology object is disabled (alarm reaction: remove enable).

- The actual value does not reach the positioning window during the tolerance time.
- The actual value exits the positioning window during the minimum dwell time.

3.16.3 Following error monitoring

The following error in the positioning axis/synchronous axis technology object is monitored based on a velocity-dependent following error limit. The permissible following error depends on the setpoint velocity.

A constant permissible following error can be specified for velocities less than an adjustable velocity low limit.

Above this lower velocity limit, the permissible following error increases in proportion to the setpoint velocity. The maximum permissible following error may be reached at the maximum velocity.

Calculation of the following error

The following error is the difference between the position setpoint and the actual position value. The transmission times of the setpoint to the drive, and of the actual position value to the controller, are taken into account in the calculation of the following error, i.e., subtracted out.

Warning limit

A warning limit can be specified for the following error. The warning limit is input as a percentage value and operates relative to the current permissible following error. If the warning limit of the following error is reached, then technology alarm 522 is output. This is a warning and contains no alarm response.

Exceedance of the permissible following error

If the permissible following error is exceeded, then technology alarm 521 is output, and the technology object is disabled (alarm response: remove enable).

3.16.4 Tags

The following technology object tags are relevant for positioning monitoring:

Status indicators	
<TO>.StatusWord.X7 (Standstill)	Is set to the value TRUE , when the actual velocity value goes below the velocity threshold, and does not exit it within the minimum dwell time. The standstill signal is only present at the positioning axis/synchronous axis.
<TO>.StatusWord.X6 (Done)	Positioning axis/synchronous axis Is set to the value TRUE, when the actual velocity value reaches the positioning window within the tolerance time, and remains for the minimum dwell time in the window. Speed axis Is set to TRUE, when the motion is completed and thus the speed setpoint is equal to zero.
<TO>.ErrorWord.X12 (PositioningFault)	A positioning error has occurred.
Positions and times	
<TO>.PositioningMonitoring.ToleranceTime	Maximum permissible time until positioning window is reached The time is started with the end of the setpoint interpolation.
<TO>.PositioningMonitoring.MinDwellTime	Minimum dwell time in the positioning window
<TO>.PositioningMonitoring.Window	Positioning window
Standstill signal	
<TO>.StandstillSignal.VelocityThreshold	Velocity threshold for the standstill signal
<TO>.StandstillSignal.MinDwellTime	Minimum dwell time below the velocity threshold

The following technology object tags are relevant for following error monitoring:

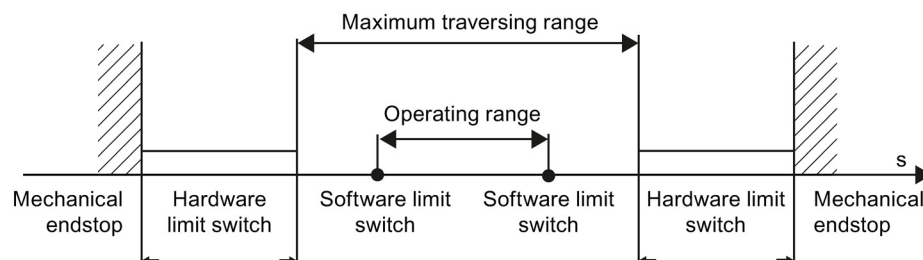
Status indicators	
<TO>.StatusPositioning.FollowingError	Current following error
<TO>.ErrorWord.X11 (FollowingErrorFault)	Status indication, that the following error is too large
<TO>.WarningWord.X11 (FollowingError-Warning)	Status indication, that the following error warning limit has been reached
Control bits	
<TO>.FollowingError.EnableMonitoring	Enabling / disabling following error monitoring
Limit values	
<TO>.FollowingError.MinVelocity	Lower setpoint velocity for the characteristic curve of the maximum following error
<TO>.FollowingError.MinValue	Permissible following error below the <TO>.FollowingError.MinVelocity
<TO>.FollowingError.MaxValue	Maximum permissible following error at maximum axis velocity
<TO>.FollowingError.WarningLevel	Warning limit as a percentage value relative to the maximum permissible following error (velocity-dependent in accordance with the characteristic curve)

3.17 Traversing range limitation

3.17.1 Brief description

Hardware and software limit switches limit the permissible traversing range and operating range of the positioning axis/synchronous axis. Before use, they must be enabled in the configuration or in the user program.

The following figure shows the relationship between operating range, maximum traversing range and the limit switches:



3.17.2 Hardware limit switches

Hardware limit switches are limit position switches that limit the maximum permissible traversing range of the axis.

Select the positions of the hardware limit switches so that there is adequate braking distance for the axis when needed. The axis should come to a standstill before a mechanical endstop.

Approaching the hardware limit switches

In the monitoring of range limitation, no distinction is made, whether the switches are approached or overshoot.

If a hardware limit switch is approached, technology alarm 531 is output, and the technology object is disabled (alarm response: remove enable).

Exception

If the hardware limit switches are used as reversing cams or reference cams, then the monitoring of the hardware limit switches has no effect.

Retracting

The position of the axis when the hardware limit switch is detected is stored internally on the CPU. The status of the approached hardware limit switch is reset only after the hardware limit switch is left and the axis is once again in the maximum traversing range.

To be able to traverse the axis again after reaching the hardware limit switch and to reset the status of the hardware limit switch, follow the steps below:

1. To allow movement away from the limit switch, acknowledge the technology alarm.

2. Traverse the axis away from the hardware limit switch until it leaves it.

The axis must then be within the maximum traversing range.

If you traverse the axis in the direction of the limit switch before the axis has left it, the monitoring will be triggered again.

The following diagram shows the response of the status word when reaching the hardware limit switch and when releasing the axis again:

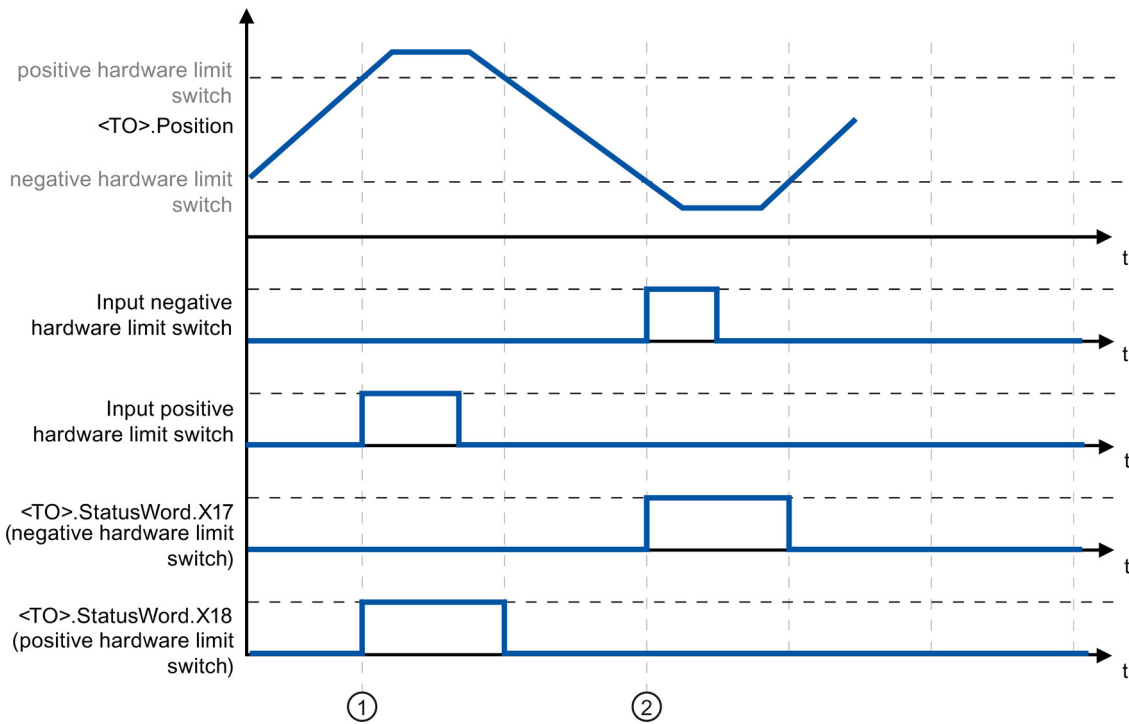


Figure 3-1 Status message HW-ES

At the time ① the position of the axis when the positive hardware limit switch is detected is stored internally on the CPU. To reset the status of the hardware limit switch, the axis must be pulled back from this position.

At the time ② the position of the axis when the negative hardware limit switch is detected is stored internally on the CPU. To reset the status of the hardware limit switch, the axis must pass this position.

3.17.3 Software limit switch

The operating range of the axis is limited with software limit switches. Relative to the traversing range, always position the software limit switches within the hardware limit switches. Since the positions of the software limit switches can be flexibly configured, the operating range of the axis can be individually adapted in accordance with the current velocity profile.

Software limit switches are only effective when there is a valid actual value after homing the technology object. The monitoring of the software limit switches is relative to the setpoint.

Modulo enabled

With modulo enabled, the modulo position is monitored.

The software limit switches are enabled or disabled using the tags in the technology data block. If the positions of both software limit switches are outside the modulo range, then the monitoring has no effect. It is not checked, whether the positions of the software limit switches are within the modulo range.

Approaching the software limit switches

At the beginning of a positioning motion, it is not checked, whether the software limit switches will be approached by approaching the specified target position.

If the software limit switches are approached, then technology alarm 533 is output, and the axis is stopped with the maximum dynamic values (alarm response: Stop with maximum dynamic values). The technology object remains enabled.

Overshooting the software limit switches

If a software limit switch is overshoot, technology alarm 534 is output, and the technology object is disabled (alarm response: remove enable).

Retracting

Proceed as follows to retract the axis after violation of the software limit switch:

1. Acknowledge the technology alarm.
2. Move the axis in the free travel direction, until the software limit switch is exited.

If you move opposite to the free travel direction before exiting the software limit switch, then the monitor will be triggered again.

3.17.4 Tags

The following technology object tags are relevant for software limit switches:

Status indicators	
<TO>.StatusWord.X15 (SWLimitMinActive)	Negative software limit switch is enabled
<TO>.StatusWord.X16 (SWLimitMaxActive)	Positive software limit switch is enabled
<TO>.ErrorWord.X8 (SWLimit)	An alarm is pending, that a software limit switch was violated
Control bits	
<TO>.PositonLimits_SW.Active	Enables / disables the monitoring of the software limit switches
Position values	
<TO>.PositonLimits_SW.MinPosition	Position of the negative software limit switch
<TO>.PositonLimits_SW.MaxPosition	Position of the positive software limit switch

The following technology object tags are relevant for hardware limit switches:

Status indicators	
<TO>.StatusWord.X17 (HWLimitMinActive)	Negative hardware limit switch is enabled
<TO>.StatusWord.X18 (HWLimitMaxActive)	Positive hardware limit switch is enabled
<TO>.ErrorWord.X9 (HWLimit)	An alarm is queued; a hardware limit switch was violated
Control bits	
<TO>.PositonLimits_HW.Active	Enables / disables the monitoring of the hardware limit switches
Parameter	
<TO>.PositonLimits_HW.MinSwitchLevel	Level selection for enablement of the lower hardware limit switch: FALSE: At low level, the signal is enabled TRUE: At high level, the signal is enabled
<TO>.PositonLimits_HW.MinSwitchAddress	Byte number of the I/O address of the hardware limit switch for the lower or minimum position
<TO>.PositonLimits_HW.MinSwitchBitNumber	Bit number of the I/O address of the hardware limit switch for the lower or minimum position
<TO>.PositonLimits_HW.MaxSwitchLevel	Level selection for enablement of the upper hardware limit switch: FALSE: At low level, the signal is enabled TRUE: At high level, the signal is enabled
<TO>.PositonLimits_HW.MaxSwitchAddress	Byte number of the I/O address of the hardware limit switch for the upper or maximum position
<TO>.PositonLimits_HW.MaxSwitchBitNumber	Bit number of the I/O address of the hardware limit switch for the upper or maximum position

3.18 Motion control and limits for dynamics

3.18.1 Brief description

Motion control of the axis occurs by means of velocity profiles (Page 70). The velocity profiles are calculated in accordance with the specifications for dynamics. A velocity profile defines the behavior of the axis during approach, braking and changes in velocity. During positioning a velocity profile is calculated, that moves the axis to the target point.

Maximum values for velocity, acceleration and jerk result from the properties of the drive and the mechanics. These maximum values can be configured in the limits for dynamics. The limits for dynamics are in effect as limits for every motion generated by means of the technology object.

The configurable emergency stop deceleration (Page 71) is triggered by the Motion Control instruction MC_Power or by a technology alarm.

The jerk limit reduces the mechanical load during an acceleration ramp or deceleration ramp. A "smoothed" velocity profile results.

3.18.2 Velocity profile

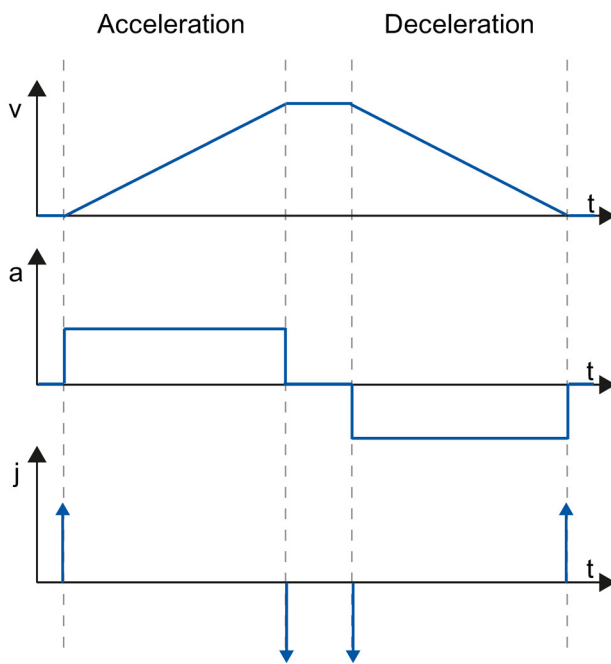
A velocity profile without jerk limit and a velocity profile with jerk limit are both supported for Motion Control of the axis.

The dynamic values for the motion are specified in the Motion Control job. Alternatively the dynamic default values can be used. The defaults and the limits for velocity, acceleration, deceleration and jerk are set in the configuration.

To influence velocity, a velocity override can override the current traversing velocity.

Velocity profile without jerk limit

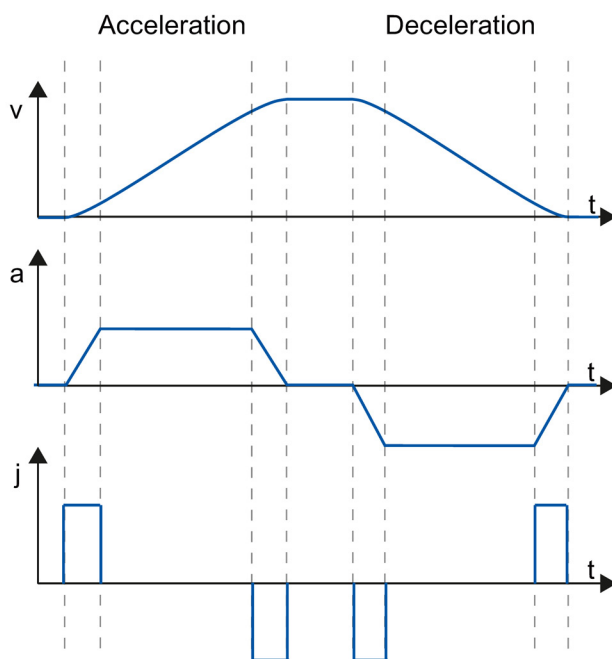
The following figure shows velocity, acceleration and jerk:



v - velocity
a - acceleration
j - jerk
t - time

Velocity profile with jerk limit

The following figure shows velocity, acceleration and jerk:



v - velocity
a - acceleration
j - jerk
t - time

A velocity profile with jerk limit is employed for a continuous acceleration and deceleration sequence. The jerk can be specified.

3.18.3 Emergency stop deceleration

When stopping with the emergency stop ramp, the axis is braked to a standstill without a jerk limit, using the configured emergency stop deceleration.

In the following cases the configured emergency stop deceleration is in effect:

- For an emergency stop ramp that has been enabled via the Motion Control instruction "MC_Power" with parameter "StopMode" = 0.
- For a technology alarm with the local alarm response "Stop with emergency stop ramp".

This emergency stop deceleration can be set greater than the maximum deceleration. If the emergency stop deceleration is set lower than this, it may occur that the axis does not stop until after the limit switch in the case of "Stop at software limit switch" and the occurrence of a technology alarm with the local alarm response "Stop with emergency stop ramp".

3.18.4 Tags

The following technology object tags are relevant for motion control:

Status	
<TO>.StatusWord	Status indicators for an active motion
<TO>.Position	Setpoint position
<TO>.Velocity	Setpoint velocity / setpoint speed
<TO>.ActualPosition	Actual position
<TO>.ActualVelocity	Actual velocity
<TO>.ActualSpeed	Actual speed of the motor (with analog setpoint = 0.0)
<TO>.Acceleration	Setpoint acceleration
<TO>.ActualAcceleration	Actual acceleration
Override	
<TO>.Override.Velocity	Velocity override
Dynamic limit values	
<TO>.DynamicLimits.MaxVelocity	Dynamic limit for maximum velocity
<TO>.DynamicLimits.MaxAcceleration	Dynamic limit for maximum acceleration
<TO>.DynamicLimits.MaxDeceleration	Dynamic limit for maximum deceleration
<TO>.DynamicLimits.MaxJerk	Dynamic limit for maximum jerk
Defaults for the dynamics	
<TO>.DynamicDefaults.Velocity	Default velocity
<TO>.DynamicDefaults.Acceleration	Default acceleration
<TO>.DynamicDefaults.Deceleration	Default deceleration
<TO>.DynamicDefaults.Jerk	Default jerk
<TO>.DynamicDefaults.EmergencyDeceleration	Emergency stop deceleration

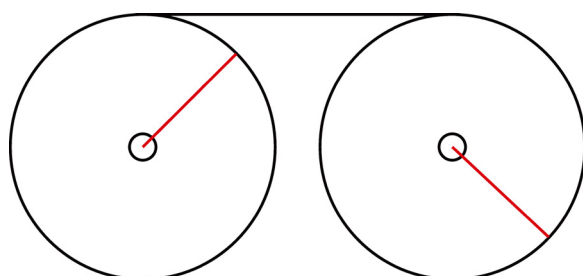
3.19 Synchronous operation

3.19.1 Brief description

The functionality of relative gearing is provided by the synchronous axis technology object.

The change of the leading axis position setpoint is multiplied by a specified gear ratio and passed on to the following axis as change in the position setpoint.

The relative gearing couples a following axis to a leading axis as if the axes were connected via a mechanical transmission.



A

B

A

Leading axis (driven axis)

B

Following axis

—

Relative position relationship

The following axis is synchronized to the leading axis by means of the Motion Control instruction "MC_GearIn", which represents the mechanical transmission in this case. An active synchronous operation is overridden by motion jobs on the following axis.

3.19.2 Relative gearing

The gear ratio is specified as the relationship between two integers at the Motion Control instruction "MC_GearIn". The result is a linear transmission function. With relative gearing, there is a relative correlation between the leading axis and the following axis. The change of the leading axis position setpoint results from the change in the position setpoint of the leading axis multiplied by the gear ratio.

Synchronization

Synchronization begins by starting an "MC_GearIn" job. When a synchronous axis synchronizes to a master value, it is displayed in the tag of the <TO>.StatusWord.X21 (Synchronizing) technology object. Active motion jobs are overridden. The dynamic values (acceleration, delay, jerk) of the following axis for the synchronization are specified at "MC_GearIn".

The following axis is synchronized and moves synchronously to the leading axis when the following axis reaches the velocity and acceleration of the leading axis, taking the gear ratio into consideration.

Duration and length of synchronization depend on the dynamic of the leading axis and the dynamic defaults at "MC_GearIn". A position offset can result between leading axis and following axis. This position offset is not compensated.

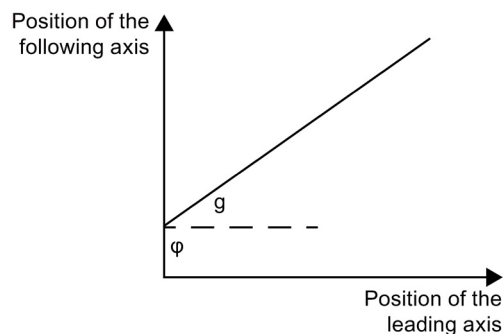
Synchronous motion

When a synchronous axis is synchronized to a master value, the "synchronous" status is displayed by the parameter "MC_GearIn.InGear" = TRUE as well as in the tag of the <TO>.StatusWord.X22 (Synchronous) technology object. The following axis follows the dynamics of the leading axis according to the gear ratio.

The dynamic limits configured on the following axis are no longer in effect in the "synchronous" state. The speed setpoint output to the drive is limited to the configured maximum speed of the drive (<TO>.Actor.DriveParameter.MaxSpeed).

If the following axis cannot follow the master value, a following error occurs which is monitored by the following error monitoring.

The response characteristic of gearing is expressed as a linear correlation between the master value and the slave value.



- g Gear ratio (transformation ratio)
 - φ Position offset between master value and slave value in synchronous operation
- The position offset is derived from the synchronization and is constant thereafter.

The slave value is calculated according to the following formula:

$$\text{Slave value} = g \times \text{master value} + \varphi$$

Overriding synchronous operation

An active synchronous operation is overridden by motion jobs on the following axis.

Direction

The numerator of the gear ratio is specified as positive or negative. This results in the following response:

- **Positive gear ratio:**
The leading and following axes move in the same direction.
- **Negative gear ratio:**
The following axis rotates in the opposite direction of the leading axis.

Homing with active synchronous operation

A position offset at the following axis is not compensated with relative gearing. This means a new offset results when homing the following axis during an active synchronous operation. A job for active homing at a following axis overrides synchronous operation.

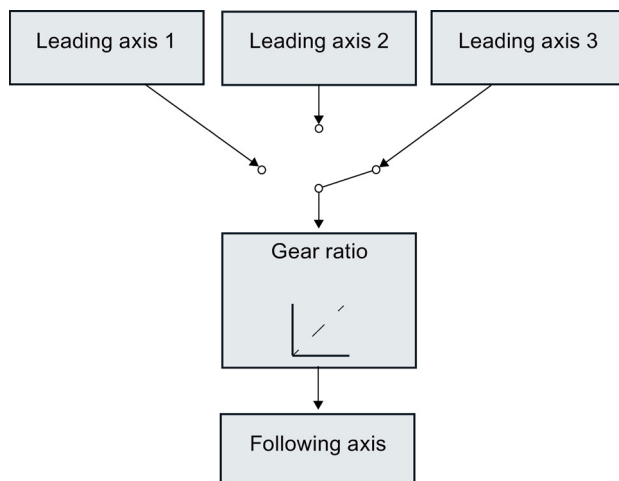
NOTICE
Drive damage
The position of the leading axis can change suddenly during homing of the leading axis. This master value jump has the effect of a setpoint jump at the following axis. The setpoint jump is traversed at the following axis taking the gear ratio into consideration. Jerky compensation motions at the following axis and drive damage could result.
If homing of the leading axis is required during active synchronous operation, keep the master value jump and its effects on the following axis to a minimum.

3.19.3 Master value coupling

The master value for synchronous operation is provided by a leading axis. The master values are always the position setpoints of the leading axis (setpoint coupling). A following axis can be coupled with different master values. Only one master value is actively evaluated at any one time. The master value can be specified by positioning axes or synchronous axes.

The master value is specified in the user program with the call of the Motion Control instruction "MC_GearIn". The master value is switched when you call the "MC_GearIn" again specifying a different leading axis.

The figure below shows an example of a synchronous axis with several master values:



The following rules apply to the master value coupling:

- Positioning axes and synchronous axes can specify master values. A leading axis can output the master value to several following axes.
- The synchronous axis can be interconnected with different master values. All interconnections required during operation must be set up during configuration of the synchronous axis technology object.
- Only one master value is actively evaluated at any one time.
- Recursive interconnections are not possible. A leading axis cannot be interconnected as following axis to its own master value.

The following example shows a recursive interconnection that is not permitted:

The following interconnections are configured in the TIA Portal:

Interconnection		Axis 1		Axis 2
A	Axis 1 is a possible leading axis for axis 2	Leading axis	→	Following axis
B	Axis 2 is possible leading axis for axis 1	Following axis	←	Leading axis

Use the Motion Control instruction "MC_GearIn" to enable interconnection A or interconnection B. Interconnections A and B cannot be enabled at the same time because it would be a recursive interconnection.

Note

The master values and slave values are coupled without conversion into the relevant configured user unit. If the leading axis is a linear axis (millimeters) and the following axis is a rotary axis (degrees), for example, the unit is not converted during synchronous operation. If the leading axis moves by 10 mm, the following axis moves by 10° with a gear ratio of 1:1.

3.19.4 Tags

The following technology object tags are relevant for synchronous operation:

Status indicators	
<TO>.StatusSynchronizedMotion.ActualMaster	When a "MC_GearIn" job is started, the number of the technology data block of the currently used leading axis is displayed. "ActiveMaster" = 0 with disabled synchronous operation
<TO>.StatusWord.X21 (Synchronizing)	When the synchronous axis synchronizes to a master value, the value is set to TRUE.
<TO>.StatusWord.X22 (Synchronous)	When the synchronous axis is synchronized and moves synchronously to the leading axis, the value is set to TRUE .
<TO>.ErrorWord.X14 (SynchronousError)	Error during synchronous operation The leading axis specified at the Motion Control instruction "MC_GearIn" was not configured as a possible leading axis.

3.20 Operational sequence

3.20.1 Organization Blocks for Motion Control

Description

When you create a technology object, organization blocks are automatically created for processing the technology objects. The Motion Control functionality of the technology objects creates its own execution level, and is called according to the Motion Control application cycle.

The following blocks are created:

- **MC-Servo [OB91]**
Calculation of the Position Controller
- **MC-Interpolator [OB92]**
Evaluation of the motion control instructions, generation of setpoints and monitoring functionality

The organization blocks are protected (know-how protection). The program code cannot be viewed or changed.

The frequency relationship of the two organization blocks to one another is always 1:1. MC-Servo [OB91] is always executed before MC-Interpolator [OB92].

You can set the application cycle and the priority of the organization blocks according to your requirements for control quality and system load.

Application cycle

You can set the application cycle in which the MC-Servo [OB91] is called in the properties of the organization block in "General > Cycle Time":

- **Synchronous to the bus**

MC-Servo [OB91] is called synchronously with or at a reduced ratio to a bus system. You set the send clock in the properties of the selected bus system. In the "Distributed I/O" drop-down list, you can select the following bus systems:

- Isochronous PROFIBUS DP
- Isochronous PROFINET IO

You cannot call the MC-Servo [OB91] synchronously with a bus system that is connected to the CPU via a communications processor/communications module (CP/CM).

- **Cyclic**

The MC-Servo [OB91] is called cyclically with the specified application cycle.

The selected application cycle must be long enough to be able to process the technology objects in one cycle. If the processing time of the technology objects is longer than the application cycle, overflows (Page 80) will occur.

You can check the runtime of MC-Servo [OB91] and MC-Interpolator [OB92] with the expanded instruction "RT_INFO".

Clock reduction (CPU V1.5 and higher)

You can reduce the application cycle of the MC-Servo [OB91] relative to the send clock of an isochronous PROFINET IO system. You can set an integer multiple of the send clock as the factor. Values up to 14 times the send clock (maximum 32 ms) are possible for the application cycle.

If you call a isochronous interrupt OB and the MC-Servo [OB91] synchronously with the same PROFINET IO system, set the same application cycle for both organization blocks.

Priority

You can configure the priority of the organization blocks as needed in their properties under "General > Properties > Priority":

- **MC Servo [OB91]**

Priority 17 to 31 (default value 25)

- **MC Interpolator [OB92]**

Priority 16 to 30 (default value 24)

The priority of MC Servo [OB91] must be at least one higher than the priority of the MC Interpolator [OB92].

3.20.2 Process image partition "OB Servo PIP"

The process image partition "OB Servo PIP" is made available in isochronous mode for Motion Control. All drives and encoders used by Motion Control are assigned to this process image partition.

Additionally, you should assign all I/O modules used by Motion Control to this process image partition (e.g. hardware limit switches). The assignment results in chronologically synchronous processing with the technology object.

The input process image partition is also updated in STOP mode.

Process image partition in the user program

As of CPU version V1.5, you can access the process image partition "TPA OB Servo" in your user program. This makes it possible to evaluate the process image partition using the trace and logic analyzer function.

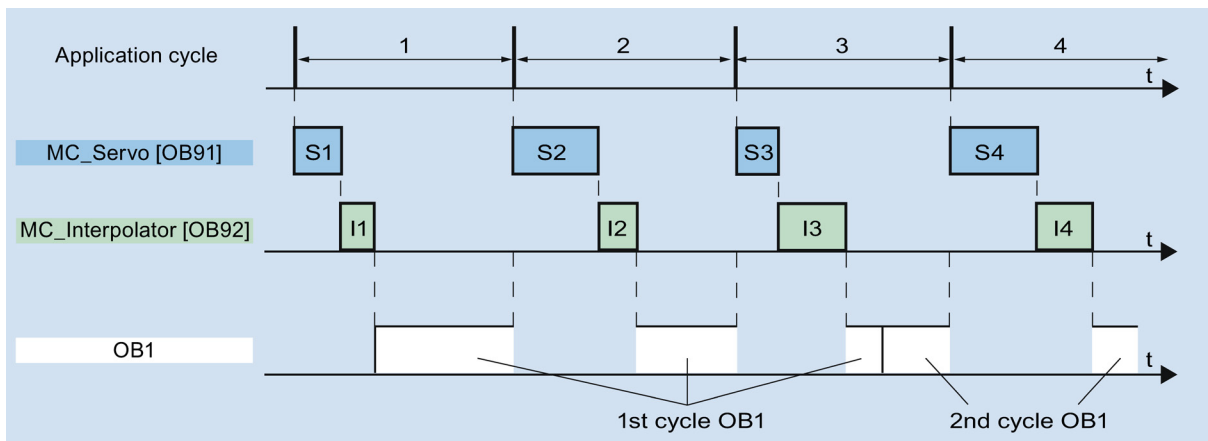
3.20.3 Operational Sequence and Timeouts

When processing the motion control functionality, the organization blocks MC-Servo [OB91] and MC-Interpolator [OB92] are called and processed in each application cycle. The remaining cycle time is available for the processing of your user program.

For error-free program execution, keep to the following rules:

- In each application cycle, MC-Servo [OB91] must be started and executed completely.
- In every application cycle, the relevant MC-Interpolator [OB92] must at least be started.

The following figure shows an example of the error-free operational sequence for the processing of organization block OB1:

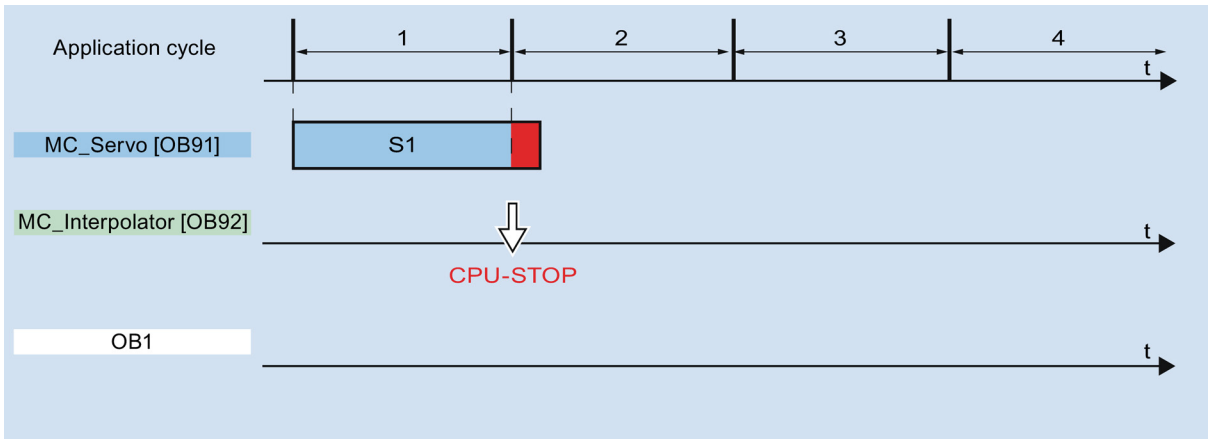


Overflows

If the set application cycle is not adhered to, for example because the application cycle is too short, overflows can occur.

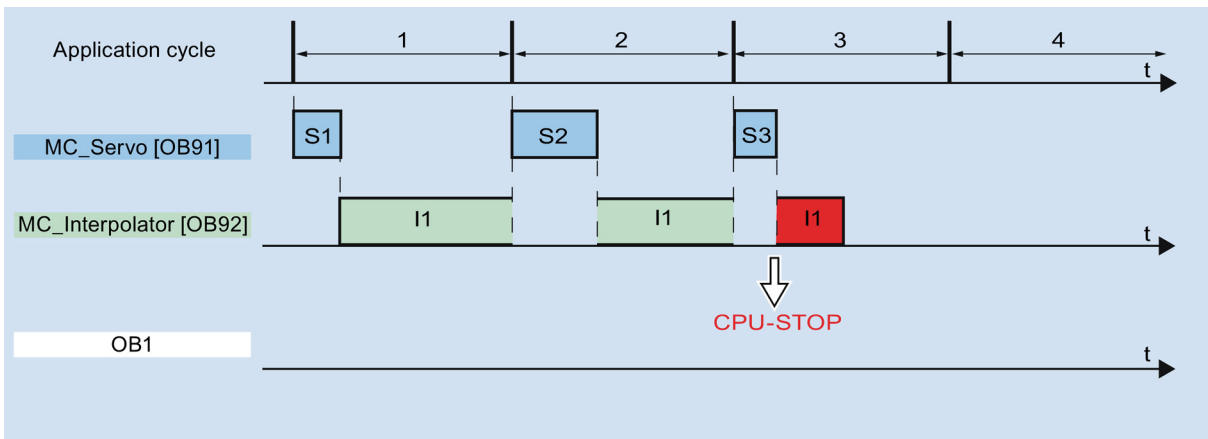
The CPU will not tolerate overflow of MC-Servo [OB91]. An overflow will cause the CPU to change to STOP mode.

The following figure shows the operational sequence if there is an overflow of MC-Servo [OB91]:



The execution of an MC-Interpolator [OB92] may only be interrupted by an MC-Servo [OB91] call. If more interruptions occur, the CPU switches to STOP mode.

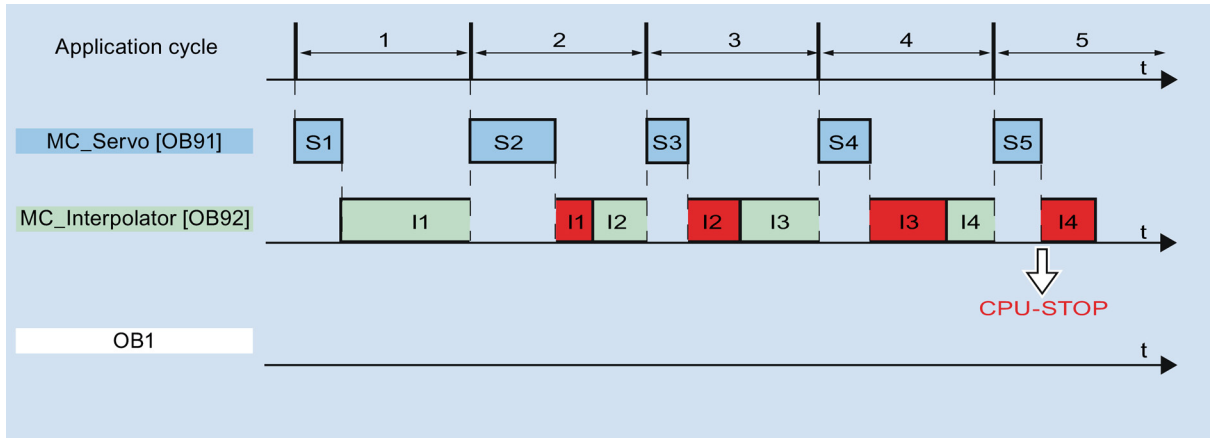
The following figure shows the sequence when an MC-Interpolator [OB92] is interrupted over two time slices:



3.20 Operational sequence

The CPU tolerates a maximum of three consecutive overflows of MC-Interpolator [OB92]. If more overflows occur, the CPU switches to STOP mode.

The following figure shows the sequence if there are four consecutive individual overflows of MC-Interpolator [OB92]:

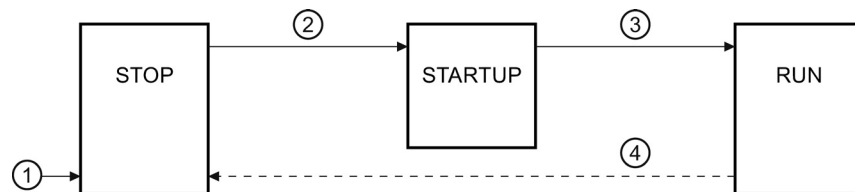


3.20.4 Operating modes

This section examines the behavior of Motion Control in each operating mode, and in the transitions between operating modes. A general description of the operating modes can be found in system manual S7-1500.

Operating modes and transitions

The CPU has three operating modes: STOP, STARTUP and RUN. The following figure shows the operating modes and the operating mode transitions:



STOP mode

In STOP mode the user program is not processed and all process outputs are disabled. Thus no Motion Control jobs are executed.

The technology data blocks are updated.

STARTUP mode

Before the CPU starts processing of the cyclical user program, the startup OBs are processed one time.

In STARTUP mode, the process outputs are disabled. Motion Control jobs are rejected.

The technology data blocks are updated.

RUN mode

The user program is processed in RUN mode.

In RUN mode, the programmed Motion Control jobs are cyclically called and processed.

The technology data blocks are updated.

Operating mode transitions

The following table shows the behavior of Motion Control in the transitions between the operating modes:

No.	Operating mode transition	Behavior
①	POWER ON → STOP	The CPU performs a restart of the technology objects. The technology objects are reinitialized with the values from the load memory.
②	STOP → STARTUP	Not relevant to Motion Control.
③	STARTUP → RUN	The process outputs are enabled.
④	RUN → STOP	When the CPU changes to RUN mode after STOP mode, all technology objects are disabled in accordance with the alarm response "remove enablement". Running Motion Control jobs are terminated.

Guidelines

4.1 Guidelines on use of motion control

The guidelines described here present the basic procedure for using Motion Control with the CPU S7-1500. These guidelines serve as recommendations.

Requirements

- A project with a CPU S7-1500 has been created.

Procedure

Proceed as follows to use Motion Control with the CPU S7-1500:

1. Add technology object (Page 99)
2. Working with the configuration editor (Page 100)
3. Programming (Page 172)
4. Downloading to CPU (Page 198)
5. Functional test in the Commissioning window (Page 199)
6. Diagnostics (Page 214)

Using versions

5.1 Overview of versions

The technology version for S7-1500 Motion Control includes the version of the technology objects and the version of the Motion Control instructions. Only one technology version can be operated on a CPU. This means that operation of two different technology versions side-by-side is not possible on one CPU.

When changing to a CPU V1.6, you must change the technology version to V2.0. Card replacement from a CPU < V1.6 to a CPU V1.6 is not permitted. In the TIA Portal, you can only work on projects with technology version V2.0 with a CPU V1.6.

There are two ways of changing the technology version:

- Changing the version of the Motion Control instructions

You change the version of the Motion Control instructions in the "Instructions" task card in the folder "Technology > Motion Control > S7-1500 Motion Control".

If the Motion Control instruction version used does not correspond to the compatibility list, the relevant Motion Control instructions are highlighted in red in the program editor.

- Adding a technology object with an alternative version

If a technology object with an alternative version is added in the "Add new object" dialog, the technology version is changed to the alternative version.

The technology objects and Motion Control instructions are only converted to the selected version of the technology during compilation.

The version of a technology object or a Motion Control instruction can be checked in the object properties in the "General > Information" tab in the "Version" box.

Compatibility list

The table below shows the compatibility of the technology version with the CPU version:

CPU	Technology	Technology object	Motion Control Instruction
V1.0, V1.1, V1.5 ¹	V1.0	Speed axis V1.0 Positioning axis V1.0 External encoder V1.0	MC_Power V1.0 MC_Home V1.0 MC_MoveJog V1.0 MC_MoveVelocity V1.0 MC_MoveRelative V1.0 MC_MoveAbsolute V1.0 MC_Halt V1.0 MC_Reset V1.0
V1.6	V2.0	Speed axis V2.0 Positioning axis V2.0 External encoder V2.0 Synchronous axis V2.0	MC_Power V2.0 MC_Home V2.0 MC_MoveJog V2.0 MC_MoveVelocity V2.0 MC_MoveRelative V2.0 MC_MoveAbsolute V2.0 MC_Halt V2.0 MC_Reset V2.0 MC_GearIn V2.0 MC_MoveSuperimposed V2.0
	Innovations: <ul style="list-style-type: none"> • Synchronous axis • Relative gearing • MC_GearIn • MC_MoveSuperimposed • Standardization of the "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control • Simulation mode • Support of the safety functions of the drive 		

1) Card replacement from a CPU < V1.6 to a CPU V1.6 is not supported.

Parameter "Mode" of the Motion Control instruction "MC_Home"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter.

The table below shows a comparison of the "MC_Home.Mode" parameter for technology V1.0 and V2.0:

MC_Home.HomingMode V1.0	Parameter value	MC_Home.Mode V2.0
Direct homing (absolute)	0	Direct homing (absolute)
Direct homing (relative)	1	Direct homing (relative)
Passive homing	2	Passive homing (without reset)
Passive homing (with configured home position)	3	Active homing
Active homing	4	Reserved
Active homing (with configured home position)	5	Active homing (with configured home position)
Absolute encoder adjustment (relative)	6	Absolute encoder adjustment (relative)
Absolute encoder adjustment (absolute)	7	Absolute encoder adjustment (absolute)
Passive homing (without reset)	8	Passive homing
Canceling passive homing	9	Canceling passive homing
-	10	Passive homing (with configured home position)

You can find additional information about the "MC_Home.Mode" parameter in the description of the Motion Control instruction "MC_Home" (Page 239).

5.2 Changing a technology version

Before you can access all the benefits of a new technology version, you need to change the technology version for existing projects.

Changing technology version to V2.0

To change the technology version to V2.0, follow these steps:

1. Replace the CPU V1.0...V1.5 in the project with a CPU V1.6.
2. Open the programming editor (e.g., by opening the OB1).

The technology objects and Motion Control instructions are highlighted in red after the CPU is replaced.

3. In the "Instructions" task card, open the technology version V2.0 in the "Technology > Motion Control > S7-1500 Motion Control" folder.

4. Save and compile the project.

The version of the technology objects and Motion Control instructions is changed to V2.0 during compilation of the project.

Pay attention to any error information that is displayed during compilation. Deal with the causes of the errors indicated.

5. Check the configuration of the technology objects.

Resetting the parameter "Mode" of the Motion Control instruction "MC_Home"

When the technology version is changed from V1.0 to V2.0, the "MC_Home.HomingMode" (V1.0) parameter is renamed to "MC_Home.Mode" (V2.0). The assignment of the parameter values is changed as well.

To reset the "MC_Home.Mode" (V2.0) parameter, follow these steps:

1. To change the technology version, follow the instructions given above.

When compiling the project, the "MC_Home.HomingMode" (V1.0) parameter is renamed to "MC_Home.Mode" (V2.0):

- The assignment of the parameter values is changed. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

You can find additional information about the "MC_Home.Mode" parameter in the description of the Motion Control instruction "MC_Home" (Page 239).

- The value configured at the "MC_Home.HomingMode" parameter (V1.0) is lost. As a note on renaming, the following text is entered at the "MC_Home.Mode" (V2.0) parameter as parameter value:

"Die Schnittstelle hat sich geändert. Weitere Informationen finden Sie in der Beschreibung der Motion Control-Anweisung MC_Home."

- There is a message in the "Info > Compile" tab in the Inspector window stating that the operand has the wrong data type.
2. Change the value of the "MC_Home.Mode" parameter (V2.0) in your user program according to the new assignment.
 3. Save and compile the project.

Configuring

6.1 Adding and configuring drives in the device configuration

6.1.1 Add and configure PROFINET IO drives

Adding and configuring a PROFINET IO drive is described below using a **SINAMICS S120 drive**. Adding and configuring other PROFINET IO drives may differ from the description in certain respects.

Requirements

- The SIMATIC S7-1500 device is created in the project.
- The desired drive can be selected in the hardware catalog.

If the drive is not available in the Hardware Catalog, then it must be installed in the "Extras" menu as a device description file (GSD).

Adding a drive and frame in the device configuration

1. Open the device configuration and change to the network view.
2. In the hardware catalog, open the folder "Additional Field Devices > PROFINET IO > Drives > Siemens AG > SINAMICS".
3. Select the desired drive with the desired version, then drag it to the network view.
4. Assign the drive to the PROFINET interface of the PLC.
5. Open the drive in the device view.
6. Drag a Drive Object (DO) and a standard frame from the hardware catalog to the slot of the device overview of the drive.

Depending on the version of the SINAMICS S120 drive, select "DO with standard telegram X", or "DO Servo" and a "Standard telegram X" for the frame.

For more information on suitable frames, refer to the section Frames (Page 29).

Repeat step 6, if you want to add another drive and another standard frame.

Enable isochronous operation of the drive in the device configuration

PROFINET drives can always be operated in isochronous mode or non-isochronous mode. Isochronous mode, however, increases the quality of the position control of the drive.

Proceed as follows if you want to control the drive in isochronous mode:

1. Open the device view in the drive.
2. In the properties dialog, select the tab "PROFINET Interface [X1] > Advanced options > Isochronous mode".
3. Select the "Isochronous mode" check box in this tab.

The entry for the frame also has to be selected for isochronous mode in the detailed view.

Interconnecting the port of the PLC with the port of the drive

1. Open the topology view in the device configuration.
2. Interconnect the port of the PLC with the port of the drive.

Configuring the PLC as the sync master and setting isochronous mode

1. Select the device view of the PLC.
2. In the properties dialog, select the tab "PROFINET Interface [X1] > Advanced options > Realtime settings > Synchronization".
3. Select "Sync master" from the "Synchronization role" drop-down list.
4. Click the "Domain settings" button.
5. Open the "Domain Management > Sync Domains" tab and set the desired "Send clock" (isochronous clock).

Select drive in the configuration of the technology object

1. Add a new axis technology object, or open the configuration of an existing axis.
2. Open the configuration "Hardware interface > Drive".
3. Select "PROFIdrive" from the "Drive type" drop-down list.
4. Select the Drive Object of the PROFINET drive from the "Drive" list.

For information on how to add a technology object, refer to the section Add technology object (Page 99).

Result

The technology object is connected to the drive and the "MC Servo" organization block can be checked / configured.

The frame of the configured drive is assigned to the "PIP OB Servo" process image.

Checking/configuring the properties of the MC Servo

1. Open the "Program blocks" folder in the project navigator.
2. Select the "MC Servo" organization block.
3. Select the "Properties" command in the shortcut menu.
4. Select the "Cycle time" entry in the area navigation.
5. The option "Synchronous to the bus" must be selected in the dialog box.
6. A "PROFINET IO_System" must be selected in the "Distributed I/O" drop-down list.
7. The application cycle of "MC-Servo" must correspond to the send clock of the bus or be reduced by an integral factor relative to the send clock of the bus.

Result

The PROFINET IO drive is now configured so that it can be controlled in the PROFINET IO network in isochronous mode.

The properties of the SINAMICS drive must be configured according to the configuration of the axis with a separate STARTER program.

Checking isochronous mode on the drive

If the configuration sequence described above is not adhered to during configuration of the axis, and drive-specific error occurs when the project is compiled, the setting for isochronous mode on the drive must be checked.

1. Open the device view in the drive.
2. Select standard message item in the device overview.
3. Select the properties dialog "General > I/O Addresses".
4. The following settings apply for the input and output addresses:
 - "Isochronous mode" is enabled.
 - "MC Servo" must be select the "Organization block".
 - "PIP OB Servo" must be select the "Process image".

See also

Frames (Page 29)

Add technology object (Page 99)

6.1.2 Add and configure PROFIBUS DP drives

Adding and configuring a PROFIBUS IO drive is described below using a **SINAMICS S120**. Adding and configuring other PROFIBUS drives may differ from the description in certain respects.

Requirements

- The SIMATIC S7-1500 device is created in the project.
- You have a basic knowledge of how to configure PROFIBUS DP networks.
- The desired drive can be selected in the hardware catalog.

If the drive is not available in the Hardware Catalog, then it must be installed in the "Extras" menu as a device description file (GSD).

Adding a drive and frame in the device configuration

1. Open the device configuration and change to the network view.
2. In the hardware catalog, open the folder "Additional Field Devices > PROFIBUS DP > Drives > Siemens AG > SINAMICS".
3. Select the folder of the desired drive with the desired version, then drag the drive object to the network view.
4. Assign the drive to the PROFIBUS interface of the PLC.
5. Open the drive in the device view.
6. Drag a standard frame from the hardware catalog to the slot of the device overview of the drive.

For more information on suitable frames, refer to the section Frames (Page 29).

Use the "Axis disconnecter" in the hardware catalog if you want to add another drive and another standard frame in the device overview.

Enable isochronous operation of the drive in the device configuration

PROFIBUS drives can always be operated in cyclic mode or isochronous mode. Isochronous mode, however, increases the quality of the position control of the drive.

Proceed as follows if you want to control the drive in isochronous mode:

1. Open the device view in the drive.
2. In the properties dialog, select the tab "General > Isochronous Mode".
3. Select the "Synchronize DP slave to constant DP bus cycle time" check box .

Setting isochronous mode

1. Select the network view.
2. Select the DP master system.
3. In the properties dialog, select the tab "General > Constant bus cycle time".
4. Select the desired "Constant DP bus cycle times".

Select drive in the configuration of the technology object

1. Add a new axis technology object, or open the configuration of an existing axis.
2. Open the configuration "Hardware interface > Drive".
3. Select "PROFIdrive" from the "Drive type" drop-down list.
4. Select the standard frame of the PROFIBUS drive from the "Drive" list.

For information on how to add a technology object, refer to the section Add technology object (Page 99).

Result

The technology object is connected to the drive and the "MC Servo" organization block can be checked/configured.

The frame of the configured drive is assigned to the "PIP OB Servo" process image.

Checking/configuring the properties of the MC Servo

1. Open the "Program blocks" folder in the project navigator.
2. Select the "MC Servo" organization block.
3. Select the "Properties" command in the shortcut menu.
4. Select the "Cycle time" entry in the area navigation.
5. The option "Synchronous to the bus" must be selected in the dialog box.
6. A "PROFINET IO system" must be selected in the "Distributed I/O" drop-down list.
7. The application cycle of "MC-Servo" must correspond to the send clock of the bus or be reduced by an integral factor relative to the send clock of the bus.

You can select a drive connected to the CPU via a communications processor/communications module (CP/CM) in the configuration of the technology object. You cannot select the DP master system of the CP/CM as the source clock for MC-Servo [OB91].

Result

The PROFIBUS DP drive is now configured so that it can be controlled in the PROFIBUS network in isochronous mode.

The properties of the SINAMICS drive must be configured according to the configuration of the axis with a separate STARTER program.

Checking isochronous mode on the drive

If the configuration sequence described above is not adhered to during configuration of the axis, and drive-specific error occurs when the project is compiled, isochronous mode can be checked on the drive.

1. Open the device view in the drive.
2. Select standard message item in the device overview.
3. Select the properties dialog "General > I/O Addresses".
4. The following settings apply for the input and output addresses:
 - "MC Servo" must be select the "Organization block".
 - "PIP OB Servo" must be select the "Process image".

See also

Add technology object (Page 99)

Frames (Page 29)

6.1.3 Adding and configuring drives with analog connections

A description is provided below of how to add and configure a drive with an analog drive connection and an encoder. An incremental encoder and a technology module in the rack of the PLC is used as an example of the connection.

Requirements

The SIMATIC S7-1500 device is created in the project.

Adding and configuring an analog output module in the device configuration

1. Open the device configuration of the PLC.
2. Select an analog output module from the hardware catalog and drag the module to the rack of the PLC.
3. Select the analog output module in the device view.
4. Open the "General" tab in the properties dialog and select there "Name of the Analog Output Module > I/O Addresses".
5. Enter the desired start address.
6. In the properties dialog, select the tab "General > IO Tags".
7. Enter the tag name for the desired analog output.

Adding and configuring a technology module

1. Switch to the device view of the PLC.
2. In the hardware catalog, open the folder "TM > Count > TM Count 2X24V".
3. Drag the counter module to a free slot in the rack.
4. Select the technology module in the device view.
5. In the properties dialog, open the "General" tab and select there "Count 2x24V > Basic Parameters > Channel X > Operating Mode" of the channel to be used.
6. Select "Position detection for motion control" option for "Selection of the operating mode for the channel".
7. Under "Module parameters", adapt the parameters of the incremental encoder (steps per revolution = increments per revolution).
8. Under "Reaction to CPU STOP", select the item "Continue working".

Selecting the drive and encoder in the configuration of the technology object

1. Add a new positioning axis/synchronous axis technology object, or open the configuration of an existing positioning axis/synchronous axis.
2. Open the configuration "Hardware interface > Drive".
3. Select "Analog drive connection" from the "Drive type" drop-down list.
4. Select the previously defined tag name of the analog output from the "Output" list.
5. Open the configuration "Hardware interface > Encoder".
6. Under "Select encoder coupling" select "Encoder on technology module (TM)".
7. Select the channel of the incremental encoder from the "Technology module" list under "local modules".

For information on how to add a technology object, refer to the section Add technology object (Page 99)

Result

The analog drive connection and the encoder connection are configured.

The analog addresses and the addresses of the TM module are assigned to the process image "PIP OB Servo".

Checking the encoder connection / drive connection

The encoder data are applied to the position control cycle clock. If in doubt, check the following settings:

1. Switch to the device view of the PLC.
2. Select the module technology.
3. Open the properties dialog "Basic Parameters > I/O Addresses".
4. The following settings apply for the input and output addresses:
 - "MC Servo" must be select the "Organization block".
 - "PIP OB Servo" must be select the "Process image".
5. Select the analog module.
6. Open the properties dialog "Name of the Analog Module > I/O Addresses".
7. The settings from Step 4 apply for the input and output addresses

See also

Add technology object (Page 99)

6.2 Add technology object

To add a technology object in the project navigator, proceed as follows:

Requirement

A project with a CPU S7-1500 has been created.

Procedure

1. Open the CPU's folder in the project navigator.
2. Open the "Technology Objects" folder.
3. Double-click "Add new object".
The "Add new object" dialog box opens.
4. Select the "Motion Control" technology.
5. Open the folder "Motion Control" > "SIMATIC S7-1500".
6. If you want to add an axis from an older version, then click on the Version entry and select an alternative version of the technology.
7. Select the "TO_SpeedAxis" object for a speed axis, "TO_PositioningAxis" for a positioning axis, "TO_SynchronousAxis" for a synchronous axis or "TO_ExternalEncoder" for an external encoder.
8. In the "Name" field, adapt the name of the axis to your requirements.
9. Select the "Manual" option if you want to change the suggested data block number.
10. Click on "Further Information" if you want to add your own information to the technology object.
11. Click on the "Cancel" button if you want to discard the entries.

Activate the "Add new and open" check box if you want to open the configuration after adding the technology object.

Click on the "OK" button if you want to add the technology object.

Result

The new technology object was created and saved in the project navigator in the folder "Technology objects".

If the organization blocks "MC Servo" and "MC Interpolator" had not yet been added, they have now been added.

6.3 Working with the configuration editor




You configure the properties of a technology object in the configuration window. To open the configuration window of the technology object in the project view, follow these steps:

1. Open the device "Technology objects" group in the project navigator.
2. Select the technology object and double-click on "Configuration".

The configuration is divided into categories which depend on the object type, for example: Basic parameters, hardware interface, extended parameters.

Configuration editor icons

Icons in the area navigation of the configuration show additional details about the status of the configuration:

	<p>The configuration contains default values and is complete.</p> <p>The configuration contains only default values. With these default values you can use the technology object without additional changes.</p>
	<p>The configuration contains values set by the user and is complete.</p> <p>All input fields of the configuration contain valid values and at least one preset value has changed.</p>
	<p>The configuration is incomplete or incorrect</p> <p>At least one input field or drop-down list contains an invalid value. The corresponding field or the drop-down list is displayed on a red background. Click the field shows you the roll-out error message that indicates the cause of error.</p>

6.4 Compare values

If there is an online connection to the CPU, the "Compare values" function appears in the configuration of the technology object.





The "Compare values" function provides the following options:

- Comparison of configured start values of the project with the start values in the CPU and the actual values
- Direct editing of actual values and the start values of the project
- Immediate detection and display of input errors with suggested corrections
- Backup of actual values in the project
- Transfer of start values of the project to the CPU as actual values

Symbols and operator controls

If there is an online connection to the CPU, the actual values are displayed at the parameters.

In addition to the actual values of the parameters, the following symbols appear:

Symbol	Description
	Start value in CPU matches the configured Start value in the project
	Start value in CPU does not match the configured Start value in the project
	The comparison of the Start value in CPU with the configured Start value in the project cannot be performed
	Use the button to show the start value of the CPU and the start value of the project for each parameter.

The actual value and the start value of the CPU can be changed directly, and then downloaded to the CPU. The change of actual value is transferred directly to the CPU for directly modifiable parameters.

6.5 Configuring the Speed-Control Axis technology object

6.5.1 Configuration - Basic Parameters

Configure the basic properties of the technology object in the "Basic Parameters" configuration window.

Axis name

Define the name of the speed axis in this field. The technology object is listed in the project navigation under this name. The tags of the speed axis can be used in the user program under this name.

Speed unit

Select the measuring system for speed from the drop-down list box.

6.5.2 Hardware interface

6.5.2.1 Configuration - Drive

In the "Drive" configuration window, configure which drive type and which drive you want to use.

Drive type

In the drop-down list, select whether you want to deploy a PROFIdrive drive or a drive with an analog drive connection.

PROFIdrive drives are connected to the controller by means of a digital communication system (PROFINET or PROFIBUS). The communication occurs via PROFIdrive frames.

Drives with an analog drive connection receive the setpoint speed via an analog output signal (e.g. from -10 V to +10 V) from the PLC.

Drive (drive type: PROFIdrive)

In the "Drive" field, select an already configured PROFIdrive drive / slot. If a PROFIdrive drive was selected, then it can be configured using the "Device configuration" button.

Switch to the device configuration, and add a PROFIdrive drive in the network view, in the event that no PROFIdrive drive can be selected.

Analog output (drive type: Analog drive connection)

In the "Output" field, select the PLC tag of the analog output over which the drive is to be controlled. If an output was selected, then it can be configured using the "Device configuration" button.

In order to be able to select an output, an analog output module must have been added in the device configuration, and the PLC tag name for the analog output must be defined.

Activate enable output (drive type: Analog drive connection)

In the "Enable output" field, select the PLC tag of the digital output to enable the drive. With the enable output, the speed controller in the drive is enabled, or disabled.

In order to be able to select an enable output, a digital output module must have been added in the device configuration, and the PLC tag name for the digital output must be defined.

Note

If you do not use an enable output, the drive cannot be immediately disabled on the part of the system due to error reactions or monitoring functions. A controlled stop of the drive is not guaranteed.

Enable ready input (drive type: Analog drive connection)

In the "Ready input" field, select the PLC tag of the digital input with which the drive is to report its operational readiness to the technology object. The power unit is switched on and the analog setpoint speed input is enabled.

In order to be able to select a ready input, a digital input module must have been added in the device configuration, and the PLC tag name for the digital input must be defined.

Note

The enable output and the ready input can be separately enabled.

The following conditions apply to the enabled ready input:

- The axis is not enabled (MC_Power Status=TRUE), until a signal is pending at the ready input.
 - If the signal at the ready input goes away for an enabled axis, then the axis is disabled with an error.
 - If the axis is disabled with the instruction MC_Power (Enable= FALSE), then the axis is disabled even with a pending signal at the ready input.
-

See also

Configuration - Data exchange (Page 104)

6.5.2.2 Configuration - Data exchange

Data exchange with the drive

In this area, you can configure the data transmission to the drive.

Message frame type (drive type PROFIdrive)

In the drop-down list, select the frame for the drive. The specification must match the setting in the device configuration.

Reference speed (drive type PROFIdrive)

In this field, configure the reference speed of the drive in accordance with the manufacturer's specifications. The specification of the drive's speed occurs as a percentage of the reference speed in the range from -200% to 200%.

Reference speed (drive type analog drive connection)

The reference speed of the drive is the speed, with which the drive spins when there is an output of 100% at the analog output. The reference speed must be configured in the drive, and transferred into the configuration of the technology object.

The analog value that is output at 100% depends on the type of the analog output. As an example, with an analog output with +/- 10 V, the value 10 V is output at 100%.

Analog outputs can be overloaded by about 17%. This means that an analog output can be operated in the range from -117% to 117%, insofar as the drive permits this.

Maximum speed

In this field, specify the maximum speed of the drive.

Invert drive direction

Select the check box if the rotation direction of the drive should be inverted.

6.5.3 Extended Parameters

6.5.3.1 Configuration - Mechanics

Configure the connection of the load to the drive in the "Mechanics" configuration window.

Number of motor revolutions / number of load revolutions

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

6.5.3.2 Configuration - Dynamic limits

In the "Dynamic limits" configuration window, configure the maximum values for speed, acceleration, deceleration and jerk of the axis.

Maximum speed

In this field, define the maximum permitted speed of the axis.

Maximum acceleration / maximum deceleration - ramp-up time / ramp-down time

Set the desired acceleration in the "Ramp-up time" or "Acceleration" fields. The desired deceleration can be set in the "Ramp-down time" or "Deceleration" fields.

The relationship between ramp-up time and acceleration, and ramp-down time and deceleration can be seen in the following equations:

$$\text{Ramp-up time} = \frac{\text{Maximum velocity}}{\text{Acceleration}}$$

$$\text{Ramp-down time} = \frac{\text{Maximum speed}}{\text{Deceleration}}$$

Note

A change in the maximum speed influences the acceleration and deceleration values of the axis. The ramp-up and ramp-down times are retained.

Smoothing time / jerk

You can enter the jerk limit parameters in the "Smoothing time" box, or alternatively in the "Jerk" box:

- Set the desired jerk for the acceleration ramp and the deceleration ramp in the "Maximum jerk" box. The value 0 means that the jerk is not limited.
- Set the required smoothing time for the acceleration ramp in the "Smoothing time" box.

Note

The configured smoothing time displayed in the configuration, applies only to the acceleration ramp.

If the values of the acceleration and deceleration differ, the smoothing time of the deceleration ramp is calculated and used according to the jerk of the acceleration ramp.

The smoothing time of the deceleration is adapted as follows:

- **Acceleration > Deceleration**
A shorter smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration < Deceleration**
A longer smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration = Deceleration**
The smoothing times of the acceleration ramp and the deceleration ramp are the same.

If an error occurs, the axis decelerates with the configured emergency stop deceleration. A configured jerk limit is not taken into account for this.

The following equations show the relationship between the smoothing times and the jerk:

$$\text{Rounding off time (acceleration ramp)} = \frac{\text{Acceleration}}{\text{Jerk}}$$

$$\text{Rounding off time (deceleration ramp)} = \frac{\text{Deceleration}}{\text{Jerk}}$$

Traversing jobs initiated in the user program are executed with the selected jerk.

6.5.3.3 Configuration - Dynamic Defaults

In the "Dynamic defaults" configuration window, configure the default values for speed, acceleration, deceleration and jerk of the axis.

The default values have an effect, when values < 0 are specified in Motion Control instructions for the "Velocity", "Acceleration", "Deceleration" or "Jerk" parameters. The default values can be applied separately for each of the parameters just listed.

Speed

In this field, define the default value for the speed of the axis.

Acceleration / deceleration - ramp-up time / ramp-down time

Set the desired default value for acceleration in the "Ramp-up time" or "Acceleration" fields. The desired deceleration can be set in the "Ramp-down time" or "Deceleration" fields.

The relationship between ramp-up time and acceleration, and ramp-down time and deceleration can be seen in the following equations:

$$\text{Ramp-up time} = \frac{\text{Speed}}{\text{Acceleration}}$$

$$\text{Ramp-down time} = \frac{\text{Speed}}{\text{Deceleration}}$$

Note

A change in the velocity influences the acceleration and deceleration values of the axis. The ramp-up and ramp-down times are retained.

Smoothing time / jerk

You can enter the jerk limit parameters in the "Smoothing time" box, or alternatively in the "Jerk" box:

- Set the desired jerk for the acceleration ramp and the deceleration ramp in the "Jerk" box. The value 0 means that the jerk is disabled.
- Set the required smoothing time for the acceleration ramp in the "Smoothing time" box.

Note

The configured smoothing time displayed in the configuration, applies only to the acceleration ramp.

If the values of the acceleration and deceleration differ, the smoothing time of the deceleration ramp is calculated and used according to the jerk of the acceleration ramp.

The smoothing time of the deceleration is adapted as follows:

- **Acceleration > Deceleration**
A shorter smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration < Deceleration**
A longer smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration = Deceleration**
The smoothing times of the acceleration ramp and the deceleration ramp are the same.

If an error occurs, the axis decelerates with the configured emergency stop deceleration. A configured jerk limit is not taken into account for this.

The following equations show the relationship between the smoothing times and the jerk:

$$\text{Rounding off time (acceleration ramp)} = \frac{\text{Acceleration}}{\text{Jerk}}$$

$$\text{Rounding off time (deceleration ramp)} = \frac{\text{Deceleration}}{\text{Jerk}}$$

Traversing jobs initiated in the user program are executed with the selected jerk.

6.5.3.4 Configuration - Emergency stop

In the "Emergency stop" configuration window, you can configure the emergency stop deceleration of the axis. In the event of an error, and when disabling the axis, the axis is brought to a standstill with this deceleration using the Motion Control instruction "MC_Power" (input parameter StopMode = 0).

Emergency stop deceleration / Emergency stop ramp-down time

Configure the deceleration value for emergency stop in the "Emergency stop deceleration" field or the "Emergency stop ramp-down time" field.

The relationship between emergency stop ramp-down time and emergency stop deceleration can be seen in the following equation:

$$\text{Emergency stop ramp-down time} = \frac{\text{Maximum speed}}{\text{Emergency stop deceleration}}$$

The configuration of the emergency stop deceleration is related to the configured maximum speed of the axis. If the maximum speed of the axis changes, then the value of the emergency stop deceleration also changes (the emergency stop ramp-down time remains unchanged).

6.6 Configuring the positioning axis/synchronous axis technology object

6.6.1 Configuration - Basic Parameters

Axis name

Define the name of the positioning axis/synchronous axis in this field. The technology object is listed in the project navigation under this name. The variables of the technology object can be used in the user program under this name.

Axis type

In this selection, configure whether the axis should perform linear or rotary motions.

Units of measure

In the drop-down list, select the desired measurement system for the position and velocity of the axis.

Modulo

Select the check box "Enable modulo", if you want to employ a recurring unit of measure for the axis (e.g. 0-360° for an axis of the "rotary" axis type).

- **Modulo start value**

In this field, define the position at which the modulo range should begin (e.g. 0° for an axis of the "rotary" axis type).

- **Modulo length**

In this field, define the length of the modulo range (e.g. 360° for an axis of the "rotary" axis type).

6.6.2 Hardware interface

6.6.2.1 Configuration - Drive

In the "Drive" configuration window, configure which drive type and which drive you want to use.

Drive type

In the drop-down list, select whether you want to deploy a PROFIdrive drive or a drive with an analog drive connection.

PROFIdrive drives are connected to the controller by means of a digital communication system (PROFINET or PROFIBUS). The communication occurs via PROFIdrive frames.

Drives with an analog drive connection receive the setpoint speed via an analog output signal (e.g. from -10 V to +10 V) from the PLC.

Drive (drive type: PROFIdrive)

In the "Drive" field, select an already configured PROFIdrive drive / slot. If a PROFIdrive drive was selected, then it can be configured using the "Device configuration" button.

Switch to the device configuration, and add a PROFIdrive drive in the network view, in the event that no PROFIdrive drive can be selected.

Analog output (drive type: Analog drive connection)

In the "Output" field, select the PLC tag of the analog output over which the drive is to be controlled. If an output was selected, then it can be configured using the "Device configuration" button.

In order to be able to select an output, an analog output module must have been added in the device configuration, and the PLC tag name for the analog output must be defined.

Activate enable output (drive type: Analog drive connection)

In the "Enable output" field, select the PLC tag of the digital output to enable the drive. With the enable output, the speed controller in the drive is enabled, or disabled.

In order to be able to select an enable output, a digital output module must have been added in the device configuration, and the PLC tag name for the digital output must be defined.

Note

If you do not use an enable output, the drive cannot be immediately disabled on the part of the system due to error reactions or monitoring functions. A controlled stop of the drive is not guaranteed.

Enable ready input (drive type: Analog drive connection)

In the "Ready input" field, select the PLC tag of the digital input with which the drive is to report its operational readiness to the technology object. The power unit is switched on and the analog setpoint speed input is enabled.

In order to be able to select a ready input, a digital input module must have been added in the device configuration, and the PLC tag name for the digital input must be defined.

Note

The enable output and the ready input can be separately enabled.

The following conditions apply to the enabled ready input:

- The axis is not enabled (MC_Power Status=TRUE), until a signal is pending at the ready input.
 - If the signal at the ready input goes away for an enabled axis, then the axis is disabled with an error.
 - If the axis is disabled with the instruction MC_Power (Enable= FALSE), then the axis is disabled even with a pending signal at the ready input.
-

6.6.2.2 Configuration - Encoder

For position control, positioning axes/synchronous axes require an actual position value in the form of an encoder position. The encoder position is transmitted to the controller by means of a PROFIdrive frame. In the "Encoder" configuration window, configure the encoder coupling with which the encoder is to be connected.

Select encoder coupling:

In this area, select how the encoder will be connected in keeping with the graphic representation.

- **Connection to drive (not with analog drive connection)**

Select this option, if the encoder is connected to the drive. The configuration of the encoder occurs via the configuration of the PROFIdrive drive. The drive evaluates the encoder signals and sends them to the controller in a PROFIdrive frame.

- **Encoder on technology module (TM)**

Select this option, if the encoder is connected to a technology module (TM).

- **Technology module:**

In the "Technology module" field, select a technology module that has already been configured, and the channel to be used. Only technology modules set to the "Position detection for motion control" mode are displayed for selection.

If no technology module is available for selection, change to the device configuration and add a technology module. If you have selected a technology module, you can change to the configuration of the technology module using the "Device configuration" button.

You can operate the technology module centrally on an S7-1500 PLC, or distributed on a distributed I/O. You can identify the technology modules suitable for position detection for Motion Control in the documentation for the technology module and the catalog data.

- **PROFIdrive encoder on PROFINET/PROFIBUS (PROFIdrive)**

Select this option, if you are deploying a PROFIdrive compatible encoder.

- **PROFIdrive encoder:**

In the "PROFIdrive encoder" field, select a configured encoder on PROFINET/PROFIBUS. If an encoder was selected, then it can be configured using the "Device configuration" button.

Switch to the device configuration in the network view, and add an encoder, in the event that no encoder can be selected.

6.6.2.3 Configuration - Data exchange

Configuration - Data exchange

In the "Data exchange" configuration window, you can configure the data exchange of the drive and the encoder. The configuration varies according to the drive type and encoder coupling:

- Analog driver connection - Encoder to technology module (TM) (Page 114)
- Analog driver connection - PROFIdrive encoder on PROFINET/PROFIBUS (Page 116)
- PROFIdrive Drive - Encoder to Drive (Page 118)
- PROFIdrive drive - Encoder on the technology module (TM) (Page 120)
- PROFIdrive drive - PROFIdrive encoder on PROFINET/PROFIBUS (Page 122)

Analog driver connection - Encoder to technology module (TM)

Data exchange with the drive

In this area, you can configure the data exchange with the drive.

- **Drive message frame:**

Since the analog drive is controlled via an analog signal, the selection of the frame type is omitted.

- **Reference speed:**

The reference speed of the drive is the speed, with which the drive spins when there is an output of 100% at the analog output. The reference speed must be configured in the drive, and transferred into the configuration of the technology object.

The analog value that is output at 100% depends on the type of the analog output. As an example, with an analog output with +/- 10 V, the value 10 V is output at 100%.

Analog outputs can be overloaded by about 17%. This means that an analog output can be operated in the range from -117% to 117%, insofar as the drive permits this.

- **Maximum speed**

In this field, specify the maximum speed of the drive.

- **Invert drive direction**

Select the check box if the rotation direction of the drive should be inverted.

Data exchange with encoder

In this area, you can configure how the encoder data are to be evaluated. The specifications must match those in the device configuration.

- **Encoder message frame:**

The encoder data can be transferred only with encoder message frame 83.

- **Encoder type:**

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

Analog driver connection - PROFIdrive encoder on PROFINET/PROFIBUS

Data exchange with the drive

In this area, you can configure the data exchange with the drive.

- **Drive message frame:**

Since the analog drive is controlled via an analog signal, the selection of the frame type is omitted.

- **Reference speed:**

The reference speed of the drive is the speed, with which the drive spins when there is an output of 100% at the analog output. The reference speed must be configured in the drive, and transferred into the configuration of the technology object.

The analog value that is output at 100% depends on the type of the analog output. As an example, with an analog output with +/- 10 V, the value 10 V is output at 100%.

Analog outputs can be overloaded by about 17%. This means that an analog output can be operated in the range from -117% to 117%, insofar as the drive permits this.

- **Maximum speed**

In this field, specify the maximum speed of the drive.

- **Invert drive direction**

Select the check box if the rotation direction of the drive should be inverted.

Data exchange with encoder

In this area, you can configure the encoder frame and the criteria for how the encoder data are to be evaluated. The specifications must match those in the device configuration.

- **Encoder message frame:**

In the drop-down list, select the frame of the encoder. The specification must match the setting in the device configuration.

- **Encoder type:**

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (Gn_XIST2)	In this field, configure the number of bits for fine resolution within the absolute actual value (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (Gn_XIST2)	In this field, configure the number of bits for fine resolution within the absolute actual value (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

PROFIdrive Drive - Encoder to Drive

Data exchange with the drive

In this area, you can configure the data exchange with the drive.

- **Drive message frame:**
In the drop-down list, select the frame for the drive. The specification must match the setting in the device configuration.
- **Reference speed:**
In this field, configure the reference speed of the drive in accordance with the manufacturer's specifications. The specification of the drive's speed occurs as a percentage of the reference speed in the range from -200% to 200%.
- **Maximum speed**
In this field, specify the maximum speed of the drive.
- **Invert drive direction**
Select the check box if the rotation direction of the drive should be inverted.

Data exchange with encoder

In this area, you can configure how the encoder data are to be evaluated. The specifications must match those in the device configuration.

- **Encoder message frame:**

The encoder data is transmitted with the drive frame. Therefore, no frame selection is available.

- **Encoder type:**

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

PROFIdrive drive - Encoder on the technology module (TM)

Data exchange with the drive

In this area, you can configure the data exchange with the drive.

- **Drive message frame:**
In the drop-down list, select the frame for the drive. The specification must match the setting in the device configuration.
- **Reference speed:**
In this field, configure the reference speed of the drive in accordance with the manufacturer's specifications. The specification of the drive's speed occurs as a percentage of the reference speed in the range from -200% to 200%.
- **Maximum speed**
In this field, specify the maximum speed of the drive.
- **Invert drive direction**
Select the check box if the rotation direction of the drive should be inverted.

Data exchange with encoder

In this area, you can configure how the encoder data are to be evaluated. The specifications must match those in the device configuration.

- **Encoder message frame:**

The encoder data can be transferred only with encoder message frame 83.

- **Encoder type:**

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

PROFIdrive drive - PROFIdrive encoder on PROFINET/PROFIBUS

Data exchange with the drive

In this area, you can configure the data exchange with the drive.

- **Drive message frame:**
In the drop-down list, select the frame for the drive. The specification must match the setting in the device configuration.
- **Reference speed:**
In this field, configure the reference speed of the drive in accordance with the manufacturer's specifications. The specification of the drive's speed occurs as a percentage of the reference speed in the range from -200% to 200%.
- **Maximum speed**
In this field, specify the maximum speed of the drive.
- **Invert drive direction**
Select the check box if the rotation direction of the drive should be inverted.

Data exchange with encoder

In this area, you can configure the encoder frame and the criteria for how the encoder data are to be evaluated. The specifications must match those in the device configuration.

- **Encoder message frame:**

In the drop-down list, select the frame of the encoder. The specification must match the setting in the device configuration.

- **Encoder type:**

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

6.6.3 Configuration - master value interconnections (synchronous axis only)

You can interconnect a synchronous axis with multiple leading axes. You can only actively interconnect one leading axis as a master value during runtime of your user program.

All interconnection required during operation must be set up during configuration of the technology object.

Possible master values

Add all axes that you require for operation as a master value for the synchronous axis in the "Possible master values" list. You can add positioning axes or synchronous axes as leading axes.

You can interconnect the axes added in the list as master value with the synchronous axis with the Motion Control instruction "MC_GearIn".

All configured master value interconnections for the technology object are displayed in the cross-reference list of the technology object.

6.6.4 Extended Parameters

6.6.4.1 Configuration - Mechanics

Configuration - Mechanics

In the "Mechanics" configuration window, you can configure the mounting type of the encoder, and the adaptation of the encoder value to the mechanical conditions.

Type of encoder mounting

In the drop-down list, select how the encoder is mounted on the mechanism. The configuration varies depending on the axis type and the type of encoder mounting.

Axis type: Linear

- Linear - On the motor shaft (Page 125)
- Linear - On the motor side (Page 126)
- Linear - External Measuring System (Page 126)

Axis type: Rotary

- Rotary - On the motor shaft (Page 127)
- Rotary - On the load side (Page 127)
- Rotary - External Measuring System (Page 128)

Linear - On the motor shaft

The encoder is firmly mechanically connected with the motor shaft. Motor and encoder form a unit.

Load gear

- **Consider load gear and leadscrew pitch for encoder evaluation**

Activate the check box, if you want to perform the configuration based on the gear ratio and the leadscrew pitch.

Deactivate the check box, if you want to perform the configuration based on the motor revolution and the resulting distance.

- **Number of motor revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Position parameter

- **Leadscrew pitch (select "Consider load gear and leadscrew pitch for encoder evaluation")**
In this field, configure the distance by which the load is moved when the leadscrew makes one revolution.
- **Leadscrew pitch (select "Consider load gear and leadscrew pitch for encoder evaluation")**
In this field, configure the load distance for one motor revolution.

Linear - On the motor side

The encoder is mechanically connected with the load side of the gear.

Load gear

- **Number of motor revolutions / number of load revolutions**
The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Position parameter

- **Leadscrew pitch**
In this field, configure the distance by which the load is moved when the leadscrew makes one revolution.

Linear - External Measuring System

An external measuring system provides the position values of the linear load motion.

Load gear

- **Consider load gear and leadscrew pitch for encoder evaluation**

Activate the check box, if you want to perform the configuration based on the gear ratio and the leadscrew pitch.

Deactivate the check box, if you want to perform the configuration based on the motor revolution and the resulting distance.

- **Number of motor revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Position parameter

- **Leadscrew pitch (select "Consider load gear and leadscrew pitch for encoder evaluation")**

In this field, configure the distance by which the load is moved when the leadscrew makes one revolution.

- **Leadscrew pitch (select "Consider load gear and leadscrew pitch for encoder evaluation")**

In this field, configure the distance by which the load is moved when the motor makes one revolution.

- **Distance per encoder revolution**

In this field, configure the distance recorded by the external measuring system per encoder revolution.

Rotary - On the motor shaft

The encoder is firmly mechanically connected with the motor shaft. Motor and encoder form a unit.

Load gear

- **Number of motor revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Rotary - On the load side

The encoder is mechanically connected with the load side of the gear.

Load gear

- **Number of motor revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Rotary - External Measuring System

An external measuring system provides the position values of the rotary load motion.

Load gear

- **Number of motor revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Position parameter

- **Distance per encoder revolution**
- In this field, configure the distance recorded by the external measuring system per encoder revolution.

6.6.4.2 Configuration - Position monitoring

Configure the hardware and software limit switches of the axis in the "Position monitoring" configuration window.

Enable HW limit switches

The check box activates the function of the negative and positive hardware limit switches. The negative hardware limit switch is located on the side in the negative direction of travel, and the positive hardware limit switch on the side in the positive direction of travel.

With enabled hardware limit switches, the drive is disabled when the hardware limit switch is approached or overshoot. The drive brakes with the braking ramp configured in the drive.

Exception: If a hardware limit switch is overshoot during an active home position approach with activated direction reversal at the hardware limit switch, then the axis stops with the configured maximum deceleration, and continues the home position approach in the opposite direction.

Note

Only use hardware limit switches that remain permanently switched after the approach. This switch state may only be canceled after the return into the permitted traversing range.

The digital inputs of the hardware limit switch are evaluated by default in cyclical data exchange. In the settings for the input module under "I/O addresses", select the entry "MC-Servo" for "Organization block" and the entry "PIP OB servo" for "Process image" if the hardware limit switches are to be evaluated in the position control cycle of the drive.

Negative / positive HW limit switch input

In these fields, select the PLC tags of the digital input for the negative and positive HW limit switches.

In order to be able to select an input, a digital input module must have been added in the device configuration, and the PLC tag name for the digital input must be defined.

CAUTION

During installation of hardware limit switches, attention must be paid to the filter times of the digital inputs

Based on the time for a servo clock cycle and the filter time of the digital inputs, the resulting delay times must be taken into account.

The filter time is configurable in individual digital input modules in the device configuration.

The digital inputs are set to a filter time of 6.4 ms by default. If these are used as hardware limit switches, undesired decelerations may occur. If this occurs, reduce the filter time for the relevant digital inputs.

The filter time can be set under "Input filter" in the device configuration of the digital inputs.

Negative / positive HW limit switch level selection

Select the triggering signal level ("Lower level" / "Upper level") of the hardware limit switch. At "Lower level", the input signal is FALSE after the axis has reached or passed the hardware limit switch. At "Upper level", the input signal is TRUE after the axis has reached or passed the hardware limit switch.

Enable software limit switch

This check box activates the upper and lower software limit switches. An active motion is stopped after the axis has reached a position of the software limit switch. The technological object reports a fault. After acknowledging the error, the axis can again be moved in the direction of its working range.

Note

Enabled software limit switches only affect a homed axis.

Position of negative / positive SW limit switch

Configure the operating range of the axis using the positions of the negative and positive software limit switches.

6.6.4.3 Configuration - Dynamic limits

In the "Dynamic limits" configuration window, configure the maximum values for velocity, acceleration, deceleration and jerk of the axis.

Maximum velocity

In this field, define the maximum permitted velocity of the axis.

Maximum acceleration / maximum deceleration - ramp-up time / ramp-down time

Set the desired acceleration in the "Ramp-up time" or "Acceleration" fields. The desired deceleration can be set in the "Ramp-down time" or "Deceleration" fields.

The relationship between ramp-up time and acceleration, and ramp-down time and deceleration can be seen in the following equations:

$$\text{Ramp-up time} = \frac{\text{Maximum velocity}}{\text{Acceleration}}$$

$$\text{Ramp-down time} = \frac{\text{Maximum velocity}}{\text{Deceleration}}$$

Note

A change in the maximum velocity influences the acceleration and deceleration values of the axis. The ramp-up and ramp-down times are retained.

The "maximum deceleration" for active homing with change of direction at the hardware limit switch must be set sufficiently large, to brake the axis before reaching the mechanical endstop.

Smoothing time / jerk

You can enter the jerk limit parameters in the "Smoothing time" box, or alternatively in the "Jerk" box:

- Set the desired jerk for the acceleration ramp and the deceleration ramp in the "Jerk" box. The value 0 means that the jerk is not limited.
- Set the required smoothing time for the acceleration ramp in the "Smoothing time" box.

Note

The configured smoothing time displayed in the configuration, applies only to the acceleration ramp.

If the values of the acceleration and deceleration differ, the smoothing time of the deceleration ramp is calculated and used according to the jerk of the acceleration ramp.

The smoothing time of the deceleration is adapted as follows:

- **Acceleration > Deceleration**
A shorter smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration < Deceleration**
A longer smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration = Deceleration**
The smoothing times of the acceleration ramp and the deceleration ramp are the same.

If an error occurs, the axis decelerates with the configured emergency stop deceleration. A configured jerk limit is not taken into account for this.

The following equations show the relationship between the smoothing times and the jerk:

$$\text{Rounding off time (acceleration ramp)} = \frac{\text{Acceleration}}{\text{Jerk}}$$

$$\text{Rounding off time (deceleration ramp)} = \frac{\text{Deceleration}}{\text{Jerk}}$$

Traversing jobs initiated in the user program are executed with the selected jerk.

6.6.4.4 Configuration - Dynamic Defaults

In the "Dynamic defaults" configuration window, configure the default values for velocity, acceleration, deceleration and jerk of the axis.

The default values have an effect, when values < 0 are specified in Motion Control instructions for the "Velocity", "Acceleration", "Deceleration" or "Jerk" parameters. The default values can be applied separately for each of the parameters just listed.

The default values for acceleration and deceleration additionally have an effect on the traversing motions of active homing.

Velocity

In this field, define the default value for the velocity of the axis.

Acceleration / deceleration - ramp-up time / ramp-down time

Set the desired default value for acceleration in the "Ramp-up time" or "Acceleration" fields. The desired deceleration can be set in the "Ramp-down time" or "Deceleration" fields.

The relationship between ramp-up time and acceleration, and ramp-down time and deceleration can be seen in the following equations:

$$\text{Ramp-up time} = \frac{\text{Velocity}}{\text{Acceleration}}$$

$$\text{Ramp-down time} = \frac{\text{Velocity}}{\text{Deceleration}}$$

Note

A change in the velocity influences the acceleration and deceleration values of the axis. The ramp-up and ramp-down times are retained.

Smoothing time / jerk

You can enter the jerk limit parameters in the "Smoothing time" box, or alternatively in the "Jerk" box:

- Set the desired jerk for the acceleration ramp and the deceleration ramp in the "Jerk" box. The value 0 means that the jerk is disabled.
- Set the required smoothing time for the acceleration ramp in the "Smoothing time" box.

Note

The configured smoothing time displayed in the configuration, applies only to the acceleration ramp.

If the values of the acceleration and deceleration differ, the smoothing time of the deceleration ramp is calculated and used according to the jerk of the acceleration ramp.

The smoothing time of the deceleration is adapted as follows:

- **Acceleration > Deceleration**
A shorter smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration < Deceleration**
A longer smoothing time is used for the deceleration ramp compared with the acceleration ramp.
- **Acceleration = Deceleration**
The smoothing times of the acceleration ramp and the deceleration ramp are the same.

If an error occurs, the axis decelerates with the configured emergency stop deceleration. A configured jerk limit is not taken into account for this.

The following equations show the relationship between the smoothing times and the jerk:

$$\text{Rounding off time (acceleration ramp)} = \frac{\text{Acceleration}}{\text{Jerk}}$$

$$\text{Rounding off time (deceleration ramp)} = \frac{\text{Deceleration}}{\text{Jerk}}$$

Traversing jobs initiated in the user program are executed with the selected jerk.

6.6.4.5 Configuration - Emergency stop

In the "Emergency stop" configuration window, you can configure the emergency stop deceleration of the axis. In the event of an error, and when disabling the axis, the axis is brought to a standstill with this deceleration using the Motion Control instruction "MC_Power" (input parameter StopMode = 0).

Emergency stop deceleration / Emergency stop ramp-down time

Configure the deceleration value for emergency stop in the "Emergency stop deceleration" field or the "Emergency stop ramp-down time" field.

The relationship between emergency stop ramp-down time and emergency stop deceleration can be seen in the following equation:

$$\text{Emergency stop ramp-down time} = \frac{\text{Maximum velocity}}{\text{Emergency stop deceleration}}$$

The configuration of the emergency stop deceleration is related to the configured maximum velocity of the axis. If the maximum velocity of the axis changes, then the value of the emergency stop deceleration also changes (the emergency stop ramp-down time remains unchanged).

6.6.4.6 Homing

Homing means matching the position value of a technology object to the real, physical location of the drive. Absolute positions on the axis can only be approached with a homed axis.

In S7-1500 Motion Control, axis homing is implemented with the Motion Control instruction, "MC_Home". A distinction is made between the following operation modes of the Motion Control instruction:

Operation modes of the Motion Control instruction "MC_Home"

- **Active homing**

In active homing mode, the Motion Control instruction "MC_Home" performs the configured home position approach. Active traversing motions are aborted. When the homing mark is detected, the position of the axis is set according to the configuration.

- **Passive homing**

During passive homing, the motion control instruction "MC_Home" does not carry out any homing motion. The traversing motion required for this step must be implemented by the user via other motion control instructions. Active traversing motions are not aborted upon start of passive homing. When the homing mark is detected, the axis is set according to the configuration.

- **Direct homing absolute**

The axis position is set regardless of the homing switch. Active traversing motions are not aborted. The value of input parameter "Position" of motion control instruction "MC_Home" is set immediately as the home position of the axis.

- **Direct homing relative**

The axis position is set regardless of the homing switch. Active traversing motions are not aborted. The following statement applies to the axis position after homing:

New axis position = current axis position + value of parameter "Position" of instruction "MC_Home".

Active homing

Configuration - Active homing

Configure the parameters for active homing in the "Active Homing" configuration window. "Active Homing" is performed using the Motion Control instruction "MC_Home" Mode = 3 and 5.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

Selecting the homing mode

Select from among the following homing modes:

- Zero mark via PROFIdrive frame and proximity switch (Page 137)
- Zero mark via PROFIdrive frame (Page 138)
- Homing mark via digital input (Page 138)

Zero mark via PROFIdrive frame and proximity switch

Enable direction reversal at the hardware limit switch

Select this check box to use the hardware limit switch as a reversing cam for the home position approach. After the axis has reached the hardware limit switch during active homing, it is ramped down at the configured maximum deceleration rate and the direction is then reversed. The proximity switch is then sought in the reverse direction. If this function is not enabled and the axis reaches the hardware limit switch during active homing, then the drive is disabled and braked with the ramp configured in the drive.

Approach direction

Select the approach direction for seeking the proximity switch.

"Positive" is the approach direction in the direction of positive position values; "negative" in the direction of negative position values.

Homing direction

Select the direction in which the zero mark should be approached for homing.

Approach velocity

In this field, specify the velocity at which the proximity switch is sought during the home position approach. A possibly configured home position offset is traversed with the same velocity.

Homing velocity

In this field, specify the velocity at which the axis approaches the zero mark for homing. For zero mark detection, the proximity switch must be exited.

Home position offset

In the case of a differing zero mark position and home position, enter the corresponding home position offset in this field. The axis approaches the home position at approach velocity.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect, when the Motion Control instruction "MC_Home" is executed with Mode = 5.

Zero mark via PROFIdrive frame

Enable direction reversal at the hardware limit switch

Select this check box to use the hardware limit switch as a reversing cam for the home position approach. After the axis has reached the hardware limit switch during active homing, it is ramped down at the configured maximum deceleration rate and the direction is then reversed. The zero mark is then sought in the reverse direction. If this function is not enabled and the axis reaches the hardware limit switch during active homing, then the drive is disabled and braked with the ramp configured in the drive.

Homing direction

Select the direction in which the next zero mark should be approached for homing.

"Positive" is the homing direction in the direction of positive position values; "negative" in the direction of negative position values.

Approach velocity

In the "Zero mark via PROFIdrive frame" homing mode, the approach velocity for traversing the home position offset is used.

Homing velocity

In this field, specify the velocity at which the axis approaches the zero mark for homing.

Home position offset

In the case of a differing zero mark position and home position, enter the corresponding home position offset in this field. The axis approaches the home position at approach velocity.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect, when the Motion Control instruction "MC_Home" is executed with Mode = 5.

Homing mark via digital input

If a digital input is used as a homing mark, the accuracy of the homing process is not as high as with hardware-supported homing using zero marks.

You can improve the accuracy by using a low homing velocity and a timer-supported input module.

Pay attention to the setting of short filter times at the digital input as well.

Digital input, homing mark

In this field, select the PLC tag of the digital input, which should act as a homing mark (reference cam).

In order to be able to select an input, a digital input module must have been added in the device configuration, and the PLC tag name for the digital input must be defined.

Enable direction reversal at the hardware limit switch

Select this check box to use the hardware limit switch as a reversing cam for the home position approach. After the axis has reached the hardware limit switch during active homing, it is ramped down at the configured maximum deceleration rate and then reversed. The home position switch is then sensed in reverse direction. If this function is not enabled and the axis reaches the hardware limit switch during active homing, then the drive is disabled and braked with the ramp configured in the drive.

Approach direction

Select the approach direction for seeking the homing mark.

"Positive" is the approach direction in the direction of positive position values; "negative" in the direction of negative position values.

Homing direction

Select the direction in which the homing mark should be approached for homing.

Homing mark

Select the switch position of the "digital input" that is to be used as homing mark.

When a "digital input" is overshot, two switch edges which are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated based on the same mechanical position.

The positive side is the switch position with a greater position value; the negative side is the switch position with the lesser position value.

The selection of the side is independent of the approach direction, and independent of whether it causes a rising or falling edge.

Approach velocity

In this field, specify the velocity at which the "digital input" should be sought during the home position approach. A possibly configured home position offset is traversed with the same velocity.

Homing velocity

In this field, specify the velocity at which the axis approaches the home position for homing.

Home position offset

In the case of a differing switch position and home position, enter the corresponding home position offset in this field. The axis approaches the home position at approach velocity.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect, when the Motion Control instruction "MC_Home" is executed with Mode = 5.

Passive homing

Configuration - Passive homing

Configure the parameters for passive homing in the "Passive Homing" (homing on the fly) configuration window. The homing function "Passive homing" is performed using the Motion Control instruction "MC_Home" Mode = 2, 8 and 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

Selecting the homing mode

Select from among the following homing modes:

- Zero mark via PROFIdrive frame and proximity switch (Page 141)
- Zero mark via PROFIdrive frame (Page 142)
- Homing mark via digital input (Page 143)

Zero mark via PROFIdrive frame and proximity switch

Homing direction

Select the direction in which the zero mark should be approached for homing. The next zero mark after exiting the proximity switch is used.

The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

Zero mark via PROFIdrive frame

Homing direction

Select the direction in which the next zero mark should be approached for homing. The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

Homing mark via digital input

Digital input

In this dialog field, select a digital input which should act as a homing mark (reference cam).

Homing direction

Select the direction in which the homing mark should be approached for homing.

The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Homing mark

Select which switch position of the "digital input" is to be used as homing mark.

When a "digital input" is overshot, two switch edges which are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated based on the same mechanical position.

The positive side is the switch position with a greater position value; the negative side is the switch position with the lesser position value.

The selection of the side is independent of the approach direction, and independent of whether it causes a rising or falling edge.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

6.6.4.7 Position monitoring

Configuration - Positioning monitoring

In the "Positioning Monitoring" configuration window, configure the criteria for monitoring the target position.

Positioning window:

In this field, configure the size of the positioning window. If the axis is located within this window, then the position is considered to be "reached".

Positioning tolerance time:

In this field, configure the tolerance time, in which the position value must reach the positioning window.

Minimum dwell time in the positioning window:

In this field, configure the minimum dwell time. The current position value must be located in the positioning window for at least the "minimum dwell time".

If one of the criteria is violated, then the axis is stopped and a positioning alarm is displayed.

Configuration - Following error

In the "Following Error" configuration window, configure the permissible deviation of the actual position of the axis from the setpoint position. The following error can be dynamically adapted to the current velocity of the axis.

Enable following error monitoring

Activate this check box, if you want to enable following error monitoring. When following error monitoring is enabled, the axis will be stopped in the error range (orange); in the warning range an alarm will be displayed.

When following error monitoring is disabled, the configured limits have no effect.

Maximum following error:

In this field, configure the following error that is permissible at maximum velocity.

Warning level:

In this field, configure a percentage of the current following error limit, above which a following error warning should be output.

Example: The current maximum following error is 100 mm; the warning level is configured at 90%. If the current following error exceeds a value of 90 mm, then a following error warning will be output.

Following error:

In this field, configure the permissible following error for low velocities (without dynamic adaptation).

Beginning of dynamic adaptation:

In this field, configure the velocity above which the following error should be dynamically adapted. Above this velocity the following error will be adapted up to the maximum following error at the maximum velocity.

Configuration - Standstill signal

In the "Standstill Signal" configuration window, configure the criteria for standstill detection.

Standstill window:

In this field, configure the size of the standstill window. For standstill to be indicated, the velocity of the axis must be within this window.

Minimum dwell time in the standstill window:

In this field, configure the minimum dwell time in the standstill window. The velocity of the axis must also be in the standstill window for the specified duration.

If both criteria are met, then the standstill of the axis is indicated.

6.6.4.8 Configuration - Control loop

In the "Control loop" configuration window, configure the gain Kv of the position control loop.

The Kv factor affects the following parameters:

- Positioning accuracy and stop control
- Uniformity of motion
- Positioning time

The better the mechanical conditions of the axis are (high stiffness), the higher the Kv factor can be configured. This reduces the following error, and a higher dynamic response is achieved.

For basic information, refer to the section Control (Page 59).

Precontrol

In this box, configure the percentage velocity precontrol of the position control loop.

Gain

In the input field, enter the gain Kv of the control loop.

Dynamic Servo Control (DSC):

For position-controlled axes (positioning axes/synchronous axes), the position control can occur either in the CPU or in the drive, provided the drive supports the Dynamic Servo Control (DSC) control process. Select your preferred control process:

- **Position control in drive (DSC enabled)**
- **Position control in the PLC**

Note

Dynamic Servo Control (DSC) is only possible with standard frame 5.

See also

Function and structure of the optimization (Page 207)

Control (Page 59)

6.7 Configuring the External Encoder technology object

6.7.1 Configuration - Basic Parameters

Configure the basic properties of the technology object in the "Basic Parameters" configuration window.

Name of the external encoder

Define the name of the external encoder in this field. The technology object is listed in the project navigation under this name. The tags of the external encoder can be used in the user program under this name.

Type of the external encoder

In this selection, configure whether the external encoder records linear or rotary motions.

Units of measure

In the drop-down list, select the desired measurement system for the position and velocity of the external encoder.

Modulo

Select the check box "Activate modulo", if you want to employ a recurring unit of measure for the external encoder (e.g. 0-360° for an external encoder of the "rotary" type).

- **Modulo start value**

In this field, define the position at which the modulo range should begin (e.g. 0° for an external encoder of the "rotary" type).

- **Modulo length**

In this field, define the length of the modulo range (e.g. 360° for an external encoder of the "rotary" type).

6.7.2 Hardware interface

6.7.2.1 Configuration - Encoder

The external encoder records the position of an externally controlled drive. The encoder required for this purpose communicates the encoder position to the controller by means of a PROFIdrive frame. In the "Encoder" configuration window, configure the encoder coupling with which the encoder is to be connected.

Select encoder coupling:

In this area, select how the encoder will be connected in keeping with the graphic representation.

- **Connection via technology module (TM)**

Select this option, if the encoder is connected to a technology module (TM).

- **Technology module:**

In the "Technology module" field, select a technology module that has already been configured, and the channel to be used. Only technology modules set to the "Position detection for motion control" mode are displayed for selection.

If no technology module is available for selection, change to the device configuration and add a technology module. If you have selected a technology module, you can change to the configuration of the technology module using the "Device configuration" button.

You can operate the technology module centrally on an S7-1500 PLC, or distributed on a distributed I/O. You can identify the technology modules suitable for position detection for Motion Control in the documentation for the technology module and the catalog data.

- **Connection via PROFINET/PROFIBUS (PROFIdrive)**

Select this option, if you are deploying a PROFIdrive compatible encoder.

- **Encoder:**

In the "Encoder" field, select a configured encoder on PROFINET/PROFIBUS. If an encoder was selected, then it can be configured using the "Device configuration" button.

Switch to the device configuration in the network view, and add an encoder, in the event that no encoder can be selected.

6.7.2.2 Configuration - Data exchange

Configuration - Data exchange

In the "Data transmission" configuration window, configure the data transmission to the encoder. The configuration varies according to the encoder coupling:

- Encoder to technology module (Page 149)
- Encoder to PROFINET/PROFIBUS (Page 151)

Encoder to technology module

Data exchange with encoder

In this area, you can configure the encoder frame and the criteria for how the encoder data are to be evaluated. The specifications must match those in the device configuration.

Encoder message frame

In the drop-down list for the technology module, select the message frame that you have configured in the technology module.

Encoder type

In this area, you can configure how the encoder data are to be evaluated. The specifications must match those in the device configuration.

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (Gn_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (Gn_XIST1).
Bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2)	In this field, configure the number of reserved bits for the multiplication factor of the absolute value of the fine resolution (Gn_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

See also

Configuration - Data exchange (Page 149)

Encoder to PROFINET/PROFIBUS (Page 151)

Encoder to PROFINET/PROFIBUS

Data exchange with encoder

In this area, you can configure the encoder frame and the criteria for how the encoder data are to be evaluated. The specifications must match those in the device configuration.

Encoder message frame

In the drop-down list, select the frame of the encoder. The specification must match the setting in the device configuration.

Encoder type

Depending on the selected encoder type, configure the following parameters:

Encoder type	Rotary incremental
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Bits for fine resolution in the incremental actual value (GN_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (GN_XIST1).

Encoder type	Rotary absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (GN_XIST1)	In this field, configure the number of reserved bits for fine resolution within the incremental actual value (GN_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (GN_XIST2).

Encoder type	Rotary cyclic absolute
Steps per revolution:	In this field, configure the number of steps that the encoder resolves per revolution.
Number of revolutions:	In this field, configure the number of revolutions that the absolute value encoder can detect.
Bits for fine resolution in the incremental actual value (GN_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (GN_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (GN_XIST2).

Encoder type	Linear incremental
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (GN_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (GN_XIST1).

Encoder type	Linear absolute
Distance between two increments:	In this field, you can configure the distance between two steps of the encoder.
Bits for fine resolution in the incremental actual value (GN_XIST1)	In this field, configure the number of bits for fine resolution within the incremental actual value (GN_XIST1).
Bits for fine resolution in the absolute actual value (GN_XIST2)	In this field, configure the number of reserved bits for fine resolution within the absolute actual value (GN_XIST2).

Invert encoder direction

Select this check box if you would like to invert the actual value of the encoder.

See also

Configuration - Data exchange (Page 149)

Encoder to technology module (Page 149)

6.7.3 Extended Parameters

6.7.3.1 Configuration - Mechanics

Configuration - Mechanics

Configure the encoder parameters for the position of the externally controlled drive in the "Mechanics" configuration window.

The configuration varies according to the type of encoder:

- Linear (Page 153)
- Rotary (Page 154)

Linear

Measuring gearbox

- **Consider measuring gearbox and leadscrew pitch for encoder evaluation**

Activate the check box, if you want to perform the configuration based on the gear ratio and the leadscrew pitch.

Deactivate the check box, if you want to perform the configuration based on the encoder revolution and the resulting distance.

- **Number of encoder revolutions / number of load revolutions**

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions. Specify here an integral number of motor revolutions and the resulting number of load revolutions.

Position parameter

- **Leadscrew pitch (select "Consider measuring gear and leadscrew pitch for encoder evaluation")**

In this field, configure the distance by which the load is moved when the leadscrew makes one revolution.

- **Load movement per motor revolution (select "Consider measuring gear and leadscrew pitch for encoder evaluation")**

In this field, configure the load distance for one motor revolution.

See also

Configuration - Mechanics (Page 153)

Rotary (Page 154)

Rotary

Measuring gearbox

- **Number of encoder revolutions / number of load revolutions**

The gear ratio of the measuring gearbox is specified as the ratio between encoder revolutions and load revolutions. Specify here an integral number of load revolutions and the resulting number of encoder revolutions.

Select the same values for the number of motor revolutions and load revolutions, if no load gear is present.

Position parameter

- **Distance per encoder revolution**

In this field, configure the value indicated by the external measuring system per encoder revolution.

See also

Configuration - Mechanics (Page 153)

Linear (Page 153)

6.7.3.2 Homing

Configuration - Homing

Configure the parameters for homing the external encoder in the "Homing" configuration window. Homing is performed using the Motion Control instruction "MC_Home" Mode = 2, 8 and 10.

Note**Parameter "MC_Home.Mode"**

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

Selecting the homing mode

Select from among the following homing modes:

- Zero mark via PROFIdrive frame and proximity switch (Page 156)
- Zero mark via PROFIdrive frame (Page 157)
- Homing mark via digital input (Page 158)

Zero mark via PROFIdrive frame and proximity switch

Homing direction

Select the direction in which the zero mark should be approached for homing. The next zero mark after exiting the proximity switch is used.

The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

See also

Configuration - Homing (Page 155)

Zero mark via PROFIdrive frame (Page 157)

Homing mark via digital input (Page 158)

Zero mark via PROFIdrive frame

Homing direction

Select the direction in which the next zero mark should be approached for homing. The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

See also

Configuration - Homing (Page 155)

Zero mark via PROFIdrive frame and proximity switch (Page 156)

Homing mark via digital input (Page 158)

Homing mark via digital input

Digital input, homing mark

In this dialog field, select a digital input which should act as a homing mark (reference cam).

Homing direction

Select the direction in which the homing mark should be approached for homing.

The following options are available:

- **Positive**
Axis moves in the direction of higher position values.
- **Negative**
Axis moves in the direction of lower position values.
- **Current**
The currently effective approach direction is used for homing.

Homing mark

Select which switch position of the "digital input" is to be used as homing mark.

When a "digital input" is overshoot, two switch edges which are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated based on the same mechanical position.

The positive side is the switch position with a greater position value; the negative side is the switch position with the lesser position value.

The selection of the side is independent of the approach direction, and independent of whether it causes a rising or falling edge.

Home position

In this field, configure the absolute coordinate of the home position. The home position configured here is in effect when the Motion Control instruction "MC_Home" is executed with Mode = 10.

Note

Parameter "MC_Home.Mode"

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

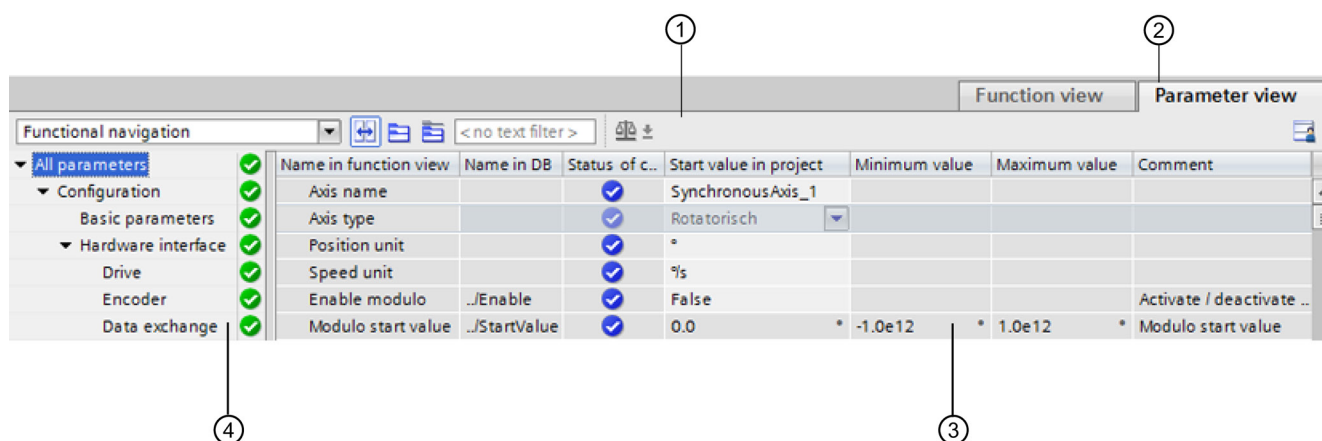
See also

- Configuration - Homing (Page 155)
- Zero mark via PROFIdrive frame (Page 157)
- Zero mark via PROFIdrive frame and proximity switch (Page 156)

6.8 Parameter view

6.8.1 Introduction to the parameter view

The Parameter view provides you with a general overview of all relevant parameters of a technology object. You obtain an overview of the parameter settings and can easily change them in offline and online mode.



- ① Toolbar (Page 161)
- ② "Parameter view" tab
- ③ Parameter table (Page 162)
- ④ Navigation (Page 161)

Function scope

The following functions are available for analyzing the parameters of the technology objects and for enabling targeted monitoring and modification.

Display functions:

- Display of parameter values in offline and online mode
- Display of status information of the parameters
- Display of value deviations and option for direct correction
- Display of configuration errors
- Display of value changes as a result of parameter dependencies
- Display of all memory values of a parameter: Start value PLC, Start value project, Monitor value
- Display of the parameter comparison of the memory values of a parameter

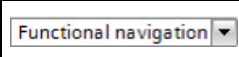






Operator control functions:

- Navigation for quickly changing between the parameters and parameter structures.
- Text filter for faster searches for particular parameters.
- Sorting function for customizing the order of parameters and parameter groups to requirements.
- Memory function for backing up structural settings of the Parameter view.
- Monitoring and modifying of parameter values online.
- Function for saving a snapshot of parameter values of the CPU in order to capture momentary situations and to respond to them.
- Function for applying a snapshot of parameter values as start values.
- Download of modified start values to the CPU.
- Comparison functions for comparing parameter values with one another.

6.8.2 Structure of the parameter view

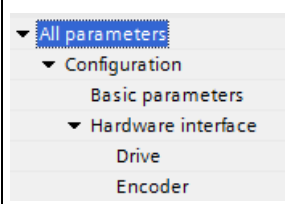
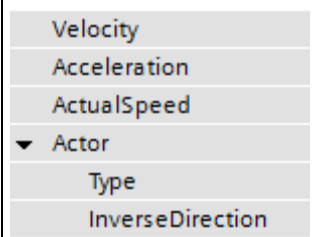
6.8.2.1 Toolbar

The following functions can be selected in the toolbar of the parameter view.

Symbol	Function	Explanation
	Select navigation structure	Toggle between function-based navigation and the view for the data structure of the technology data block.
	Couple the function view and parameter view for the objects selected in the navigation	Enables the targeted toggling between the parameter view for function-based view.
	Collapse/expand all nodes and objects	Collapses or expands all nodes and objects of the navigation or the data structure in the currently active view.
	Collapse/expand the nodes below the marked nodes	Collapses or expands all marked nodes and objects of the navigation or the data structure in the currently active view.
	Text filter...	After entry of a character string: Display of all parameters containing the specified string in one of the currently visible columns.
	Selection of compare values	Selection of parameter values that are to be compared with one another in online mode (Start value project, Start value PLC) Only in online mode.
	Save window settings	Saves your display settings for the Parameter view (e.g., selected navigation structure, activated table columns, etc.)

6.8.2.2 Navigation

Within the "Parameter view" tab, the following alternative navigation structures can be selected.

Navigation		Explanation
Functional navigation		In the functional navigation, the structure of the parameters is based on the structure in the configuration dialog ("Functional view" tab), commissioning dialog, and diagnostics dialog.
Data structure		In the data navigation navigation, the structure of the parameters is based on the structure in the technology data block.

You can use the "Select navigation structure" drop-down list to toggle the navigation structure.

6.8.2.3 Parameter table

The table below shows the meaning of the individual columns of the parameter table. You can show or hide the columns as required.

- Column "Offline" = X: Column is visible in offline mode.
- Column "Online" = X: Column is visible in online mode (online connection to the CPU).

Column	Explanation	Offline	Online
Name in functional view	Name of the parameter in the functional view. The display field is empty for parameters that are not configured via the technology object.	X	X
Name in DB	Name of the parameter in the technology data block. If the parameter is part of a structure or UDT, the prefix ". /" is added. The display field is empty for parameters that are not contained in the technology data block.	X	X
Full name in DB	Complete path of the parameter in the instance DB. The display field is empty for parameters that are not contained in the technology data block.	X	X
Status of configuration	Display of the completeness of the configuration using status symbols.	X	
Compare result	Result of the "Compare values" function. This column is displayed when there is an online connection.		X
Start value project	Configured start value in the project. Error indication if entered values have a syntax or process-related error.	X	X
Default value	Value that is pre-assigned to the parameter. The display field is empty for parameters that are not contained in the technology data block.	X	X
Start value PLC	Start value in the CPU. This column is displayed when there is an online connection.		X
Monitor value	Current value in the CPU. This column is displayed when there is an online connection.		X
Modify value	Value that is to be used to change the monitor value. This column is displayed when there is an online connection.		X
Minimum value	Minimum process-related value of the parameter. If the minimum value is dependent on other parameters, it is defined: <ul style="list-style-type: none"> • Offline: By the Start value project. • Online: By the Monitor values. 	X	X
Maximum value	Maximum process-related value of the parameter. If the maximum value is dependent on other parameters, it is defined: <ul style="list-style-type: none"> • Offline: By the Start value project. • Online: By the Monitor values. 	X	X
Setpoint	Designates the parameter as a setpoint. These parameters can be initialized online.	X	X

Column	Explanation	Offline	Online
Data type	Data type of the parameter. The display field is empty for parameters that are not contained in the technology data block.	X	X
Retain	Designates the value as a retentive value. The values of retentive parameters are retained even after the voltage supply is switched off.	X	X
Accessible from HMI	Indicates whether the HMI can access this parameter during runtime.	X	X
Visible in HMI	Indicates whether the parameter is visible in the selection list of the HMI by default.	X	X
Comment	Brief description of the parameter.	X	X

6.8.3 Opening the parameter view

Requirement

The technology object was added in the project navigator.

Procedure

1. Open the "Technology objects" folder in the project tree.
2. Open the technology object in the project tree.
3. Double-click the "Configuration" object.
4. Select the "Parameter view" tab in the top right corner.

Result

The Parameter view opens. Each displayed parameter is represented by one row in the parameter table.

The displayable parameter properties (table columns) vary depending on whether you are working with the Parameter view in offline or online mode.

In addition, you can selectively display and hide individual table columns.

6.8.4 Working with the parameter view

6.8.4.1 Overview

The following table provides an overview of the functions of the Parameter view in online and offline mode described in the following.

- Column "Offline" = X: This function is possible in offline mode.
- Column "Online" = X: This function is possible in online mode.

Function/action	Offline	Online
Filtering the parameter table (Page 164)	X	X
Sorting the parameter table (Page 165)	X	X
Transferring parameter data to other editors (Page 165)	X	X
Indicating errors (Page 166)	X	X
Editing start values in the project (Page 166)	X	X
Monitoring values online in the parameter view (Page 168)		X
Modifying values (Page 169)		X
Comparing values (Page 170)		X

6.8.4.2 Filtering the parameter table

You can filter the parameters in the parameter table in the following ways:

- With the text filter
- With the subgroups of the navigation

Both filter methods can be used simultaneously.

With the text filter

Texts that are visible in the parameter table can be filtered. This means only texts in displayed parameter rows and columns can be filtered.

1. Enter the desired character string for filtering in the "Text filter..." input box.

The parameter table displays only the parameters containing the character string.

The text filtering is reset.

- When another parameter group is selected in the navigation.
- When navigation is changed from data navigation to functional navigation, or vice versa.

With the subgroups of the navigation

1. Click the desired parameter group in the navigation, e.g., "Static".

The parameter table only shows the static parameters. You can select further subgroups for some groups of the navigation.

2. Click "All parameters" in the navigation if all parameters are to be shown again.

6.8.4.3 **Sorting the parameter table**

The values of the parameters are arranged in rows. The parameter table can be sorted by any displayed column.

- In columns containing numerical values, sorting is based on the magnitude of the numerical value.
- In text columns, sorting is alphabetical.

Sorting by column

1. Position the cursor in the header cell of the desired column.
 The background of this cell turns blue.
2. Click the column header.

Result

The entire parameter table is sorted by the selected column. A triangle with tip facing up appears in the column header.

Clicking the column header again changes the sorting as follows:

- Symbol “▲”: Parameter table is sorted in ascending order.
- Symbol “▼”: Parameter table is sorted in descending order.
- No symbol: The sorting is removed again. The parameter table assumes the default display.

The “./” prefix in the “Name in DB” column is ignored when sorting.

6.8.4.4 **Transferring parameter data to other editors**

You can paste parameters of the parameter view in the following editors:

- Program editor
- Watch table
- Signal table for Trace

The following options are available for pasting:

- Drag-and-drop
- <Ctrl+C>/<Ctrl+V>
- Copy/Paste via shortcut menu

6.8.4.5 Indicating errors

Error indication

Parameter assignment errors that result in compilation errors (e.g., limit violation) are indicated in the Parameter view.

Every time a value is entered in the Parameter view, a check is made for process-related and syntax errors and displayed with the following indicators:

- Red error symbol in the "Status of configuration" (offline mode) or "Compare result" (online mode, depending on the selected comparison type) columns
- Table field with red background

If you click the bad field, a roll-out error message appears with information of the permissible value range or the required syntax (format)

Compilation error

From the error message of the compiler, you can directly open the Parameter view (functional navigation) containing the parameter causing the error in situations where the parameter is not displayed in the configuration dialog.

6.8.4.6 Editing start values in the project

With the Parameter view, you can edit the start values in the project in offline mode and online mode.

- You make value changes in the "Start value project" column of the parameter table.
- In the "Status of configuration" column of the parameter table, the progress of the configuration is indicated by the familiar status symbols from the configuration dialog of the technology object.

Boundary conditions

- If other parameters depend on the parameter whose start value was changed, the start value of the dependent parameters are also adapted.
- If a parameter of a technology object is not editable, it is also not editable in the parameter view. The ability to edit a parameter can also depend on the values of other parameters.

Defining new start values

To define start values for parameters in the Parameter view, follow these steps:

1. Open the Parameter view of the technology object.
2. Enter the desired start values in the "Start value project" column. The value must match the data type of the parameter and must not exceed the value range of the parameter. The limits of the value range can be seen in the "Maximum value" and "Minimum value" columns.

The "Status of configuration" column indicates the progress of the configuration with colored symbols.

Following adaptation of the start values and downloading of the technology object to the CPU, the parameters take the defined value at startup if they are not declared as retentive ("Retain" column).

Error indication

When a start value is input, a check is made for process-related and syntax errors and the result is indicated.

Bad start values are indicated by:

- Red error symbol in the "Status of configuration" (offline mode) or "Compare result" (online mode, depending on the selected comparison type) columns

and/or

- Red background in the "Start value project" field
If you click on the bad field, a roll-out error message appears with information of the permissible value range or the necessary syntax (format)

Correcting bad start values

1. Correct bad start values using information from the roll-out error message.

Red error symbol, red field background, and roll-out error message are no longer displayed.

The project cannot be successfully compiled unless the start values are error-free.

6.8.4.7 Monitoring values online in the parameter view

You can monitor the values currently taken by the parameters of the technology object in the CPU (monitor values) directly in the Parameter view.

Requirements

- There is an online connection.
- The technology object is downloaded to the CPU.
- The Parameter view of the technology object is open.

Procedure



As soon as the Parameter view is online, the following columns are additionally displayed:

- Compare result
- Start value PLC
- Monitor value
- Modify value
- Selection for transmission

The "Monitor value" column shows the current parameter values on the CPU.

Display

All columns that are only available online have an orange background:

- Values in light-orange cells  can be changed.
- Values in cells with a dark orange background  cannot be changed.

See also

Parameter table (Page 162)

6.8.4.8 Modifying values

With the Parameter view, you can modify values of the technology object in the CPU.

You can assign values to the parameter once (Modify value) and modify them immediately. The modify request is executed as quickly as possible without reference to any particular point in the user program.

DANGER

Danger when modifying:

Changing the parameter values while the plant is operating may result in severe damage to property and personal injury in the event of malfunctions or program errors.

Make sure that dangerous states cannot occur before you use the "Modify" function.

Requirements

- There is an online connection.
- The technology object is downloaded to the CPU.
- The Parameter view of the technology object is open.
- The parameter can be modified (associated field in the "Modify value" column has a light-orange background).

Procedure

To modify parameters immediately, follow these steps:

- Enter the desired modify values in the "Modify values" column of the parameter table.

The selected parameters are modified once and immediately with the specified values and can be monitored in the "Modify values" column. The check boxes for modifying in the "Selection for transmission" column are automatically cleared after the modify request is complete.

Error indication

When a start value is input, a check is made immediately for process-related and syntax errors and the result is indicated.

Bad start values are indicated by:

- Red background in the "Modify value" field

and

- If you click the bad field, a roll-out error message appears with information of the permissible value range or the necessary syntax (format)

Bad modify values

- Modify values with process-related errors can be transmitted.
- Modify values with syntax errors **cannot** be transmitted.

6.8.4.9 Comparing values

You can use comparison functions to compare the following memory values of a parameter:


- Start value project
- Start value PLC

Requirements

- There is an online connection.
- The technology object is downloaded to the CPU.
- The Parameter view of the technology object is open.

Procedure

To compare the start values on the various target systems, follow these steps:

1. Click the "Selection of compare values" icon .

A selection list containing the comparison options opens:





- Start value project - Start value PLC (default setting)

2. Select the desired comparison option.

The selected comparison option is executed as follows:

- A scales symbol appears in the header cells of the two columns selected for comparison.
- Symbols are used in the "Compare result" column to indicate the result of the comparison of the selected columns.

Symbol in "Compare result" column

Symbol	Meaning
	The compare values are equal and error-free.
	The compare values are not equal and error-free.
	At least one of the two compare values has a process-related or syntax error.
	The comparison cannot be performed. At least one of the two compare values is not available (e.g., snapshot).

Symbol in the navigation

The symbols are shown in the same way in the navigation if the comparison result applies to at least one of the parameters below the displayed navigation structure.

Programming

7.1 Introduction

The "Programming" section contains general information on supplying and evaluating the Motion Control instructions and on technology data blocks.

An overview of the Motion Control instructions can be found in the Functions (Page 20) section.

You can transmit jobs to the technology object by means of Motion Control instructions in the user program. You define the job using the input parameters of the Motion Control instructions. The current job status is indicated in the output parameters.

The technology data block is available to you as an additional interface to the technology object. Via your user program, you can access the technology data block's data.

7.2 Technology data block

7.2.1 Introduction

The properties of real objects are configured by means of the technology objects and saved in a technology data block. The technology data block contains all configuration data, setpoint and actual values, and status information of the technology object. The TIA Portal automatically creates the technology data block when the technology object is created. You access the data of the technology data block with your user program.

A listing and description of the tags can be found in the Appendix (Page 332).

7.2.2 Evaluating the technology data block

Description

Access to data in the technology data block occurs in accordance with the access to standard data blocks.

Reading values from the technology data block

In your user program you can read actual values (e.g. current position) and status information, or detect error messages in the technology object. When you program a query in your user program (e.g. current velocity), the value is directly read from the technology object.

Reading values from the technology data block takes longer than for other data blocks. If you use these tags several times in a single cycle of your user program, it is recommended to copy the tag values to local tags, and use the local tags in your program.

Writing values to the technology data block

The configuration of the technology object in the TIA Portal is used to write the corresponding data to the technology data block. After they have been loaded into the CPU, these data are stored in the CPU on the SIMATIC Memory Card (load memory).

- **Required changes in the technology data block**

In the following cases, it may be necessary for the user program to write values to the technology data block:

- Adaptation of the configuration of the technology object (e.g. dynamic limits, software limit switches)
- Use of overrides
- Adaptation of position control (e.g. "Kv" parameter)

- **Effectiveness of changes in the technology data block**

Changes to values in the technology data block by the user program can take effect at various points in time. The relevant property of the individual tags can be found in their descriptions in the Appendix (Page 332).

- **Effective immediately:**

- LREAL data type**

- (e.g. <TO>.Override.Velocity)

- Value changes take effect immediately when writing these tags. The technology object performs a range check on the written value, and immediately starts using the new value. If range limits are violated when writing, the technology object automatically corrects the values. If the value is below the range, then the value is set to the lower limit of the range; if the range is exceeded, then the value is set to the upper limit of the range. You write changes using direct assignments. The changes are retained until the next POWER OFF of the CPU or restart of the technology object.

DINT/BOOL data types

(e.g. <TO>.Senso[n].ActiveHoming.Direction)

Changes are only permitted in the defined value range. Value changes outside the value range are not applied. If you enter invalid values, the programming error OB (OB 121) is started. You write changes using direct assignments. The changes are retained until the next POWER OFF of the CPU or restart of the technology object.

– **Effective after restart:**

(e.g. <TO>.Homing.AutoReversal)

Since restart-relevant tags have dependencies on other tags, value changes cannot be applied at any arbitrary time. The changes are only used after reinitialization (restart) of the technology object. During a restart the technology object is reinitialized with the data in load memory. You therefore write changes to the starting value in load memory, using the extended instruction "WRIT_DBL" (write to data block in load memory).

You trigger the restart in your user program using the Motion Control instruction "MC_Reset" with parameter "Restart" = TRUE. Additional information on a restart can be found in the Restarting Technology Objects (Page 197) section.

Note

Save changes with "WRIT_DBL"

Changes to immediately effective tags are lost on POWER OFF of the CPU, or restart of the technology object.

If changes in the technology data block should also be retained after POWER OFF of the CPU, or restart of the technology object, you must write the changes to the starting value in load memory using the extended instruction "WRIT_DBL".

Note

Using the "READ_DBL" and "WRIT_DBL" data block functions

The "READ_DBL" and "WRIT_DBL" data block functions can only be used on a single tag in conjunction with the tags of the technology object. The "READ_DBL" and "WRIT_DBL" data block functions cannot be applied to data structures of the technology object.

Evaluation of data in the isochronous interrupt OB

If you want to write the technology data block's data isochronously from a Motion Control application cycle, there is the option of evaluating these data in the isochronous interrupt OB. The MC-Servo [OB91] is called synchronously with a bus system.

Assign the same bus cycle (Page 78) to the isochronous interrupt OB as to the MC_Servo [OB91]. By this means, the isochronous interrupt OB is called in each Motion Control application cycle.

In the isochronous interrupt OB, read the necessary data into global tags. Use these global tags for further programming.

7.2.3 Evaluate StatusWord, ErrorWord and WarningWord

To be able to use individual status and error information from the "StatusWord", "ErrorWord" and "WarningWord" data double words, the evaluation can be performed as described below. For consistent evaluation, you should avoid using bit addressing to access these data double words in the technology data block. Access to an individual bit in the technology data block only lasts as long as the access to the entire data word.

When required, copy the required data double word into a tag of a data structure and query the individual bits of the tag.

A description of the data double words and the allocation of the individual bits can be found in the Appendix:

- StatusWord (Page 351)
- ErrorWord (Page 353)
- WarningWord (Page 356)

Requirements

The technology object has been created.

Procedure

To evaluate the individual bits in the data word "StatusWord", proceed as follows:

1. Create a global data structure. Name the data structure, e.g. as "Status".
2. Create a double word (DWORD) in the data structure "Status". Name the data structure, e.g. as "Temp".
3. Create 32 Boolean tags in the "Status" data structure. You can obtain a clearer overview by naming Boolean tags as defined for the bits in the technology DB (e.g. name the fifth Boolean tag "HomingDone").
4. Copy the tag <TO>.StatusWord as needed from the technology data block to the double word "Temp" in your data structure.
5. Copy the bits of dword "Temp" to the corresponding Boolean tags by means of bit access.
6. Use the Boolean tags to query the status bits.

Evaluate the "ErrorWord" and "WarningWord" data words as specified in steps 1 to 6.

Example

The following example shows how you can read and save the fifth bit "HomingDone" of the data word "StatusWord":

SCL	
Status.Temp := <TO>.StatusWord;	Copy status word
Status.HomingDone := Status.Temp.X5;	Copy individual bits per bit access

STL	
L <TO>.StatusWord	Copy status word
T Status.Temp	
U Status.Temp.X5	Copy individual bits per bit access
= Status.HomingDone	

7.2.4 Change restart-relevant data

In order to change restart-relevant data in the technology data block, write to the starting values of the tags in load memory using the extended instruction "WRIT_DBL". In order for the changes to be applied, a restart of the technology object must be performed.

Whether changes to the value of a tag are relevant for the restart can be found in the description of the tags in the Appendix (Page 332).

Requirement

The technology object has been created.

Procedure

To change restart-relevant data, proceed as follows:

1. Create a data block and fill it with the restart-relevant values, that you want to change in the technology data block. In doing so, the data types must match the tags to be changed.
2. Write the values from your data block to the starting values of the tags of the technology data block in load memory, using the extended instruction "WRIT_DBL".

If restart-relevant data were changed, this will be indicated in the <TO>.StatusWord.X3 (OnlineStartValuesChanged) tag of the technology object.

3. Perform a restart of the technology object using the Motion Control instruction "MC_Reset" with parameter "Restart" = TRUE.

After the restart of the technology object, the new value is transferred into the technology data block in work memory, and is effective.

7.3 Motion Control instructions

7.3.1 Motion Control instruction parameters

Description

When creating your user program, take account of the following explanations of the Motion Control instruction parameters.

Reference to the technology object

The specification of the technology object to the Motion Control instruction occurs as follows:

- **"Axis" parameter**

In the "Axis" input parameter of a Motion Control instruction, a reference to the technology object is specified, which the corresponding job should use.

Job start and receipt of the input parameters of a Motion Control instruction

When jobs are started, and when changed parameter values are received, a distinction is made between the following Motion Control instructions:

- **Motion Control instructions with "Execute" parameter**

With a rising edge at the "Execute" parameter, the job is started and the values pending in the input parameters are applied.

Subsequently changed parameter values are not applied until the next job start.

Resetting the "Execute" parameter does not end the job, but does have an effect on the indication duration of the job status. As long as "Execute" is set to TRUE, the output parameters will be updated. If "Execute" is reset before the completion of a job, the parameters "Done", "Error" and "CommandAborted" are correspondingly set for only one call cycle.

- **Motion Control instructions with "Enable" parameter**

The job is started by setting the "Enable" parameter.

As long as "Enable" = TRUE. the job remains enabled and changed parameter values are immediately applied.

The job is ended by resetting the "Enable" parameter.

The input parameters "JogForward" and "JogBackward" of the "MC_MoveJog" Motion Control instruction correspond in their behavior to the "Enable" parameter.

Job status

The following output parameters indicate the status of the job processing:

- **Motion Control instructions with "Done" parameter**

The normal completion of a job is indicated with parameter "Done" = TRUE.
- **Motion Control instructions without "Done" parameter**

The achievement of the job target is indicated by means of other parameters (e.g. "Status", "InVelocity"). For more information, refer to the section "Tracking running jobs (Page 184).
- **"Busy" parameter**

As long as a job is being processed, the parameter "Busy" shows the value TRUE. If a job was ended or aborted, "Busy" shows the value FALSE.
- **"CommandAborted" parameter**

If a job was aborted by another job, CommandAborted shows the value "TRUE".
- **"Error" parameter**

If an error occurs in the Motion Control instruction, the "Error" parameter shows the value TRUE. The ErrorID parameter shows the cause of the error.

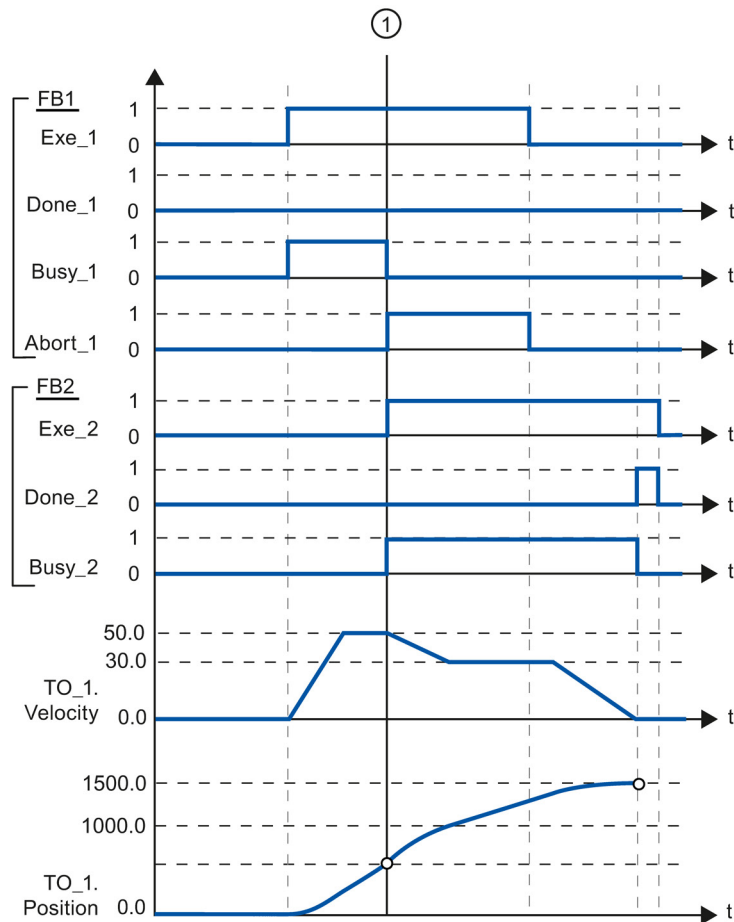
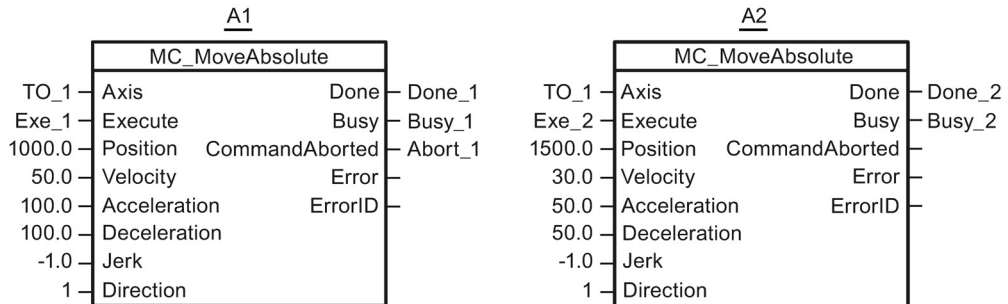
As long as the "Execute" or "Enable" parameter is set to TRUE, the output parameters will be updated. Otherwise the parameters "Done", "Error" and "CommandAborted" are correspondingly only set for one cycle.

Termination of active jobs

A running Motion Control job is terminated by the initiation of a new Motion Control job. In the process, the current dynamic setpoints (acceleration, deceleration, jerk, velocity) are set to the values of the overriding job.

Example of parameter behavior

The behavior of the parameters of Motion Control instructions is shown by way of the example of two "MC_MoveAbsolute" jobs.



Using "Exe_1", an "MC_MoveAbsolute" job (A1) with target position 1000.0 is initiated. "Busy_1" is set to TRUE. The axis is accelerated to the specified velocity and moved to the target position (see TO_1.Velocity and TO_1.Position). Before the target position is reached, the job is overridden at time ① by another "MC_MoveAbsolute" job (A2). The abort is signaled via "Abort_1", and "Busy_1" is set to FALSE. The axis is braked to the velocity specified in A2, and moved to the new target position 1500.0. When the axis reaches the target position, this is signaled via "Done_2".

7.3.2 Add Motion Control instructions

You add Motion Control instructions to a program block in the same way as other instructions. You control all available functions of the technology object using the Motion Control instructions.

Requirements

The technology object was created.

Procedure

To add Motion Control instructions in your user program, proceed as follows:

1. Double click your program block in the Project Navigator (the program block must be called in the cyclical program).

The program block is opened in the programming editor, and the available instructions are displayed.

2. In the "Instructions" task card, open the "Technology > Motion Control > S7-1500 Motion Control" folder.

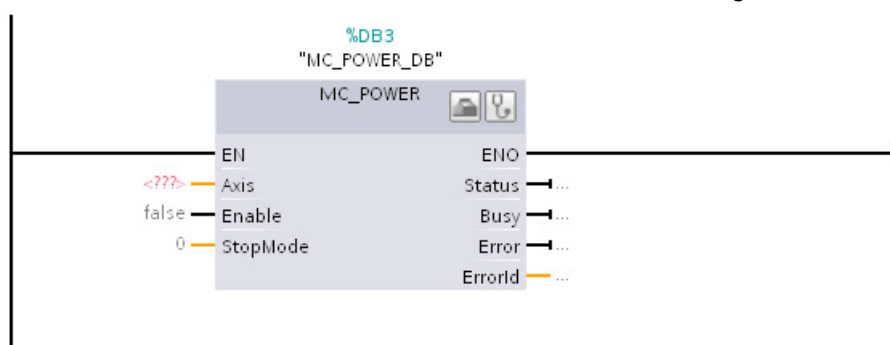
3. Drag and drop the Motion Control instruction, e.g. "MC_Power", into the desired segment of the program block.

The "Call options" dialog opens.

4. In the dialog, specify a name and a number for the instance data block of the Motion Control instruction.

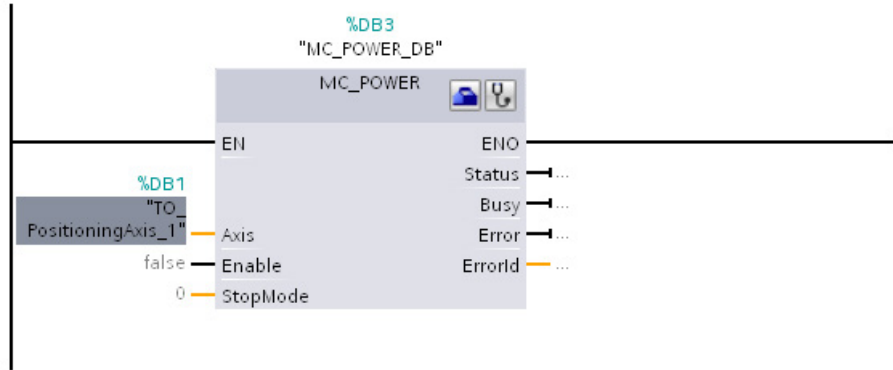
5. Click "OK".

The Motion Control instruction "MC_Power" is added to the segment.





The instance data block is automatically created under "Program Blocks > System Blocks > Program Resources".

- 6. Input parameters without a default value (e.g. "Axis"), must be supplied. Mark the technology object in the Project Navigator, and drag and drop it to <...> in the "Axis" parameter.



After specifying the technology object in the "Axis" parameter, the following buttons are available to you:

-  To open the configuration of the technology object, click on the toolbox icon.
-  To open the diagnostics of the technology object, click on the stethoscope icon.

- 7. Add additional Motion Control instructions in accordance with steps 3 through 6.

See also

Tracking active jobs (Page 184)

Tags of the positioning axis/synchronous axis technology object (Page 332)

7.4 Starting Motion Control jobs

Description

Motion Control jobs are started by setting the "Execute" or "Enable" parameter of the Motion Control instruction. The call of the Motion Control instructions for a technology object should occur in an execution level.

When executing Motion Control jobs, you should also take note of the status of the technology object.

Starting Motion Control jobs should be performed in the following steps:

1. Query the status of the technology object.
2. Initiate new job for the technology object.
3. Check job status.

These steps are explained using the example of a job for absolute positioning.

1. Query the status of the technology object

Make sure that the technology object is in the appropriate status to perform the desired job:

- **Has the technology object been released?**

To execute motion jobs, the technology object must be enabled.

Enabling is performed using the Motion Control instruction "MC_Power".

The "MC_Power.Status" parameter must show the value TRUE.

- **Is a technology alarm pending?**

To perform motion jobs, no technology alarms may be pending. After resolving the error, acknowledge any possibly pending alarms using the Motion Control instruction "MC_Reset".

A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).

- **Has the technology object been homed?**

In order to perform a job for absolute positioning, the positioning axis/synchronous axis technology object must be homed. The referencing occurs via the Motion Control instruction "MC_Home". The "<TO>.StatusWord.X5 (HomingDone)" tag of the technology object must show the value TRUE .

2. Initiate new job for the technology object

Initiate a new job.

In the "Position" parameter of the "MC_MoveAbsolute" instruction, specify the position to which the axis should be moved. Start the job with a positive edge at the "Execute" parameter.

3. Check job status

Parameter "Done" of the Motion Control instruction indicates successful completion of a job (target reached, in this case).

If an error is detected, the "Error" parameter of the Motion Control instruction is set to TRUE, and the job is rejected.

You can program an error handling routine for the Motion Control job. For this purpose, evaluate the error indicated in the "Error" parameter. The cause of the error is indicated in the ErrorID parameter. After resolving the cause of the error, restart the job.

Output of the "Error" = TRUE and "ErrorID" = 16#8001 status information during job processing indicates that a technology alarm was triggered.

A list of the ErrorIDs can be found in the appendix, Error Detection (Page 386).

Additional information

An option for the evaluation of the individual status bits, error bits, and warning bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

7.5 Tracking active jobs

7.5.1 Introduction

The current status of the job processing is made available via the output parameters of the Motion Control instruction. These parameters are updated with each call of the Motion Control instruction.

When tracking jobs, a distinction is made between three groups:

- Motion Control instructions with "Done" parameter (Page 185)
- Motion Control instructions without "Done" parameter (Page 189)
- Motion Control instruction "MC_MoveJog" (Page 193)

7.5.2 Motion Control instructions with "Done" parameter

Description

Jobs for Motion Control instructions with the "Done" parameter are started with a positive edge at the "Execute" parameter. If the job was completed without errors and without interruption by another job (e.g. "MC_MoveAbsolute": target position reached), then the "Done" parameter shows the value TRUE.

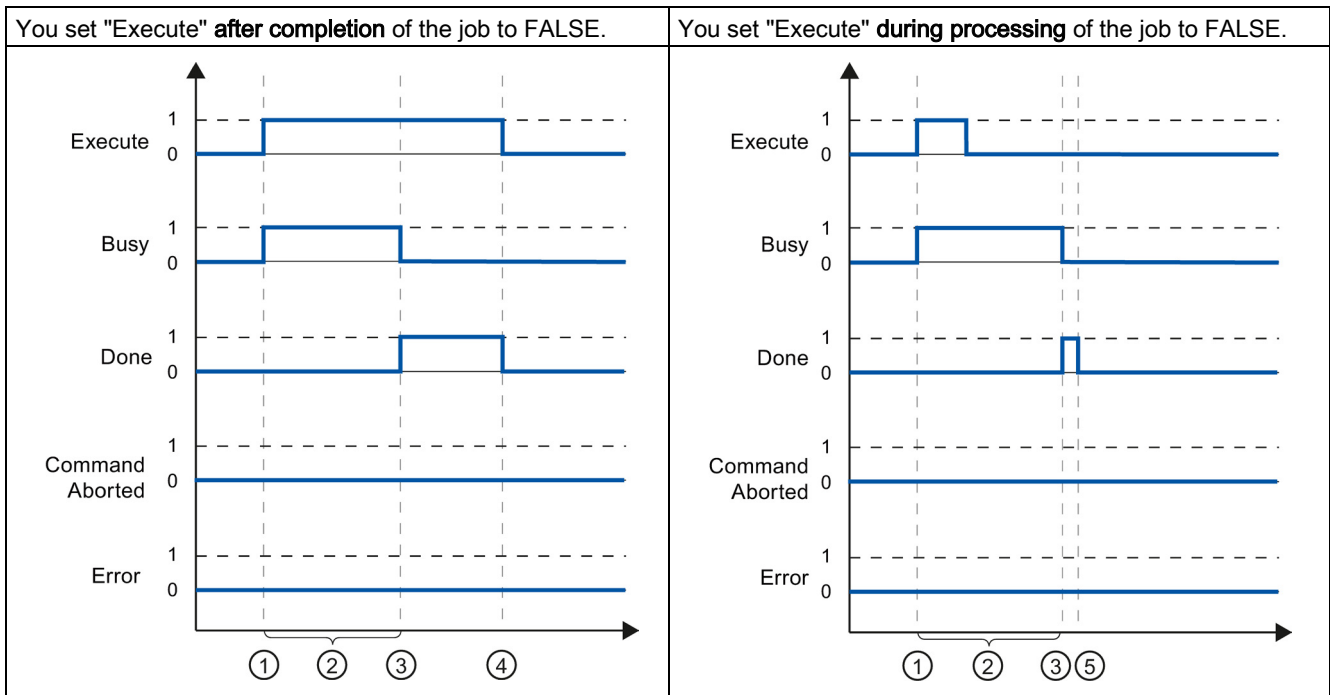
The following Motion Control instructions have a "Done" parameter:

- MC_Home
- MC_MoveRelative
- MC_MoveAbsolute
- MC_MoveSuperimposed
- MC_Halt
- MC_Reset

The behavior of the parameters is presented by way of example for various situations:

Complete execution of job

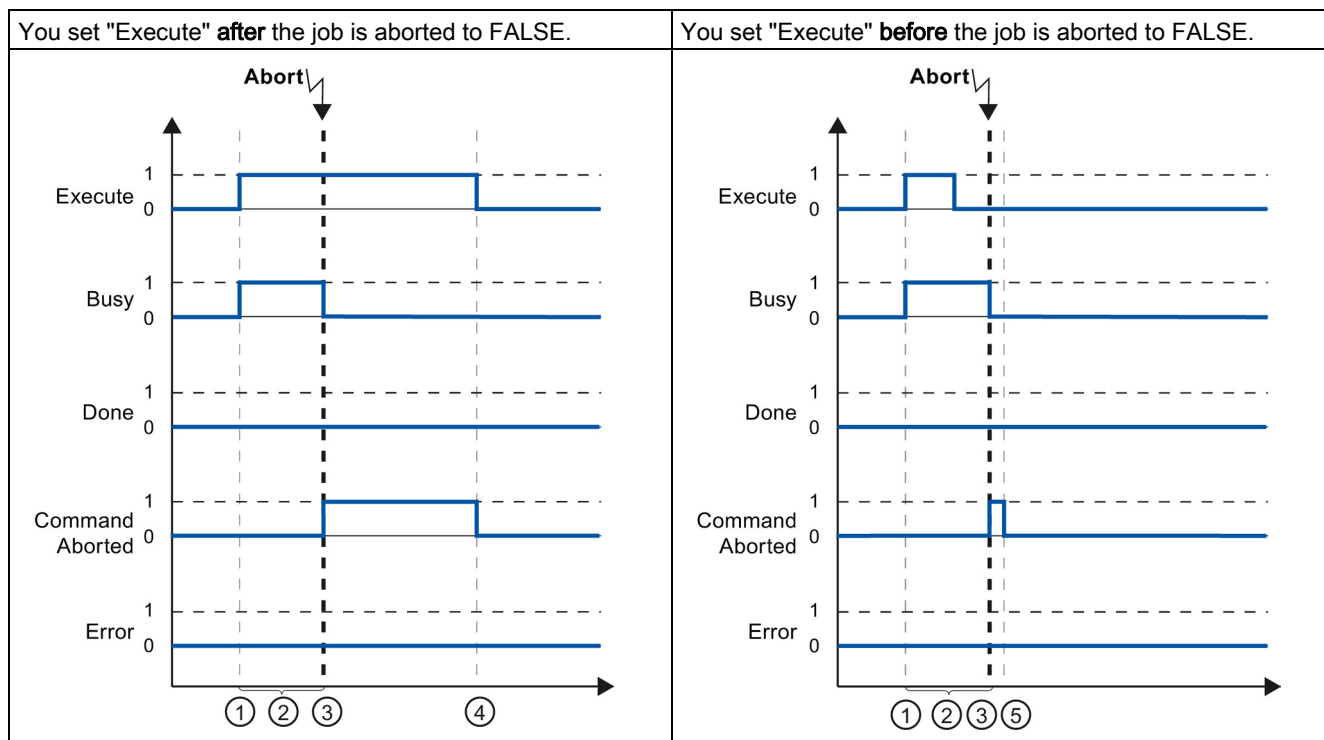
If the Motion Control job has been fully processed to the point of completion, then this is indicated in the "Done" parameter with the value TRUE. The signal status of the "Execute" parameter influences the indication duration in the "Done" parameter:



①	The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value while the job is still busy, or retain the TRUE value until the job has been completed.
②	While the job is active, the "Busy" parameter shows the value TRUE.
③	When the job is complete (for example, for Motion Control instruction "MC_MoveAbsolute": target position reached) the "Busy" parameter changes to FALSE, and the "Done" parameter to TRUE.
④	As long as the "Execute" parameter retains the value TRUE after completion of the job, the "Done" parameter also retains the value TRUE.
⑤	If the "Execute" parameter has been set to FALSE before the job is complete, then the "Done" parameter only shows the value TRUE for one execution cycle.

Job termination

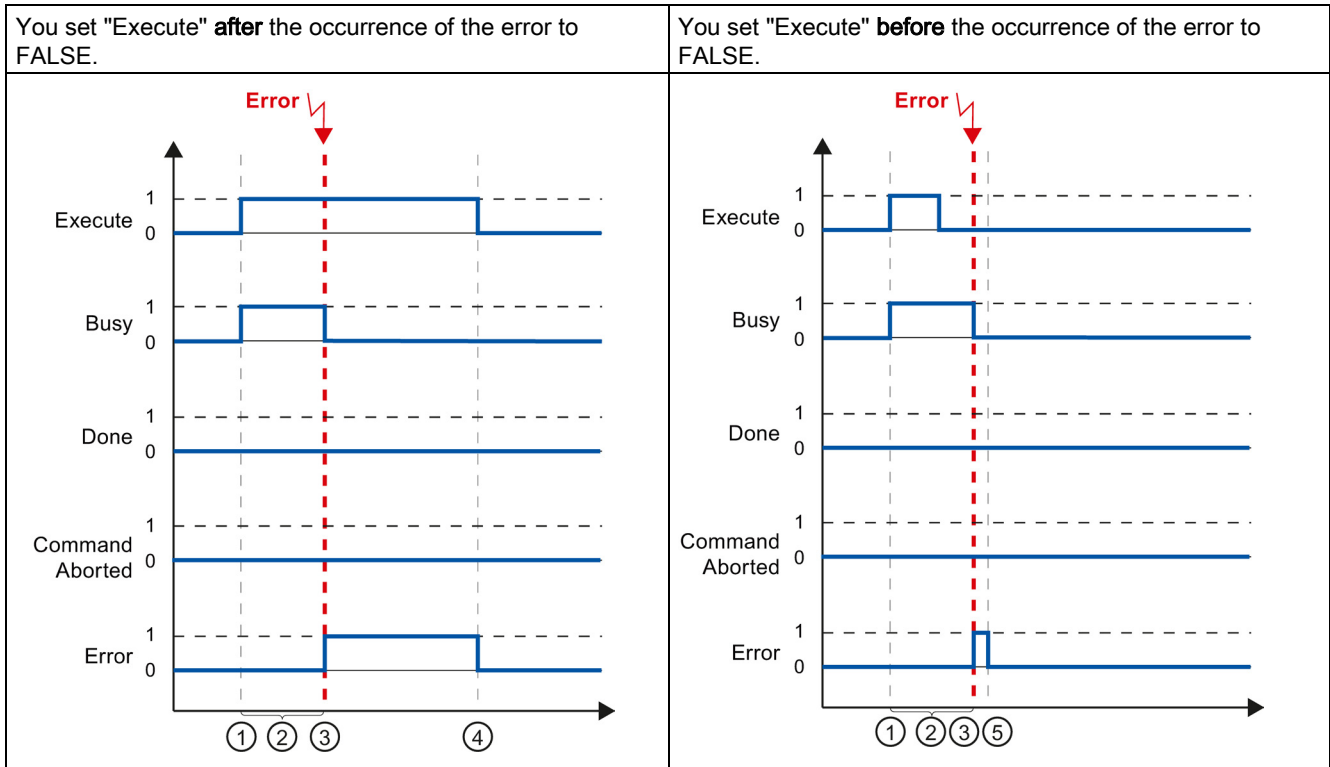
If the Motion Control job is aborted during processing by another job, then this is indicated in the "CommandAborted" parameter with the value TRUE. The signal status of the "Execute" parameter influences the indication duration in the "CommandAborted" parameter:



- | | |
|---|---|
| ① | The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value while the job is still busy, or retain the TRUE value until the job has been completed. |
| ② | While the job is active, the parameter "Busy" shows the value TRUE. |
| ③ | During job execution, the job is aborted by another Motion Control job. When the job is aborted, the "Busy" parameter changes to "FALSE" and "CommandAborted" changes to TRUE. |
| ④ | As long as the "Execute" parameter retains the value TRUE after completion of the job, the "CommandAborted" parameter also retains the value TRUE. |
| ⑤ | If the "Execute" parameter has been set to FALSE before the job is aborted, then the "CommandAborted" parameter only shows the value TRUE for one execution cycle. |

Error during job execution

If an error occurs during execution of the Motion Control job, then this is indicated in the "Error" parameter with the value TRUE. The signal status of the "Execute" parameter influences the indication duration in the "Error" parameter:



①	The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value while the job is still busy, or retain the TRUE value until the job has been completed.
②	While the job is active, the "Busy" parameter shows the value TRUE.
③	An error occurs during the execution of the job. When the error occurs, the "Busy" parameter changes to FALSE, and the "Error" parameter to TRUE.
④	As long as the "Execute" parameter retains the value TRUE after the occurrence of the error, the "Error" parameter also retains the value TRUE.
⑤	If the "Execute" parameter has been set to FALSE before the occurrence of the error, then the "Error" parameter only shows the value TRUE for one execution cycle.

7.5.3 Motion Control instructions without "Done" parameter

Description

Motion Control instructions without the "Done" parameter use a special parameter to achieve the job target (e.g. "InVelocity", "InGear"). The target state or the movement is paused until the job is canceled or an error occurs.

The following Motion Control instructions have a special parameter to display the job status:

- MC_Power (parameter "Status")
- MC_MoveVelocity (parameter "InVelocity")
- MC_GearIn (parameter "InGear")
- MC_MoveJog (parameter "InVelocity")

The special behavior of "MC_MoveJog" is described in the section Motion Control Instruction MC_MoveJog (Page 193).

The behavior of the parameter is shown for various situations using the Motion Control instruction "MC_MoveVelocity" as an example:

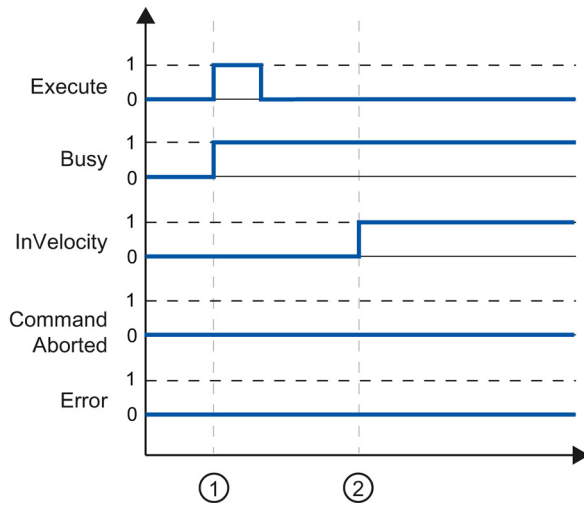
Example "MC_MoveVelocity"

An "MC_MoveVelocity" job is started with a positive edge at the "Execute" parameter. The job objective is fulfilled when the assigned velocity is reached and the axis travels at constant velocity. When the assigned velocity is reached and maintained, this is indicated in the "InVelocity" parameter with the value TRUE.

The motion of the axis can, for example, be stopped with an "MC_Halt" job.

The assigned velocity is reached and maintained

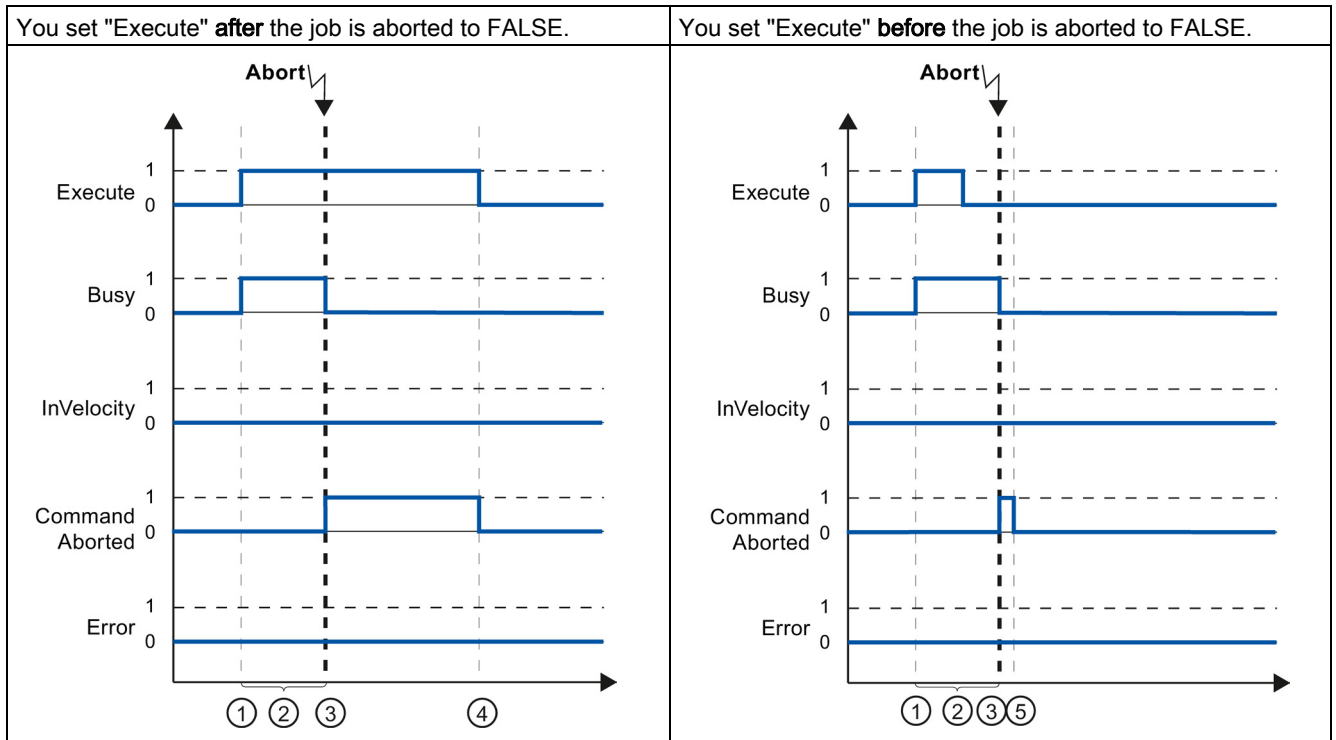
The achievement of the assigned velocity is indicated in the "InVelocity" parameter with the value TRUE. The "Execute" has no effect on the indication duration in the "InVelocity" parameter.



①	The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value before or after the parameterized velocity has been reached. While the job is active, the parameter "Busy" shows the value TRUE.
②	When the assigned velocity is reached, the "InVelocity" parameter changes to TRUE. The "Busy" and "InVelocity" parameters retain the TRUE value until a different Motion Control job overrides the "MC_MoveVelocity" job.

The job is aborted prior to reaching the assigned velocity

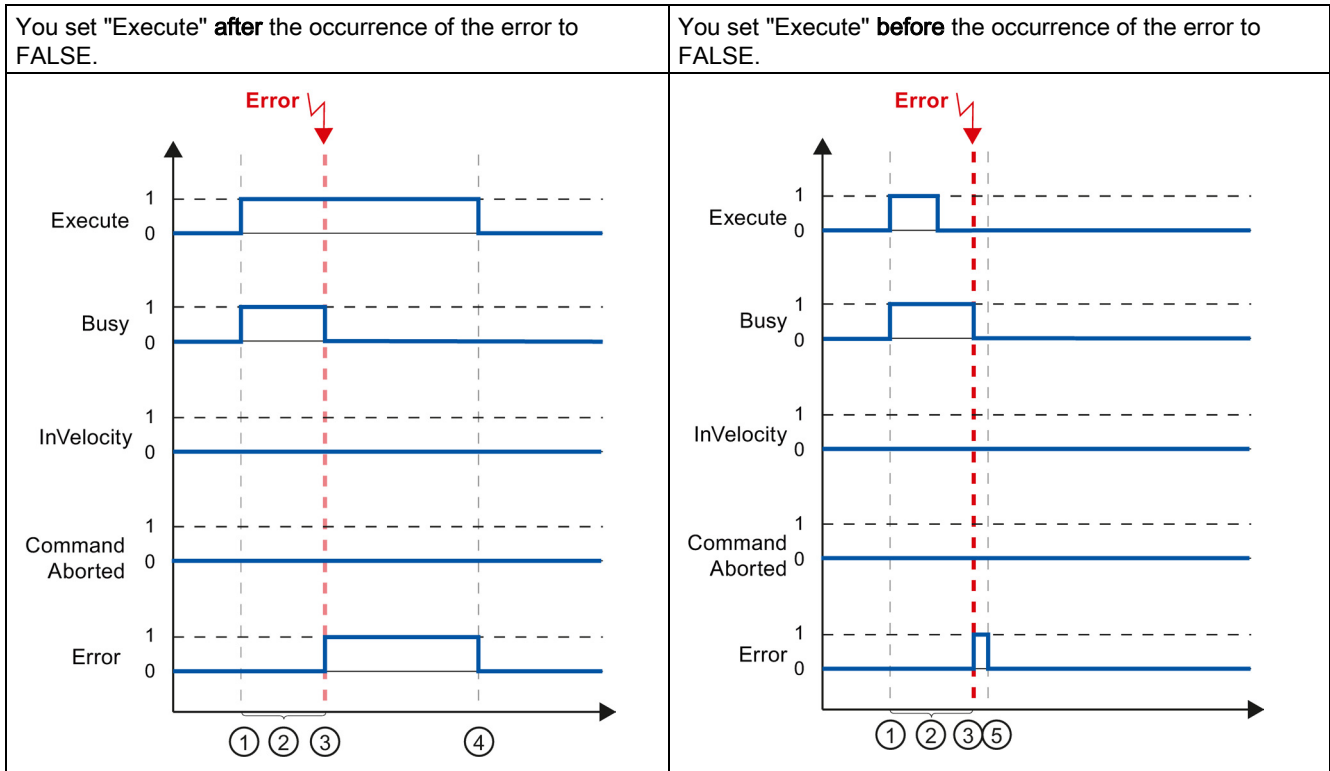
If the Motion Control job is aborted by another job before reaching the assigned velocity, then this is indicated in the "CommandAborted" parameter with the value TRUE. The signal status of the "Execute" parameter influences the indication duration in the "CommandAborted" parameter.



①	The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value while the job is still busy, or retain the TRUE value until the job is aborted.
②	While the job is active, the "Busy" parameter shows the value TRUE.
③	During job execution, the job is aborted by another Motion Control job. When the job is aborted, the "Busy" parameter changes to "FALSE" and "CommandAborted" changes to TRUE.
④	As long as the "Execute" parameter retains the value TRUE after completion of the job, the "CommandAborted" parameter also retains the value TRUE.
⑤	If the "Execute" parameter has been set to FALSE before the job is aborted, then the "CommandAborted" parameter only shows the value TRUE for one execution cycle.

An error has occurred prior to reaching the assigned velocity

If an error occurs during execution of the Motion Control job before the assigned velocity has been reached, this is indicated in the "Error" parameter with the value TRUE. The signal status of the "Execute" parameter influences the indication duration in the "Error" parameter.



- | | |
|---|---|
| ① | The job is started with a positive edge at the "Execute" parameter. Depending on the program, "Execute" can be reset to the FALSE value while the job is still busy, or retain the TRUE value until the error has occurred. |
| ② | While the job is active, the "Busy" parameter shows the value TRUE. |
| ③ | An error occurs during the execution of the job. When the error occurs, the "Busy" parameter changes to FALSE, and the "Error" parameter to TRUE. |
| ④ | As long as the "Execute" parameter retains the value TRUE after completion of the job, the "Error" parameter also retains the value TRUE. |
| ⑤ | If the "Execute" parameter has been set to FALSE before the job is aborted, then the "Error" parameter only shows the value TRUE for one execution cycle. |

7.5.4 Motion Control instruction "MC_MoveJog"

Description

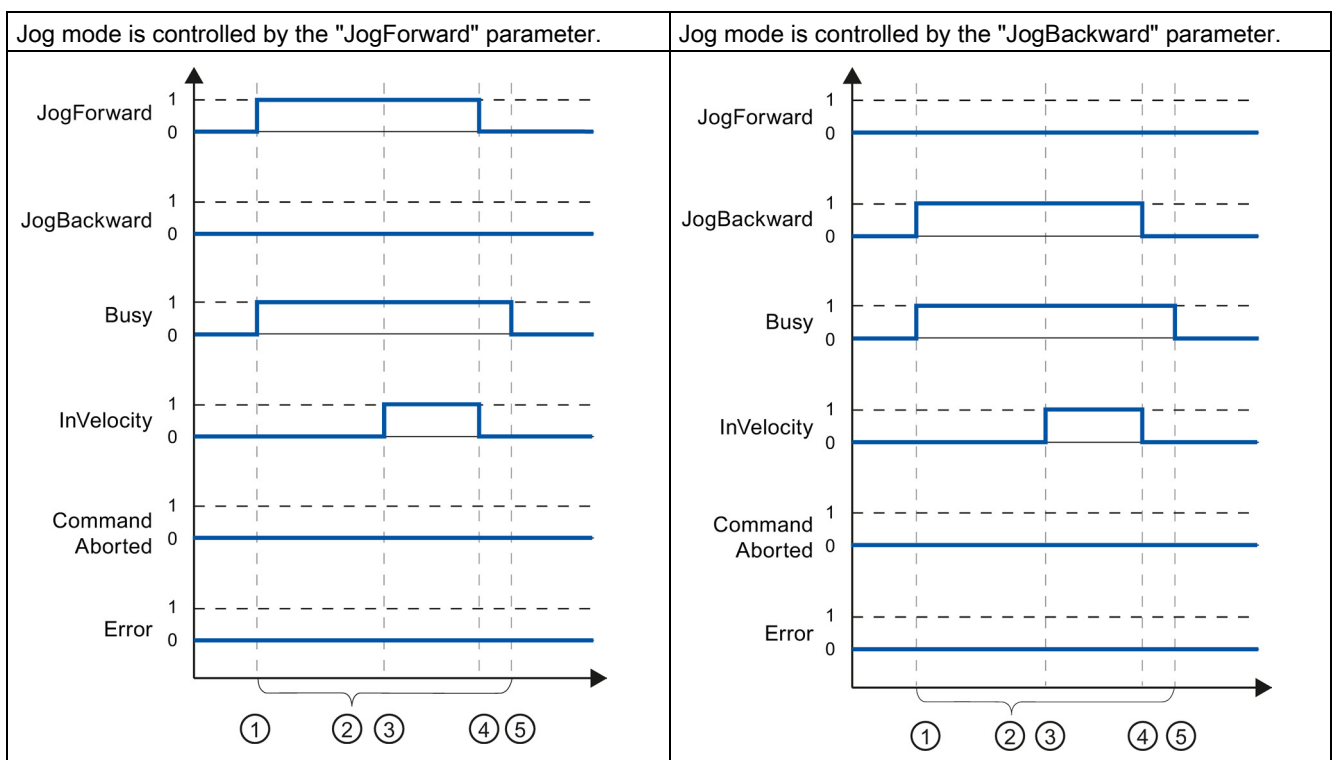
An "MC_MoveJog" job is started by setting the "JogForward" or "JogBackward" parameter. The job objective is fulfilled when the assigned velocity is reached and the axis travels at constant velocity. When the assigned velocity is reached and maintained, this is indicated in the "InVelocity" parameter with the value TRUE.

The job is complete when the "JogForward" or "JogBackward" parameter has been set to the value FALSE and the axis has come to a standstill.

The behavior of the parameters is presented below for various example situations:

The assigned velocity is reached and maintained

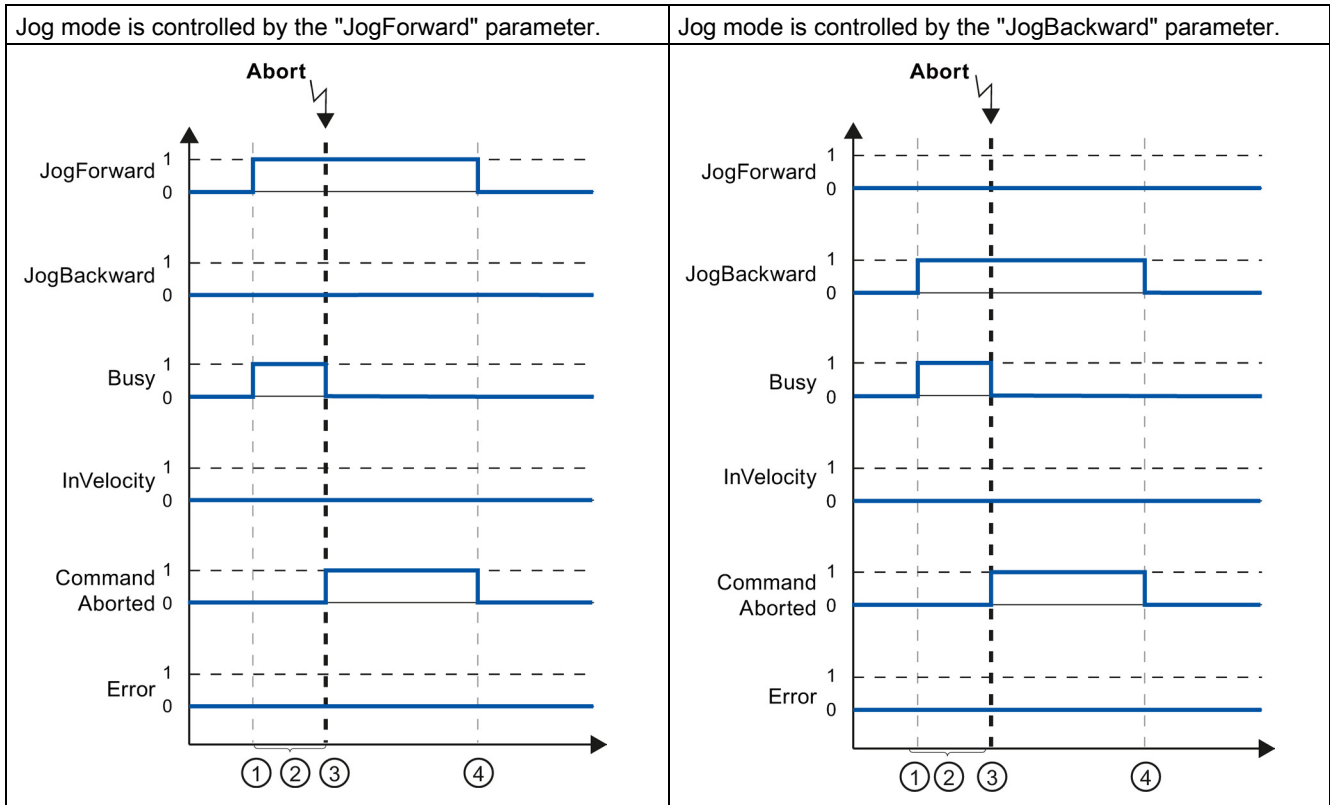
If the Motion Control job has been performed up to the point of reaching the assigned velocity, then this is indicated in the "InVelocity" parameter with the value TRUE.



①	The job is started by setting the "JogForward" or "JogBackward" parameter.
②	While the job is active, the "Busy" parameter shows the value TRUE.
③	When the assigned velocity is reached, the "InVelocity" parameter changes to TRUE.
④	When the "JogForward" or "JogBackward" parameter is reset, the motion of the axis ends. The axis decelerates. The "InVelocity" parameter changes to FALSE.
⑤	If the axis has come to a standstill, then the Motion Control job is complete and the "Busy" parameter changes to FALSE.

The job is aborted during execution

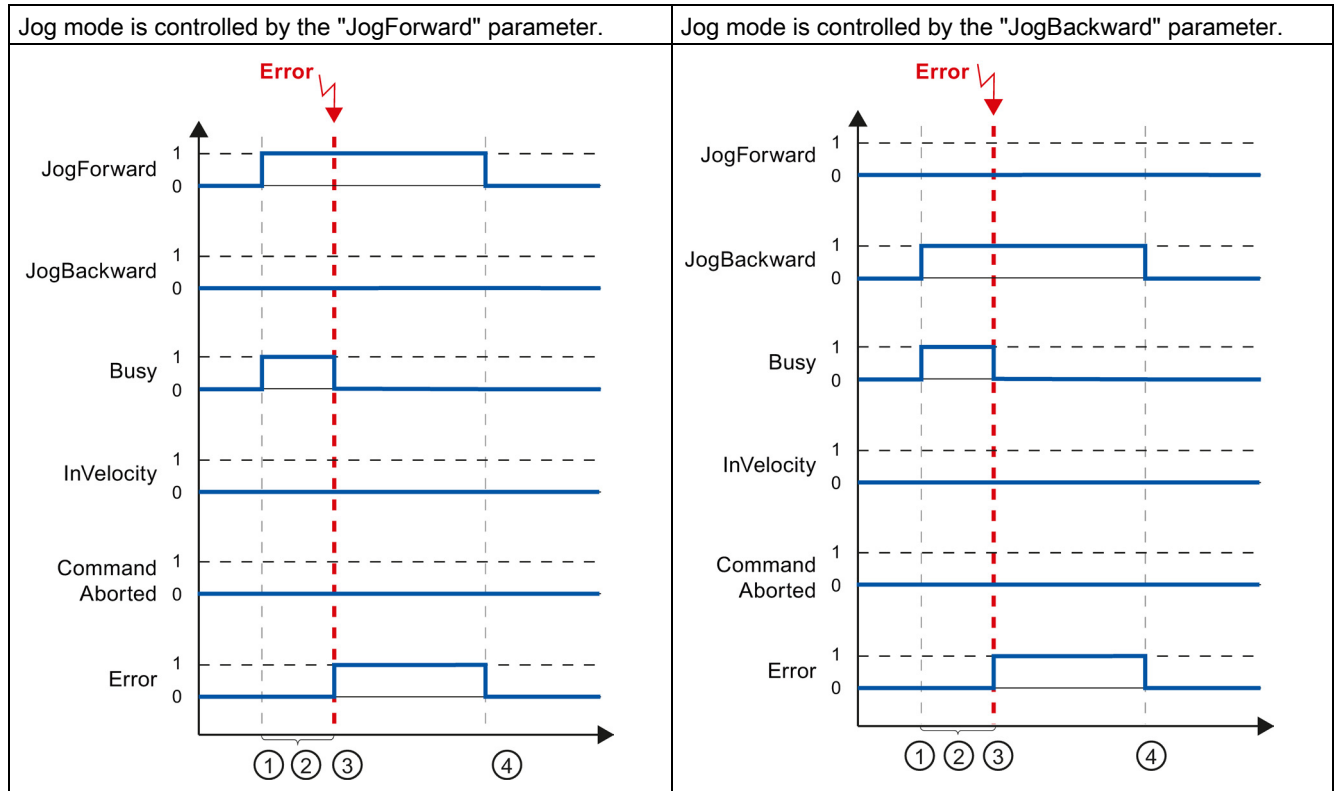
If the Motion Control job is aborted during processing by another job, then this is indicated in the "CommandAborted" parameter with the value TRUE. The behavior of the "CommandAborted" parameter is independent of reaching the assigned velocity.



①	The job is started by setting the "JogForward" or "JogBackward" parameter.
②	While the job is processing, the "Busy" parameter shows the value TRUE.
③	During job execution, the job is aborted by another Motion Control job. When the job is aborted, the "Busy" parameter changes to "FALSE" and "CommandAborted" changes to TRUE.
④	When the "JogForward" or "JogBackward" parameter is reset, the "CommandAborted" parameter likewise changes to FALSE.

An error occurs during the execution of the job

If an error occurs during execution of the Motion Control job, this is indicated in the "Error" parameter with the value TRUE. The behavior of the "Error" parameter is independent of reaching the assigned velocity.



①	The job is started by setting the "JogForward" or "JogBackward" parameter.
②	While the job is active, the "Busy" parameter shows the value TRUE.
③	An error occurs during the execution of the job. When the error occurs, the "Busy" parameter changes to "FALSE", and "Error" changes to TRUE.
④	When the "JogForward" or "JogBackward" is reset to the value FALSE, the "Error" parameter likewise changes to FALSE.

7.6 Ending Motion Control jobs

When ending a job, a distinction is made between error-free completion of the job, and the termination of a motion.

Completion of the job

The completion of a Motion Control job is indicated as described in the Tracking running jobs (Page 184) section.

Termination of a motion

If a motion must be aborted, you can perform the following measures:

- "Execute MC_Halt (Page 275)"

To abort a motion and stop the axis, you can use the "MC_Halt" instruction.

- "Disable MC_Power (Page 234)"

In an emergency, you can stop the axis using an emergency stop ramp. For this purpose, set the "Enable" parameter of the "MC_Power" instruction to FALSE. The axis is decelerated according to the selected "StopMode" and all jobs at the technology object are aborted.

7.7 Restart of technology objects

Description

After the CPU is switched on, or after technology objects are downloaded into the CPU, the system automatically initializes the technology objects with the start values from the technology data blocks. If restart-relevant changes are detected during a reload into the CPU, a restart of the technology object is automatically performed.

If restart-relevant data have been changed in RUN mode by the user program, then the technology object must be reinitialized by the user in order for the changes to be used.

If changes in the technology data block should also be retained after the restart of the technology object, then you must write the changes to the start value in load memory using the extended instruction "WRIT_DBL".

Restart necessary

A necessary TO restart is indicated at "Technology object > Diagnostics > Status and error bits > Axis status or Encoder status > Online start value changed", as well as in the tag of technology object <TO>.StatusWord.X3 (OnlineStartValuesChanged).

Restarting a technology object

A restart of the technology object is triggered by the user by means of the "MC_Reset" Motion Control instruction, with parameter "Restart" = TRUE.

During a restart, all configuration data of the technology object are loaded from load memory into work memory. In the process, the actual values in the technology data block are overwritten.

Note the following during a restart of the technology object:

- A restart resets the "Referenced" status of a technology object with incremental actual values (<TO>.StatusWord.X5 (HomingDone).
- While a restart is being performed, the technology object cannot perform any jobs. An active restart will be indicated under "Technology object > Diagnostics > Status and error bits > Axis status or Encoder status > Restart active", and in the <TO>.StatusWord.X2 (RestartActive) tag of the technology object.
- Motion Control jobs are rejected during a restart with the "Error" = TRUE and "ErrorID" = 16#800D parameters (job not executable, because a restart is active).
- While a restart is being executed, you cannot access the technology data block.

See also

Change restart-relevant data (Page 177)

Downloading to CPU

Description

When downloading to the CPU S7-1500, it is always verified that the project files are consistent online and offline after the download.

The data of the technology objects are saved in technology data blocks. The conditions for downloading blocks thus apply when loading new or modified technology objects.

Load in RUN mode

When loading in the CPU's RUN mode, it is checked whether a load without restart of the technology objects is possible.

If restart-relevant configuration values were changed, then a restart of the technology object is automatically performed after the load into the CPU.

Loading a technology object is only possible if the technology object is disabled.

You **cannot** download the following changes to the CPU in RUN mode:

- Changes to the MC-Servo clock speeds
- Changes to the hardware interface of the technology object in "Technology object > Configuration > Hardware interface"

Commissioning

9.1 Introduction

The following guidelines describe the steps that you should note when commissioning the Motion Control-specific components of your equipment.

The commissioning of other components of your automation system depends on the particular equipment configuration. Commissioning (not Motion Control) is described in the Automation System S7-1500 (<http://support.automation.siemens.com/WW/view/en/59191792>) system manual.

9.2 Commissioning guidelines

These guidelines serve as recommendations for commissioning equipment with Motion Control. The procedure is described using the example of a positioning axis technology object.

Requirement

- The configuration of the following components is complete:
 - CPU
 - BUS communication
 - Drives
 - Technology objects
- The user program has been created.
- The wiring of the CPU and of the associated I/O is complete.
- The commissioning and optimization of the drive is complete.

Procedure

Proceed as follows to commission the Motion Control-specific components of your equipment:

Step	Action to be performed	Supported by TIA Portal
Turn on CPU	Turn on the power supply and the CPU.	-
"Disable" position controller	Set the gain (Kv factor) of the position control loop to zero. (This setting avoids unwanted drive movements that may be caused by incorrect parameterization of the position control loop.)	"Technology object > Configuration > Extended parameters > Control loop"
Load project into the CPU	Bring the CPU to the STOP mode. Download your project to the CPU (load hardware and software).	<ul style="list-style-type: none"> "Toolbar > Stop CPU" "Toolbar > Download to device"
Create online connection to the CPU	Select the "Receive messages" check box under "Online & Diagnostics > Online Access". Configure the interface of the TIA Portal, and create an online connection with the CPU.	<ul style="list-style-type: none"> Device configuration "Online & Diagnostics > Online Access"
Disable Motion Control specific user program	In order to avoid conflicts with the axis control panel, lock the enabling of technology objects in your user program (MC_Power.Enable = FALSE).	<ul style="list-style-type: none"> PLC programming Motion Control instructions
Evaluating pending messages	Evaluate the message display in the inspector window. Resolve the causes of pending technology alarms. Acknowledge the technology alarms (Page 215).	"Inspector window > Diagnostics > Message display"
Check hardware limit switches	Click the hardware limit switches. Check for correct message display (technology alarm 531). Acknowledge the technology alarm.	"Inspector window > Diagnostics > Message display"
Check the connection and configuration of the drive (setpoint)	Bring the CPU into the RUN mode. Open the Axis control panel (Page 202) and take over control. Perform the following steps: <ul style="list-style-type: none"> Enable the technology object. ⇒ The drive must turn itself on, and where applicable release the brake. The position is held. Move the axis in jog mode at low velocity in the positive direction. ⇒ The drive must move. The actual position value must increase (positive direction). Disable the technology object. ⇒ The drive must turn itself off, and where applicable apply the brake. 	"Technology object > Commissioning > Axis control panel"
Check the connection and configuration of the encoder (actual value)	Check the scaling of the actual values (rotation direction, distance evaluation, and resolution of the encoder) ⇒ The change in the actual mechanical position must match the change in the actual values.	<ul style="list-style-type: none"> "Technology object > Diagnostics > PROFIdrive frame" "Technology object > Commissioning > Axis control panel"

Step	Action to be performed	Supported by TIA Portal
Checking the reference speed	<p>Traverse the axis in jog mode at low velocity in the positive direction.</p> <p>⇒ The displayed current velocity must match the velocity setpoint.</p> <p>If the displayed current velocity deviates significantly from the velocity setpoint, adjust the reference speed.</p>	<ul style="list-style-type: none"> • "Technology object > Hardware interface > Data exchange" • "Technology object > Commissioning > Axis control panel"
Optimize position controller	<p>Use the Optimization (Page 207) commissioning function to optimize the gain (Kv) of the position control loop.</p> <p>For this purpose, adapt following error limits as needed.</p>	"Technology object > Commissioning > Optimization"
Transfer the gain Kv to the project.	Enter the gain Kv that you determined by means of the optimization function in your configuration data. Load your project into the CPU.	"Technology object > Configuration > Extended parameters > Control loop"
Enable Motion Control specific user program	Unlock the enabling technology objects lock in your user program (MC_Power.Enable = TRUE).	<ul style="list-style-type: none"> • PLC programming • Motion Control instructions
Check the functioning of the user program	Check the programmed functions of your user program.	<ul style="list-style-type: none"> • Watch and force tables • Online and diagnostic functions
End of commissioning for a positioning axis technology object	To commission additional technology objects, perform the corresponding steps again.	See above.


9.3 Axis control panel

9.3.1 Function and structure of the axis control panel

Description

You traverse individual axes with the axis control panel.

A user program is necessary for the operation of the axis control panel. With the axis control panel, you take over master control for a technology object and control the movements of the axis.

 WARNING
Uncontrolled axis motions
During operation with the axis control panel, the axis can execute uncontrolled motions (e.g. due to erroneous configuration of the drive, or of the technology object). Furthermore, any synchronized following axis is moved as well when moving a leading axis with the axis control panel.
Therefore, perform the following protective measures before operation with the axis control panel:
<ul style="list-style-type: none">• Ensure that the EMERGENCY OFF switch is within the reach of the operator.• Enable the hardware limit switches.• Enable the software limit switches.• Ensure that following error monitoring is enabled.• Make sure that no following axis is coupled to the axis to be moved.

The axis control panel of the speed axis, positioning axis and synchronous axis can be found in the Project Navigator under "Technology object > Commissioning".

The axis control panel is divided into the following areas:

- Master control
- Axis
- Operating mode
- Modify
- Axis status
- Current values

The following table lists the elements of the axis control panel:

Area	Element	Description
Master control		In the "Master control" area, you take over master control of the technology object, or return it to your user program.
	"Activate" button	<p>With the "Activate" button, you set up an online connection to the CPU and take over master control for the selected technology object.</p> <ul style="list-style-type: none"> To take over master control, the technology object must be disabled in the user program. Any synchronized following axis is moved as well when moving a leading axis with the axis control panel. If the online connection to the CPU is lost during operation with the axis control panel, then after the sign of life monitoring has elapsed, the axis will be stopped with maximum deceleration. In this case, an error message is displayed ("ErrorID" = 16#8013) and the master control is passed back to the user program. When you click the "Fetch" button, a warning message is displayed. In the warning, you can adapt the sign-of-life monitoring (100 to 60000 ms). <p>If the master control of the axis control panel is lost repeatedly without a direct error message, the online connection to the CPU may be impaired because the communication load is too high. In this case, the alarm "Error during commissioning. Sign-of-life failure between controller and TIA Portal" is displayed.</p> <p>To eliminate this error, adapt the sign-of-life monitoring in the warning.</p> <ul style="list-style-type: none"> Until master control is returned, the user program has no influence on the functions of the technology object. Motion Control jobs from the user program to the technology object are rejected with the error ("ErrorID" = 16#8012: axis control panel enabled). When master control is taken over, the configuration of the technology object is adopted. Changes to the configuration of the technology object do not become effective until master control has been returned. For this reason, make any necessary changes before master control is taken over. If master control has been taken over for the technology object, the axis control panel is blocked for access by another installation of the TIA Portal (Team Engineering as of CPU V1.5).
	"Deactivate" button	With the "Deactivate" button, you return master control to your user program.
Axis		In the "Axis" area, enable or disable the technology object.
	"Enable" button	With the "Enable" button, you enable the selected technology object
	"Disable" button	With the "Disable" button, you disable the selected technology object
Operating mode		Select the required mode in the "Operating mode" drop-down list.

9.3 Axis control panel

Area	Element	Description
Modify		The "Control" area displays the parameters for traversing with the axis control panel according to the selected operating mode.
	Position	Position to which the axis is homed. (Homing and set home position modes only)
	Distance	Distance the axis is traversed. (Relative positioning mode only)
	Target position	Position to which the axis is traversed. (Absolute positioning mode only)
	Velocity/ Velocity setpoint	Velocity or speed at which the axis is traversed. Default: 10% of the default value (Velocity specification/Default speed, Jog and Positioning modes only)
	Acceleration	Acceleration with which the axis is traversed. Default: 10% of the default value
	Deceleration	Deceleration with which the axis is traversed. Default: 10% of the default value
	Jerk	Jerk with which the axis is traversed. Default: 100% of default value
	"Start" button	With the "Start" button, you start a job according to the selected operating mode.
	"Forward" button	With the "Forward" button, you start a motion in the positive direction according to the selected operating mode.
	"Backward" button	With the "Backward" button, you start a motion in the negative direction according to the selected operating mode.
	"Stop" button	With the "Stop" button, you cancel a job or stop the axis.
Axis status		The "Axis status" area displays the status of the axis and the status of the drive.
	Drive ready	The drive is ready to execute setpoints.
	Error	An error has occurred at the technology object.
	Enabled	The technology object is enabled. The axis can be controlled with Motion Control instructions.
	Homed	The technology object is homed.
	More	With the "More" link, you display the "Technology object > Diagnostics > Status and error bits" dialog.
	Active errors	The error that occurred most recently is displayed in the "Active errors" text box.
	"Confirm" button	With the "Confirm" button, you acknowledge pending errors.
Current values		The "Current values" area shows the actual values of the axis.
	Position	Actual position of the axis
	Velocity	Actual velocity of the axis

Note

No transfer of the parameters

The configured parameter values are discarded when master control is returned. Transfer the values as needed into your configuration.

If you change configuration values with the axis control panel during operation, they have no effect on the operation of the axis control panel.

Operating mode

The following table shows the operating modes of the axis control panel:

Operating mode	Description
Homing	This function corresponds to active homing. The parameters for homing (Page 39) must be configured. Homing is not possible with an absolute encoder. The technology object is not referenced when this mode is used with an absolute encoder.
Set home position	This function corresponds to direct homing (absolute). With the "Start" button, you set the actual position to the value specified in "Position" and the "Homed" status is set.
Jog	Motion commands occur by means of jogging. With the "Forward" or "Backward" button you start motion in the positive or negative direction. The motion runs for as long as you hold down the left mouse button.
Velocity specification/speed setpoint	The axis is moved at the specified velocity or speed until you stop the movement. The motion commands are performed according to the setpoints assigned under "Controller".
Positioning relative	The positioning is executed as a controlled, relative traversing motion according to the defaults assigned under "Controller".
Positioning absolute	The positioning is executed as a controlled, absolute traversing motion according to the defaults assigned under "Controller". If you have enabled the "Modulo" setting of the technology object, the buttons "Forward" and "Backward" are shown in the "Controller" area. The axis is positioned within the modulo range. Position settings outside the modular range are recalculated to the modulo range. If you have not enabled the "Modulo" setting of the technology object, only the "Start" button is shown in the "Controller" area. You can directly approach the entered position.

9.3.2 Using the axis control panel

Requirement

- The CPU must be in RUN mode.
- The project has been created and downloaded to the CPU.
- The technology object is disabled by your user program (MC_Power.Enable = FALSE).
- The axis control panel for the technology object is not used by another installation of the TIA Portal (Team Engineering as of CPU V1.5).

Procedure

Proceed as follows to enable control the axis using the axis control panel:

1. Click "Activate" in the "Master control" area to assume master control over the technology object and to set up an online connection to the CPU.
A warning message is displayed.
2. If necessary, adapt the sign-of-life monitoring and confirm with "OK".
3. In the "Axis" area, click the "Enable" button to enable the technology object.
4. In the drop-down list in the "Operation mode" area, select the desired function of the axis control panel.
5. In the "Control" area, specify the parameter values for your job.
6. Click the "Start", "Forward" or "Backward" button to start the job.
7. Click the "Stop" button to stop the job.
8. Repeat steps 3 through 6 for additional jobs.
9. In the "Axis" area, click the "Disable" button to disable the technology object.
10. In the "Master control" area, click the "Deactivate" button to return master control to your user program.

9.4 Optimization

9.4.1 Function and structure of the optimization

Description

The "Optimization" function supports you in determining the optimal gain (Kv factor) for the position control of the axis. The axis velocity profile is recorded by means of Trace function to this effect for the duration of a configurable positioning movement. Then you can evaluate the recording, and adapt the gain accordingly.


The "Optimization" function for the positioning axis and synchronous axis technology objects can be found in the Project Navigator under "Technology object > Commissioning".

The "Optimization" dialog is divided into the following areas:

- Master control
- Axis
- Optimize gain setting
- Trace

The following table lists the elements of optimization:

Area	Element	Description
Master control		In the "Master control" area, you take over master control of the technology object, or return it to your user program.
	"Activate" button	<p>With the "Activate" button, you set up an online connection to the CPU and take over master control for the selected technology object.</p> <ul style="list-style-type: none"> To take over master control, the technology object must be disabled in the user program. Any synchronized following axis is moved as well when moving a leading axis with the axis control panel. If the online connection to the CPU is lost during operation with the axis control panel, then after the sign of life monitoring has elapsed, the axis will be stopped with maximum deceleration. In this case, an error message is displayed ("ErrorID" = 16#8013) and the master control is passed back to the user program. When you click the "Fetch" button, a warning message is displayed. You can adapt the sign-of-life monitoring here (100 to 60000 ms). <p>If the master control of the axis control panel is lost repeatedly without a direct error message, the online connection to the CPU may be impaired because the communication load is too high. In this case, the alarm "Error during commissioning. Sign-of-life failure between controller and TIA Portal" is displayed.</p> <p>To eliminate this error, adapt the sign-of-life monitoring in the warning.</p> <ul style="list-style-type: none"> Until master control is returned, the user program has no influence on the functions of the technology object. Motion Control jobs from the user program to the technology object are rejected with the error ("ErrorID" = 16#8012: axis control panel enabled). When master control is taken over, the configuration of the technology object is adopted. Changes to the configuration of the technology object do not become effective until master control has been returned. For this reason, make any necessary changes before master control is taken over. If master control has been taken over for the technology object, the axis control panel is blocked for access by another installation of the TIA Portal (Team Engineering as of CPU V1.5).
	"Deactivate" button	With the "Deactivate" button, you return master control to your user program.
Axis		In the "Axis" area, enable or disable the technology object.
	"Enable" button	With the "Enable" button, you enable the selected technology object
	"Disable" button	With the "Disable" button, you disable the selected technology object

Area	Element	Description
Optimize gain setting		In the "Optimize gain setting" area, you make the settings for optimization of the gain.
	Gain	<p>Current velocity gain (Kv)</p> <p>With the  symbol beside the box, you open a list of values. The list of values contains the following gain values:</p> <ul style="list-style-type: none"> • Online actual value • Online start value • Start value project <p>In the input field for the actual value, enter the new value for the gain. The new value is applied by clicking the "Forward" or "Backward" button.</p>
	Distance	Travel distance for a test step
	Measurement duration	Time for a test step
	"Adapt dynamic values" check-box	With the "Adapt dynamic values" check box, you enable adaptation of the acceleration and the maximum velocity.
	Acceleration	Presetting of the acceleration for a test step
	Maximum velocity	Presetting of the maximum velocity for a test step
	"Forward" button	With the "Forward" button, you start a test step for optimization in the positive direction.
	"Backward" button	With the "Backward" button, you start a test step for optimization in the negative direction.
Trace		<p>The Trace function is displayed In the lower area of the "Optimization" dialog.</p> <p>With each test step a trace recording of the required parameters is automatically started and displayed after completion of the test step.</p> <p>After returning master control, the trace recording is deleted.</p> <p>You will find a full description of the trace function in the section on using the trace and logic analyzer function.</p>

Note

No transfer of the parameters

The configured parameter values are discarded after master control is returned.

Transfer the values as needed into your configuration. You can apply the gain value in your configuration using the "Project start value" value.

See also

Control (Page 59)

9.4.2 Optimize position controller

Requirement

- The CPU must be in RUN mode.
- The project has been created and downloaded to the CPU.
- The technology object is disabled by your user program (MC_Power.Enable = FALSE).
- The axis control panel for the technology object is not used by another installation of the TIA Portal (Team Engineering as of CPU V1.5).

Optimizing position control gain (Kv)

Proceed as follows to optimize the gain (Kv):

1. In the "Master control" area, click the "Activate" button to activate master control for the technology object, and to establish an online connection to the CPU.
A warning message is displayed.
2. If necessary, adapt the sign-of-life monitoring and confirm with "OK".
3. In the "Axis" area, click the "Enable" button to enable the technology object.
4. As appropriate, configure values for the distance, duration, and dynamics of a test step.
5. Enter a start value for the gain. Start with a low value.
6. Click the "Forward" or "Start" button to start a test step for the optimization.
For the specified duration, a setpoint is output according to the specified distance. The axis moves by the specified distance. A trace recording of the motion (setpoint and actual values) is created automatically.

You will find a full description of the trace function in the section on using the trace and logic analyzer function.

Note

Adapt following error limits

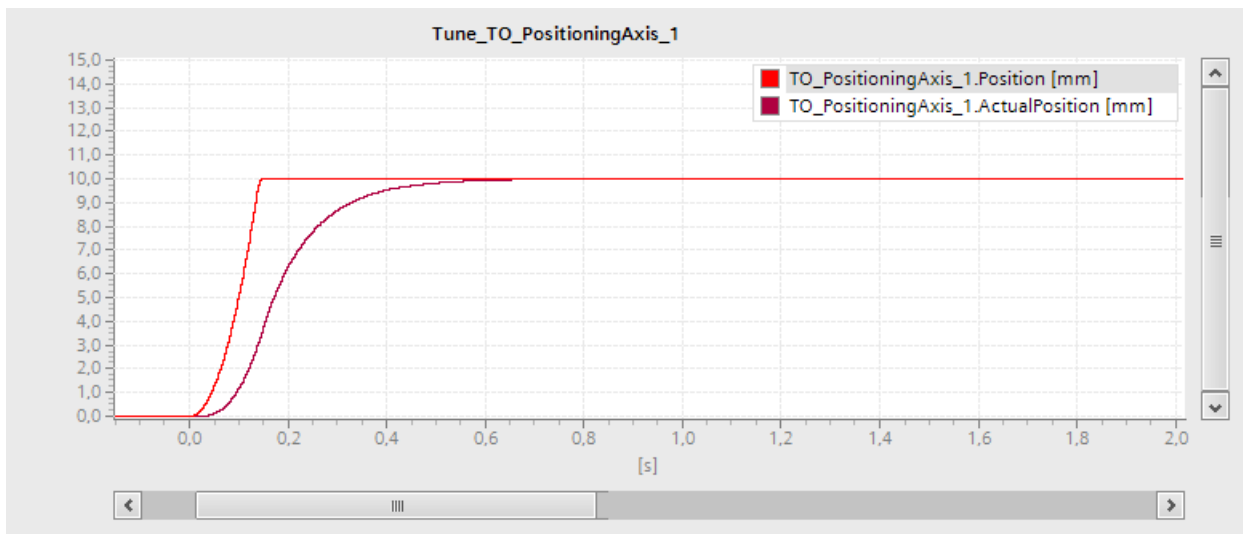
If error messages from following error monitoring are repeatedly displayed during optimization, temporarily adapt the following error limits.

7. Evaluate the curve of the trace recording. Adapt the gain incrementally. Click the "Forward" or "Backward" button after each value you enter. This applies the value and start a new movement and trace recording each time.

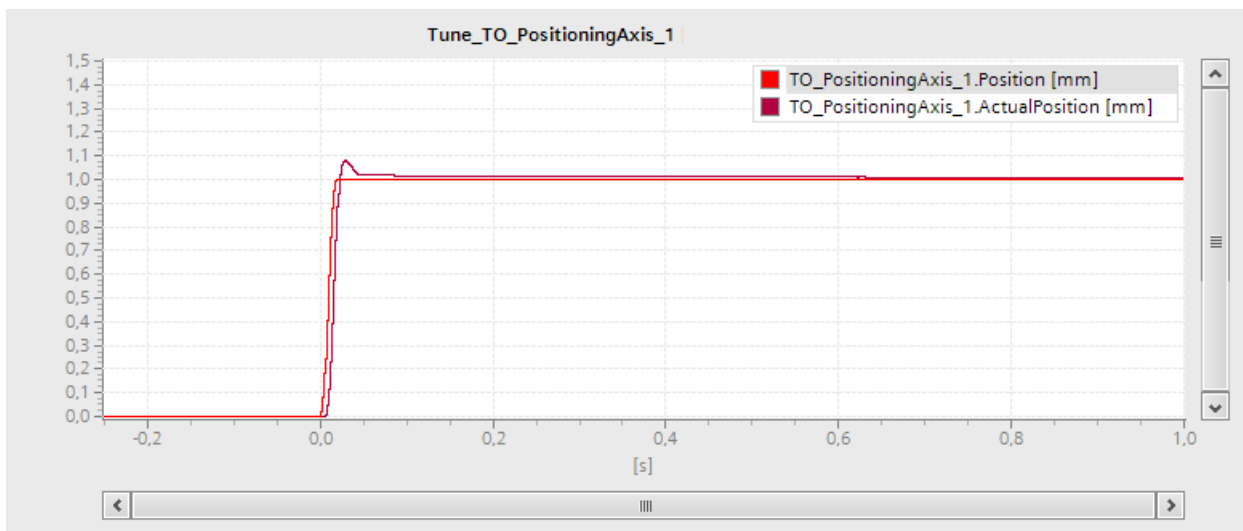
When adjusting the gain, pay attention to the following properties of the curve:

- The curve shows a brief compensation time.
- The curve does not show any motion reversal of the actual position.
- When approaching the position setpoint, no overshoot occurs.
- The curve shows a stable overall behavior (oscillation-free curve).

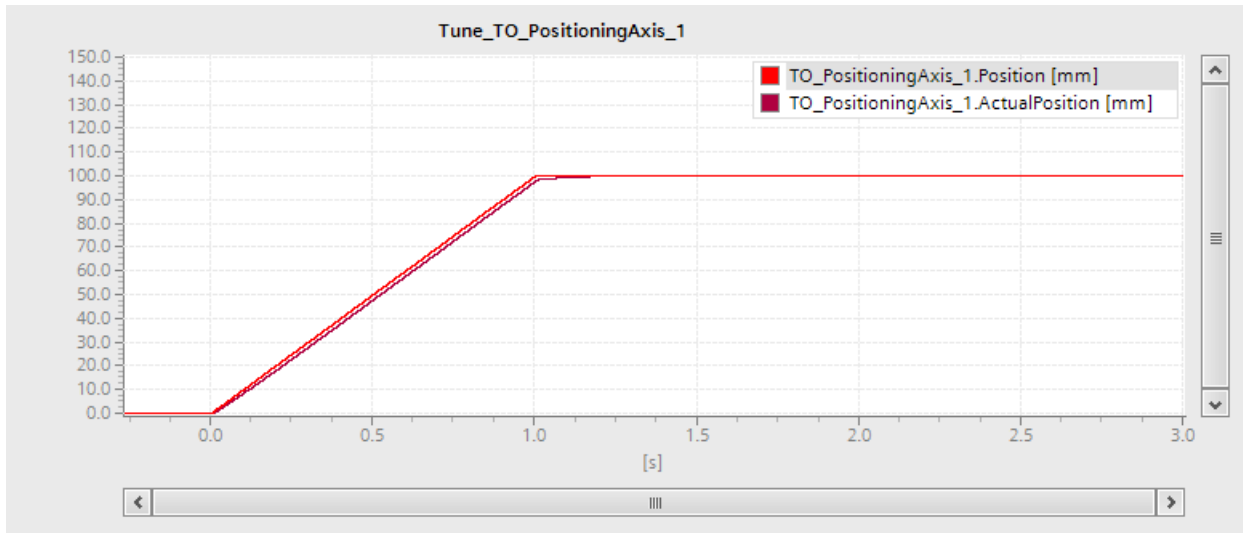
The following trace recording shows a curve with a long settling time:



The following trace recording shows a curve with overshoot when approaching the setpoint:



The following trace recording shows a curve in which the gain is optimal and the overall response is steady:



Transferring the position control gain (Kv) to the project

Proceed as follows to transfer the determined gain (Kv) into your project:

1. Click on the ⚡ icon next to the "Gain" box.
A list of values is displayed.
2. Enter the measured gain value in the "Project start value" box of the value list.
3. In the "Axis" area, click the "Disable" button to disable the technology object.
4. In the "Master control" area, click the "Deactivate" button to return master control to your user program.
5. Load your project into the CPU.

9.5 Simulation mode

S7-1500 Motion Control offers the option to traverse axes without real hardware in simulation mode. This allows speed, positioning and synchronous axes to be simulated in the CPU without a drive.

Simulation mode is only possible for the drive connection via PROFIdrive.

To traverse axes in simulation mode, follow these steps:

1. Configure the hardware, the technology objects and your user program.
2. For the each axis to be simulated, set the technology object tag <TO>.Simulation.Mode to the value 1.
3. If the hardware configured under point 1 is not connected to the CPU, change the "Configuration time for central and distributed I/O" parameter to a low value (e.g. 2000 ms). You can find the parameter in the CPU properties in the "Startup" area navigation.
4. Save the project and compile the hardware and software.
5. Download the program to the CPU.

Note

Adapting monitoring

If error messages from the monitoring functions are repeatedly displayed during simulation, temporarily adapt the monitoring limits.

Diagnostics

10.1 Introduction

The Diagnostics chapter is limited to describing the diagnostic concept for Motion Control, and describing the Diagnostics view of the individual technology objects in the TIA Portal.

For more information about system diagnostics with the S7-1500 CPU, refer to the "Diagnostics" (<http://support.automation.siemens.com/WW/view/en/59192926>) function manual.

10.2 Diagnostic concept

The diagnostic concept encompasses alarms and associated messages, as well as error messages in the Motion Control instructions. The TIA Portal also supports you with consistency checks during configuration of the technology objects, and during the creation of your user program.

All alarms in runtime (from the CPU, technology, hardware etc.) are displayed in the Inspector window of the TIA Portal. Diagnostic information that relates to technology objects (technology alarms, status information) are additionally displayed in the Diagnostics window of the respective technology object.

During Motion Control, if an error occurs at a technology object (e.g. approaching a hardware limit switch), then a technology alarm (Page 215) is triggered, and a corresponding message is displayed in the TIA Portal as well as on HMI devices.

In your user program, technology alarms are generally signaled via error bits in the technology data block. The program always displays the technology alarm that has top priority. In order to simplify error evaluation, the "Error" and "ErrorID" parameters of the Motion Control instructions also indicate that a technology alarm is pending.

Program errors (Page 219) can occur during parameter assignment or during the processing sequence of the Motion Control instructions (e.g. invalid parameter specification when calling the instruction, initiation of a job without enablement via MC_Power). Errors in Motion Control instructions are indicated when the instructions are called, by means of the "Error" and "ErrorID" parameters.

10.3 Technology alarms

Description

If an error occurs at a technology object (e.g. approaching a hardware limit switch), then a technology alarm is triggered and indicated. The impact of a technology alarm on the technology object is specified by the alarm reaction.

Alarm classes

Technology alarms are divided into three classes:

- **Warning (can be acknowledged)**

The processing of Motion Control jobs continues. The current motion of the axis can be influenced, e.g. by limitation of the current dynamic values to the configured limit values.

- **Alarm (must be acknowledged)**

Motion jobs are aborted in accordance with the alarm reaction. In order to continue job processing after resolving the cause of error, you must acknowledge the alarms.

- **Fatal error**

Motion jobs are aborted in accordance with the alarm reaction.

To be able to use the technology object again after eliminating the problem, you will need to restart the technology object (Page 197).

Display of technology alarms

A technology alarm is displayed in the following locations:

- **TIA Portal**

- **"Technology object > Diagnostics > Status and error bits"**

Display of pending technology alarms for each technology object.

- **"Technology object > Commissioning > Axis control panel"**

Display of the last pending technology alarm for each technology object.

- **"Inspector window > Diagnostics > Message display"**

Select the "Receive messages" check box under "Online & Diagnostics > Online Access" in order to display technology alarms via the message display.

With an online connection to the CPU, the pending technology alarms for all technology objects are displayed. Additionally, the archive view is available to you.

The message display can also be enabled at a connected HMI, and displayed.

- **"CPU > Online & diagnostics"**

Display of the technology alarms that have been recorded in the diagnostics buffer.

- **User program**

- **Tags <TO>.ErrorDetail.Number and <TO>.ErrorDetail.Reaction**

Indication of the number and the reaction for the last technology alarm that occurred.

- **Tag <TO>.StatusWord**

A pending technology alarm is indicated with bit 1 ("Error").

- **Tag <TO>.ErrorWord**

Indication of alarms and fatal errors.

- **Tag <TO>.WarningWord**

Indication of warnings.

- **Parameter "Error" and "ErrorID"**

In a Motion Control instruction, the parameters "Error" = TRUE and "ErrorID" = 16#8001 indicate that a technology alarm is pending.

- **Display of the CPU**

In order to show technology alarms on the CPU display, make the following setting when loading to the CPU:

In the "Load preview" dialog, select the action "Consistent download" for the "Text libraries" entry.

Alarm reaction

A technology alarm always contains an alarm reaction, which describes the impact on the technology object. The alarm reaction is specified by the system.

The following list shows possible alarm reactions:

- **No reaction (warnings only)**

<TO>.ErrorDetail.Reaction = 0

The processing of Motion Control jobs continues. The current motion of the axis can be influenced, e.g. by limitation of the current dynamic values to the configured limit values.

- **Stop with current dynamic values**

<TO>.ErrorDetail.Reaction = 1

Active motion commands are aborted. The axis is braked with the dynamic values that are pending in the Motion Control instruction, and brought to a standstill.

- **Stop with maximum dynamic values**

<TO>.ErrorDetail.Reaction = 2

Active motion commands are aborted. The axis is braked with the dynamic values configured under "Technology object > Extended parameters > Dynamic limits", and brought to a standstill. The configured maximum jerk is taken into account at the same time.

- **Stop with emergency stop ramp**

<TO>.ErrorDetail.Reaction = 3

Active motion commands are aborted. The axis is braked with the emergency stop deceleration configured under "Technology object > Extended parameters > Emergency stop ramp", without any jerk limit, and brought to a standstill.

- **Remove enable**

<TO>.ErrorDetail.Reaction = 4

The setpoint zero is output, and the enablement is removed. The axis is braked depending on the configuration in the drive, and is brought to a standstill.

- **Follow-up setpoints**

<TO>.ErrorDetail.Reaction = 5

Active motion commands are aborted. The actual values supplied by the drive are automatically tracked as setpoints. The actual values are not monitored at the controller end.

Acknowledging technology alarms

You can acknowledge technology alarms as follows:

- **TIA Portal**

- **"Technology object > Diagnostics > Status and error bits"**

- Click "Confirm" to acknowledge all alarms and warnings pending for the selected technology object.

- (Not possible for external encoder technology object)

- **"Technology object > Commissioning > Axis control panel"**

- Click "Confirm" to acknowledge all alarms and warnings pending for the selected technology object.

- (Not possible for external encoder technology object)

- **"Inspector window > Diagnostics > Message display"**

- You can acknowledge the alarms and warnings for all technology objects either individually, or all at once.

- **HMI**

- At an HMI with enabled message display, you can acknowledge the alarms and warnings for all technology objects either individually, or all at once.

- **User program**

- Acknowledge pending alarms at a technology object using the Motion Control instruction "MC_Reset".

Additional information

A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).

10.4 Errors in Motion Control instructions

Description

Errors in Motion Control instructions (e.g. invalid parameter value setting) are indicated at the "Error" and "ErrorID" output parameters.

Under the following conditions, "Error" = TRUE and "ErrorID" = 16#8xxx are indicated at the Motion Control instruction:

- Invalid status of the technology object, which prevents the execution of the job.
- Invalid parameter assignment of the Motion Control instruction, which prevents the execution of the job.
- As a result of the alarm response for an error at the technology object.

Error indication

If an error occurs in a Motion Control instruction, the "Error" parameter shows the value TRUE. The cause of the error can be found in the value of the ErrorID" parameter.

Jobs at the technology object are rejected when "Error" = TRUE. Running jobs are not influenced by rejected jobs.

If "Error" = TRUE and "ErrorID" = 16#8001 are indicated during the job processing, then a technology alarm has occurred. In this case, evaluate the indication of the technology alarm.

If "Error" = TRUE is displayed during the execution of a "MC_MoveJog" job, the axis is braked and brought to a standstill. In this case, the deceleration configured with the "MC_MoveJog" instruction takes effect.

Acknowledge errors

Acknowledging errors in Motion Control instructions is not required.

Restart a job after resolving the error.

Additional information

A list of the ErrorIDs can be found in the appendix, Error Detection (Page 386).

10.5 Speed-controlled axis technology object

10.5.1 Status and error bits

Description

You use the "Technology object > Diagnostics > Status and error bits" diagnostic function in the TIA Portal to monitor the status and error messages for the technology object. The Diagnostics function is available in online operation.

The meaning of the status and error messages is described in the following tables. The associated technology object tag is given in parentheses.

Axis status

The following table shows the possible axis status values:

Status	Description
Enabled	The technology object is enabled. The axis can be controlled with Motion Control instructions. (<TO>.StatusWord.X0 (Enable))
Error	An error has occurred at the technology object. Detailed information about the error is available in the "Error" area, and in the <TO>.ErrorDetail.Number and <TO>.ErrorDetail.Reaction tags of the technology object. (<TO>.StatusWord.X1 (Error))
Restart active	The technology object is being reinitialized. (<TO>.StatusWord.X2 (RestartActive))
Axis control panel enabled	The axis control panel is enabled. The axis control panel has master control over the technology object. The axis cannot be controlled from the user program. (<TO>.StatusWord.X4 (ControlPanelActive))
Drive ready	The drive is ready to execute setpoints. (<TO>.StatusDrive.InOperation)
Online start value changed	Data relevant for the restart has been changed. The changes will not be applied until the technology object is restarted. (<TO>.StatusWord.X3 (OnlineStartValuesChanged))

Motion status

The following table shows the possible axis motion status values:

Status	Description
Done (no active job)	No motion job is active at the technology object. (<TO>.StatusWord.X6 (Done))
Jog	The axis is being moved by a jog mode job from the Motion Control instruction "MC_MoveJog", or from the axis control panel. (<TO>.StatusWord.X9 (JogCommand))
Speed preset	The axis is traversed by means of a job with speed preset in Motion Control instruction "MC_MoveVelocity", or using the axis control panel. (<TO>.StatusWord.X10 (VelocityCommand))
Constant speed	The axis is traversing at a constant speed or is at a standstill. (<TO>.StatusWord.X12 (ConstantVelocity))
Accelerating	The axis is being accelerated. (<TO>.StatusWord.X13 (Accelerating))
Decelerating	The axis is being decelerated. (<TO>.StatusWord.X14 (Decelerating))

Warnings

The following table shows the possible warnings:

Warning	Description
Configuration adapted	One or several configuration parameters are adjusted internally at a certain time. (<TO>.WarningWord.X1 (ConfigurationFault))
Job rejected	Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met. (<TO>.WarningWord.X3 (CommandNotAccepted))
Dynamic limitation	Dynamic values were limited to the dynamic limits. (<TO>.WarningWord.X6 (DynamicError))

Error

The following table shows the possible errors:

Error	Description
System	An internal system error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data were incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigurationFault))
User program	Error in the user program in a Motion Control instruction, or in its utilization. (<TO>.ErrorWord.X2 (UserFault))
Drive	Error in the drive. (<TO>.ErrorWord.X4 (DriveFault))
Data exchange	Error in communication with a connected device. (<TO>.ErrorWord.X7 (CommunicationFault))
I/O	Error accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))
Job rejected	Command cannot be executed. A Motion Control instruction cannot be executed because the necessary conditions have not been fulfilled (e.g. technology object not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
Dynamic limitation	Dynamic values were limited to the dynamic limits. (<TO>.ErrorWord.X6 (DynamicError))

Confirm

Click "Confirm" to acknowledge alarms and warnings pending.

Additional information

An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

10.5.2 Motion status

Description

You use the "Technology object > Diagnostics > Motion status" diagnostic function in the TIA Portal to monitor the motion status of the axis. The Diagnostics function is available in online operation.

"Current values" area

The following table shows the meaning of the status data:

Status	Description
Speed setpoint	Speed setpoint of the axis (<TO>.Velocity)
Speed override	Speed setpoint correction as percentage The speed setpoint specified in motion control instructions or set by the axis control panel are superimposed with an override signal and corrected as a percentage. Valid speed correction values range from 0.0 % to 200.0 %. (<TO>.Override.Velocity)

"Dynamic limits" area

This area displays the limit values for the dynamic parameters.

The following table shows the meaning of the status data:

Status	Description
Speed	Configured maximum speed (<TO>.DynamicLimits.MaxVelocity)
Acceleration	Configured maximum acceleration (<TO>.DynamicLimits.MaxAcceleration)
Deceleration	Configured maximum deceleration (<TO>.DynamicLimits.MaxDeceleration)

10.5.3 PROFIdrive frame

Description

The "Technology object > Diagnostics > PROFIdrive frame" diagnostics function is used in the TIA Portal to monitor the PROFIdrive frame that the drive returns to the controller. The Diagnostics function is available in online operation.

"Drive" area

This area displays the following parameters contained in the PROFIdrive frame that the drive returns to the controller:

- Status words "SW1" and "SW2"
- The setpoint speed that was output to the drive (NSET)
- The actual speed that was signaled from the drive (NACT)

10.6 Positioning axis/synchronous axis technology object

10.6.1 Status and error bits

Description

You use the "Technology object > Diagnostics > Status and error bits" diagnostic function in the TIA Portal to monitor the status and error messages for the technology object. The Diagnostics function is available in online operation.

The meaning of the status and error messages is described in the following tables. The associated technology object tag is given in parentheses.

Axis status

The following table shows the possible axis status values:

Status	Description
Enabled	The technology object is enabled. The axis can be controlled with Motion Control instructions. (<TO>.StatusWord.X0 (Enable))
Homed	The technology object is homed. The relationship between the position at the technology object and the mechanical position was successfully created. (<TO>.StatusWord.X5 (HomingDone))
Error	An error has occurred at the technology object. Detailed information about the error is available in the "Error" area, and in the <TO>.ErrorDetail.Number and <TO>.ErrorDetail.Reaction tags of the technology object. (<TO>.StatusWord.X1 (Error))
Restart active	The technology object is being reinitialized. (<TO>.StatusWord.X2 (RestartActive))
Axis control panel enabled	The axis control panel is enabled. The axis control panel has master control over the technology object. The axis cannot be controlled from the user program. (<TO>.StatusWord.X4 (ControlPanelActive))
Drive ready	The drive is ready to execute setpoints. (<TO>.StatusDrive.InOperation)
Encoder values valid	The encoder values are valid. (<TO>.StatusSensor[n].State)
Online start value changed	Data relevant for the restart has been changed. The changes will not be applied until after reinitialization (restart) of the technology object. (<TO>.StatusWord.X3 (OnlineStartValuesChanged))

Status limit switch

The following table shows the possibilities for enabling the software and hardware limit switches:

Limit switch	Description
Negative software limit switch approached	The negative software limit switch was approached. (<TO>.StatusWord.X15 (SWLimitMinActive))
Positive software limit switch approached	The positive software limit switch was approached. (<TO>.StatusWord.X16 (SWLimitMaxActive))
Negative hardware limit switch approached	The negative hardware limit switch was approached. (<TO>.StatusWord.X17 (HWLimitMinActive))
Positive hardware limit switch approached	The positive hardware limit switch was approached or passed. (<TO>.StatusWord.X18 (HWLimitMaxActive))

Motion status

The following table shows the possible axis motion status values:

Status	Description
Done (no active job)	No motion job is active at the technology object. (<TO>.StatusWord.X6 (Done))
Homing job	The technology object is executing a homing job from the Motion Control instruction "MC_Home", or from the axis control panel. (<TO>.StatusWord.X11 (HomingCommand))
Jog	The axis is being moved by a jog mode job from the Motion Control instruction "MC_MoveJog", or from the axis control panel. (<TO>.StatusWord.X9 (JogCommand))
Velocity setpoint	A job traverses the axis at the speed setpoint specified in Motion Control instruction "MC_MoveVelocity" or at the axis control panel. (<TO>.StatusWord.X10 (VelocityCommand))
Positioning job	The axis is being moved by a positioning job from the Motion Control instructions "MC_MoveAbsolute", "MC_MoveRelative", or from the axis control panel. (<TO>.StatusWord.X8 (PositioningCommand))
Constant velocity	The axis is traversing at a constant velocity or is at a standstill. (<TO>.StatusWord.X12 (ConstantVelocity))
Standstill	The axis is at a standstill. (<TO>.StatusWord.X7 (StandStill))
Accelerating	The axis is being accelerated. (<TO>.StatusWord.X13 (Accelerating))
Decelerating	The axis is being decelerated. (<TO>.StatusWord.X14 (Decelerating))

Status	Description
Synchronization	Synchronous axis only The axis is synchronized to the master value of a leading axis. (<TO>.StatusWord.X21 (Synchronizing))
Gearing	Synchronous axis only The axis is synchronized and moves synchronously to the leading axis. (<TO>.StatusWord.X22 (Synchronous))

Warnings

The following table shows the possible warnings:

Warning	Description
Configuration adapted	One or several configuration parameters are adjusted internally at a certain time. (<TO>.WarningWord.X1 (ConfigurationFault))
Job rejected	Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met. (<TO>.WarningWord.X3 (CommandNotAccepted))
Dynamic limitation	Dynamic values were limited to the dynamic limits. (<TO>.WarningWord.X6 (DynamicError))

Error

The following table shows the possible errors:

Error	Description
System	An internal system error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data were incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigurationFault))
User program	Error in the user program in a Motion Control instruction, or in its utilization. (<TO>.ErrorWord.X2 (UserFault))
Drive	Error in the drive. (<TO>.ErrorWord.X4 (DriveFault))
Encoder	Error in the encoder system. (<TO>.ErrorWord.X5 (SensorFault))
Data exchange	Error in communication with a connected device. (<TO>.ErrorWord.X7 (CommunicationFault))
I/O	Error accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))
Job rejected	Command cannot be executed. A Motion Control instruction cannot be executed because the necessary conditions have not been fulfilled (e.g. technology object not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
Homing	Error during a homing process. (<TO>.ErrorWord.X10 (HomingFault))
Positioning	The axis was not correctly positioned at the end of a positioning motion. (<TO>.ErrorWord.X12 (PositioningFault))
Dynamic limitation	Dynamic values were limited to the dynamic limits. (<TO>.ErrorWord.X6 (DynamicError))
Following error	The maximum permitted following error was exceeded. (<TO>.ErrorWord.X11 (FollowingErrorFault))
SW limit switch	A software limit switch has been reached. (<TO>.ErrorWord.X8 (SwLimit))
Hardware limit switch	A hardware limit switch has been reached or overshoot. (<TO>.ErrorWord.X9 (HWLimit))
Synchronize/desynchronize	Synchronous axis only Error during synchronous operation. The leading axis specified at the Motion Control instruction "MC_GearIn" was not configured as a possible leading axis. (<TO>.ErrorWord.X14 (SynchronousError))

Confirm

Click "Confirm" to acknowledge alarms and warnings pending.

Additional information

An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

10.6.2 Motion status

Description

You use the "Technology object > Diagnostics > Motion status" diagnostic function in the TIA Portal to monitor the motion status of the axis. The Diagnostics function is available in online operation.

"Current values" area

The following table shows the meaning of the status data:

Status	Description
Target position	Current target position of an active positioning job The target position value is only valid while a positioning job is busy. (<TO>.StatusPositioning.TargetPosition)
Actual position	Actual position of the axis If the technology object is not homed, then the value is displayed relative to the position that existed when the technology object was enabled. (<TO>.ActualPosition)
Actual velocity	Actual velocity of the axis (<TO>.ActualVelocity)
Velocity override	Percentage correction of the velocity override The velocity setpoint specified in motion control instructions or set by the axis control panel are superimposed with an override signal and corrected as a percentage. Valid velocity correction values range from 0.0 % to 200.0 %. (<TO>.Override.Velocity)

"Dynamic limits" area

This area displays the limit values for the dynamic parameters.

The following table shows the meaning of the status data:

Status	Description
Velocity	Configured maximum velocity (<TO>.DynamicLimits.MaxVelocity)
Acceleration	Configured maximum acceleration (<TO>.DynamicLimits.MaxAcceleration)
Deceleration	Configured maximum deceleration (<TO>.DynamicLimits.MaxDeceleration)

10.6.3 PROFIdrive frame

Description

The "Technology object > Diagnostics > PROFIdrive frame" diagnostics function is used in the TIA Portal to monitor the PROFIdrive frame returned by the drive and encoder. The display of the Diagnostics function is available in online operation.

"Drive" area

This area displays the following parameters contained in the PROFIdrive frame that the drive returns to the controller:

- Status words "SW1" and "SW2"
- The setpoint speed that was output to the drive (NSET)
- The actual speed that was signaled from the drive (NACT)

"Encoder" area

This area displays the following parameters contained in the PROFIdrive frame that the encoder returns to the controller:

- Status word "G1_ZSW"
- The actual position value "G1_XIST1" (cyclic actual encoder value)
- The actual position value "G1_XIST2" (absolute value of the encoder)

10.7 External encoder technology object

10.7.1 Status and error bits

Description

You use the "Technology object > Diagnostics > Status and error bits" diagnostic function in the TIA Portal to monitor the status and error messages for the technology object. The Diagnostics function is available in online operation.

The meaning of the status and error messages is described in the following tables. The associated technology object tag is given in parentheses.

Encoder status

The following table shows the possible external encoder status values:

Status	Description
Enabled	The technology object is enabled. (<TO>.StatusWord.X0 (Enable))
Homed	The technology object is homed. The relationship between the position at the technology object and the mechanical position was successfully created. (<TO>.StatusWord.X5 (HomingDone))
Error	An error has occurred at the technology object. Detailed information about the error is available in the "Error" area, and in the <TO>.ErrorDetail.Number and <TO>.ErrorDetail.Reaction tags of the technology object. (<TO>.StatusWord.X1 (Error))
Restart active	The technology object is being reinitialized. (<TO>.StatusWord.X2 (RestartActive))
Encoder values valid	The encoder values are valid. (<TO>.StatusSensor[n].State)
Online start value changed	Data relevant for the restart has been changed. The changes will not be applied until the technology object is restarted. (<TO>.StatusWord.X3 (OnlineStartValuesChanged))

Motion status

The following table shows the possible axis motion status values:

Status	Description
Done (no active job)	No active Motion Control job at the TO. (Enable by "MC_Power" job excepted) (<TO>.StatusWord.X6 (Done))
Homing job	The technology object is executing a homing job from the Motion Control instruction "MC_Home". (<TO>.StatusWord.X11 (HomingCommand))

Error

The following table shows the possible errors:

Error	Description
System	An internal system error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data were incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigurationFault))
User program	Error in the user program in a Motion Control instruction, or in its utilization. (<TO>.ErrorWord.X2 UserFault))
Encoder	Error in the encoder system. (<TO>.ErrorWord.X5 (SensorFault))
Data exchange	Missing or faulty communication. (<TO>.ErrorWord.X7 (CommunicationFault))

Additional information

An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

10.7.2 Motion status**Description**

You use the "Technology object > Diagnostics > Motion status" diagnostic function in the TIA Portal to monitor the encoder values. The Diagnostics function is available in online operation.

"Current values" area

The following table shows the meaning of the status data:

Status	Description
Actual position	Actual position of the axis If the technology object is not homed, then the value is displayed relative to the position that existed when the technology object was enabled. (<TO>.ActualPosition)
Actual velocity	Actual velocity of the axis (<TO>.ActualVelocity)

10.7.3 PROFIdrive frame

Description

The "Technology object > Diagnostics > PROFIdrive interface" diagnostic function is used in the TIA Portal to monitor the PROFIdrive frame of the encoder. The display of the diagnostics function is available in the online mode TO.

"Encoder" area

This area displays the following parameters contained in the PROFIdrive frame that the encoder returns to the controller:

- Status word "G1_ZSW"
- The actual position value "G1_XIST1" (cyclic actual encoder value)
- The actual position value "G1_XIST2" (absolute value of the encoder)

Instructions

11.1 S7-1500 Motion Control V2

11.1.1 MC_Power

11.1.1.1 MC_Power: Enable, disable technology objects V2

Description

The Motion Control instruction "MC_Power" is used to enable and disable technology objects.

Applies to

- Synchronous axis
- Positioning axis
- Speed axis
- External encoder

Requirements

- The technology object has been configured correctly.

Override response

- A MC_Power job cannot be aborted by any other Motion Control job.
- A MC_Power job with the parameter Enable = TRUE enables a technology object, but does not thereby abort any other Motion Control instructions.
- Disabling the technology object (parameter "Enable" = FALSE) aborts all Motion Control jobs at the corresponding technology object in accordance with the selected "StopMode". This process cannot be aborted by the user.

Parameters

The following table shows the parameters of the "MC_POWER" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Axis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	The technology object is enabled.
				FALSE	The technology object is disabled. All current jobs at the technology object are aborted in accordance with the configured "StopMode".
StopMode	INPUT	INT	0	Not applicable to the external encoder technology object. If you disable a technology object with a falling edge at the Enable parameter, then the axis decelerates in accordance with the selected "StopMode".	
				0	Emergency stop When the technology object is disabled, the axis brakes to a standstill without any jerk limitation, using the emergency stop deceleration configured in Technology object > Configuration > Extended parameters > Emergency stop ramp. Enabling is then removed. (<TO>.DynamicDefaults. EmergencyDeceleration)
				1	Immediate stop When a technology object is disabled, the setpoint zero is output, and the enabling is removed. The axis is braked depending on the configuration in the drive, and is brought to a standstill.
				2	Stop with maximum dynamic values When the technology object is disabled, the axis brakes to a standstill using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic limits". The configured maximum jerk is taken into account at the same time. Enabling is then removed. (<TO>.DynamicLimits.MaxDeceleration; <TO>.DynamicLimits.MaxJerk)
Status	OUTPUT	BOOL	FALSE	Technology object enable status	
				FALSE	Disabled - A positioning axis or speed axis does not accept any Motion Control jobs. - Speed control and position control are not active. - The actual values of the technology object are not checked for validity.
				TRUE	Enabled - An enabled positioning axis or speed axis accepts Motion Control jobs. - Speed control and positioning control are active. - The actual values of the technology object are valid.

Parameter	Declaration	Data type	Default value	Description
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred in Motion Control instruction MC_Power. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Enabling technology objects

To enable a technology object, set the Enable parameter to TRUE.

If the Status parameter shows the value TRUE , then the technology object is enabled.

If an axis is in motion when the technology object is enabled (actual velocity is present), then the axis brakes to the setpoint zero, using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic limits" (<TO>.DynamicLimits.MaxDeceleration). This braking ramp can be overridden by Motion Control jobs.

Note

Automatic enabling after acknowledgement of a technology alarm

If the technology object is disabled due to a technology alarm, then it will automatically be enabled again after the cause has been eliminated and the alarm has been acknowledged. This requires the Enable parameter to have retained the value TRUE during this process.

Disabling technology objects

To disable a technology object, set the Enable parameter to FALSE.

If an axis is in motion, then it will be braked to a standstill according to the selected "StopMode".

If the "Busy" and "Status" parameters show the value FALSE , then the disabling of the technology object has been completed.

Drive connection by means of PROFIdrive

When coupling a drive with PROFIdrive, the setpoint, enabling, and drive status are transmitted via the PROFIdrive frame.

- **Enable technology object and drive**

The parameter ""Enable" = TRUE" is used to enable the technology object. The drive is enabled according to the PROFIdrive standard.

If the tag <TO>.StatusDrive.InOperation shows the value TRUE , then the drive is ready to execute setpoints. The "Status" parameter is set to the value TRUE .

- **Disable technology object and drive**

With the parameter "Enable" = FALSE, the "Status" parameter is set to the value FALSE, and the axis is braked according to the selected "StopMode". The drive is disabled according to the PROFIdrive standard.

Analog drive connection

The setpoint is output via an analog output. Optionally, you can configure an enabling signal via digital output (<TO>.Actor.Interface.EnableDriveOutput), and a readiness signal via digital input (<TO>.Actor.Interface.DriveReadyInput).

- **Enable technology object and drive**

With the parameter "Enable" = TRUE, the enabling output ("Enable drive output") is set.

If the drive reports back the readiness signal via the ready input ("Drive ready input"), then the "Status" parameter and the technology object's <TO>.StatusDrive.InOperation tag are set to TRUE, and the setpoint is switched at the analog output.

- **Disable technology object and drive**

With the parameter "Enable" = FALSE, the "Status" parameter is set to the value FALSE, and the axis is braked according to the selected "StopMode". When the setpoint zero is reached, the enabling output is set to FALSE.

Additional information

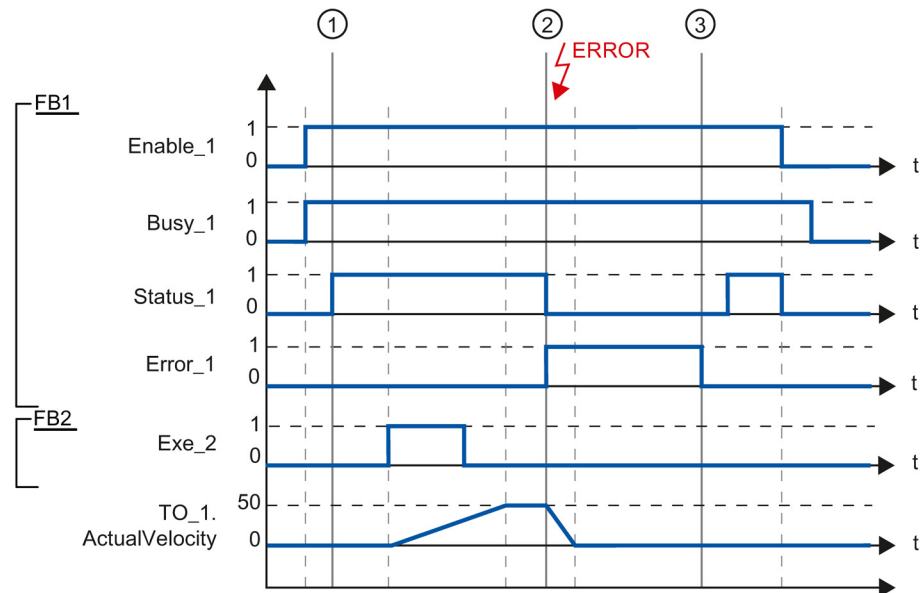
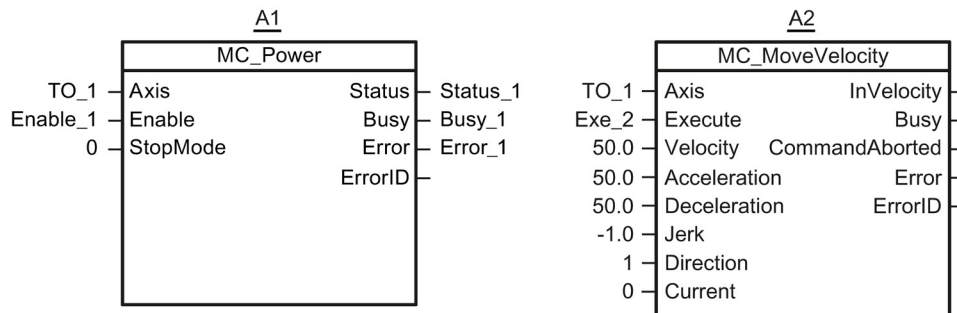
Additional information on enabling and disabling technology objects and drives can be found in the appendix, MC_Power Function Charts (Page 388).

See also

Error ID (Page 386)

11.1.1.2 MC_Power: Function chart V2

Function chart: Enabling a technology object, and example for alarm response



A technology object is enabled with "Enable_1= TRUE". Successful enabling can be read from "Status_1" at time ①. The axis will then move with an "MC_MoveVelocity" job (A2). The velocity profile of the axis can be read from "Velocity Axis_1".

At time ② an error occurs in the technology object, which results in the disabling of the technology object (alarm response: remove enable). The axis is braked depending on the configuration in the drive, and is brought to a standstill. When the technology object is disabled, Status_1 is reset. Since the axis was not disabled using "Enable_1" = FALSE, the selected "StopMode" does not apply. The cause of the error is corrected and the alarm is acknowledged at time ③.

Since "Enable_1" is still set, the technology object is enabled again. Successful enabling can be read from "Status_1". Next the technology object is disabled with "Enable_1" = FALSE.

11.1.2 MC_Home

11.1.2.1 MC_Home: Home technology objects, set home position V2

Description

With the Motion Control instruction "MC_Home", you create the relationship between the position in the technology object and the mechanical position. The position value in the technology object is assigned to a homing mark at the same time. This homing mark represents a known mechanical position.

The homing process occurs according to the mode selected with the "Mode" parameter, and the configuration under "Technology object > Configuration > Extended parameters > Homing".

The "MC_Home.Mode" parameter for S7-1200 Motion Control and S7-1500 Motion Control has been standardized within the framework of technology version V2.0. This results in a new assignment of the parameter values for the "MC_Home.Mode" parameter. A comparison of the "MC_Home.Mode" parameter for technology versions V1.0 and V2.0 is available in the section Version overview (Page 86).

The preset values under "Technology object > Configuration > Extended parameters > Dynamic default values" are used for the dynamic values Acceleration, Deceleration and Jerk.

Applies to

- Synchronous axis
- Positioning axis
- External encoder

The following table shows which modes are possible with each of the technology objects:

Operating mode	Positioning axis/ synchronous axis with incremental encoder	Positioning axis/ synchronous axis with absolute encoder	External incremental encoder	External absolute encoder
Active homing ("Mode" = 3, 5)	X	-	-	-
Passive homing ("Mode" = 2, 8, 10)	X	-	X	-
Set actual position ("Mode" = 0)	X	X	X	X
Relative shift of the actual position ("Mode" = 1)	X	X	X	X
Homing absolute encoder ("Mode" = 6, 7)	-	X	-	X

Requirement

- The technology object has been configured correctly.
- "Mode" = 2, 3, 5, 8, 10
The technology object must be enabled.
- "Mode" = 0, 1, 6, 7, 8
The encoder values must be valid. (<TO>.StatusSensor[n].State = 2)

Override response

- An MC_Home job for passive homing is aborted by:
 - Disabling the technology object by means of "MC_Power.Enable" = FALSE
 - "MC_Home" job with parameter "Mode" = 3, 5, 9
- An "MC_Home" job for passive homing does not abort any other Motion Control jobs.
- An "MC_Home" job for active homing is aborted by:
 - Disabling the technology object with "MC_Power.Enable" = FALSE
 - "MC_Home" job "Mode" = 3, 5
 - "MC_Halt" job
 - "MC_MoveAbsolute" job
 - "MC_MoveRelative" job
 - "MC_MoveVelocity" job
 - "MC_MoveJog" job
 - "MC_GearIn" job
- An "MC_Home" job for active homing aborts the following running Motion Control jobs.
 - "MC_Home" job with parameter "Mode" = 3, 5, 8, 10
 - "MC_Halt" job
 - "MC_MoveAbsolute" job
 - "MC_MoveRelative" job
 - "MC_MoveVelocity" job
 - "MC_MoveJog" job
 - "MC_GearIn" job
 - "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_Home" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Axis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Position	INPUT	LREAL	0.0	The specified value is used according to the selected "Mode".	
Mode	INPUT	INT	0	Operating mode	
				0	Direct homing (absolute) The current position of the technology object is set to the value of parameter "Position".
				1	Direct homing (relative) The current position of the technology object is shifted by the value of parameter "Position".
				2	Passive homing (without reset) Functions like "Mode" 8, with the difference that the "homed" status is not reset when the function is enabled.
				3	Active homing The TO positioning axis/synchronous axis performs a homing movement according to the configuration. After the completion of the movement, the axis is positioned at the value of the "Position" parameter.
				4	Reserved
				5	Active homing ("Position" parameter has no effect) The TO positioning axis/synchronous axis performs a homing movement according to the configuration. After completion of the movement, the axis is positioned at the home position configured under "Technology object > Configuration > Extended parameters > Homing > Active homing". (<TO>.Homing.HomePosition)
6	Absolute encoder adjustment (relative) The current position is shifted by the value of the parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[n].AbsEncoderOffset)				

Parameter	Declaration	Data type	Default value	Description
				<p>7 Absolute encoder adjustment (absolute) The current position is set to the value of the parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[n].AbsEncoderOffset)</p>
				<p>8 Passive homing When the homing mark is detected, the actual value is set to the value of the "Position" parameter.</p>
				<p>9 Canceling passive homing A running job for passive homing is aborted.</p>
				<p>10 Passive homing ("Position" parameter has no effect) When the homing mark is detected, the actual value is set to the home position configured under "Technology object > Configuration > Extended parameters > Homing > Passive homing". (<TO>.Homing.HomePosition)</p>
Done	OUTPUT	BOOL	FALSE	TRUE Job is completed
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Resetting the "Homed" status

The "Homed" status of a technology object is reset under the following conditions (<TO>.StatusWord.X5 (HomingDone)):

- **Technology objects with incremental actual values:**
 - Starting an "MC_Home" job with "Mode" = 3, 5, 8, 10
(After successful completion of the homing operation, the "Homed" status is reset.)
 - Error in the encoder system, or encoder failure
 - Restart of the technology object
 - After POWER OFF -> POWER ON of the CPU
 - Memory reset
 - Modification of the encoder configuration
- **Technology objects with absolute actual values:**
 - Restoration of the CPU factory settings
 - Modification of the encoder configuration
 - Replacement of the CPU

Homing a technology object with "Mode" = 1..8, 10

To home a technology object, follow these steps:

1. Check the requirements indicated above.
2. Specify the desired homing function in the "Mode" parameter.
3. Initialize the necessary parameters with values, and start the homing operation with a positive edge at the "Execute" parameter.

If the "Done" parameter shows the value TRUE, then the "MC_Home" job has been completed according to the selected "Mode". The "Homed" status of the technology object is indicated under "Technology object > Diagnostics > Status and error bits > Motion status > Homed" (<TO>.StatusWord.X5 (HomingDone)).

Termination of a passive homing process with "Mode" = 9

With "Mode" = 9, the technology object is not homed. If a running "MC_Home" job for passive homing ("Mode" = 2, 8, 10) is overridden by another "MC_Home" job with "Mode" = 9, then the running job is terminated with the parameter "CommandAborted" = TRUE. The overriding job with "Mode" = 9 signals successful execution with the parameter "Done" = TRUE.

Additional information

An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.1.3 MC_MoveJog

11.1.3.1 MC_MoveJog: Move axes in jog mode V2

Description

With the Motion Control instruction "MC_MoveJog", you can move an axis in jog mode. Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis/synchronous axis:
A velocity is specified in the "Velocity" parameter.
- Speed axis:
A speed is specified at the "Velocity" parameter.

Applies to

- Synchronous axis
- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveJog" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_MoveJog" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_MoveJog" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_SpeedAxis	-	Technology object
JogForward	INPUT	BOOL	FALSE	As long as the parameter is TRUE, the axis moves in the positive direction at the velocity specified in parameter "Velocity".
JogBackward	INPUT	BOOL	FALSE	As long as the parameter is TRUE, the axis moves in the negative direction at the velocity specified in parameter "Velocity".
Velocity	INPUT	LREAL	100.0	Setpoint speed / setpoint speed for the motion process Value > 0.0: The specified value is used. Value < 0.0: The specified value is used. ("Velocity" = 0.0 is permitted)
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used. Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
InVelocity	OUTPUT	BOOL	FALSE	TRUE The setpoint velocity / setpoint speed was reached and will be maintained.
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Behavior with setpoint velocity / setpoint speed zero (Velocity" = 0.0)

An "MC_MoveJog" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the setpoint velocity / setpoint speed zero is reached, the parameter "InVelocity" will indicate the value TRUE.

Under "Technology object > Diagnostics > Status and error bits > Motion status", "constant velocity" and "standstill" will be displayed (<TO>.StatusWord.X12 (ConstantVelocity); <TO>.StatusWord.X7 (Standstill)).

Moving an axis in jog mode

Proceed as follows to move an axis in jog mode:

1. Check the requirements indicated above.
2. Move the axis in the positive direction with "JogForward", or in the negative direction with "JogBackward".

The current motion state is indicated in "Busy", "InVelocity" and "Error".

Note

Behavior when changing the override

If the velocity / speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), then the "InVelocity" parameter is reset during the acceleration or deceleration. When the newly calculated velocity is reached ("Velocity" × "Override" %), then "InVelocity" is set again.

Additional information

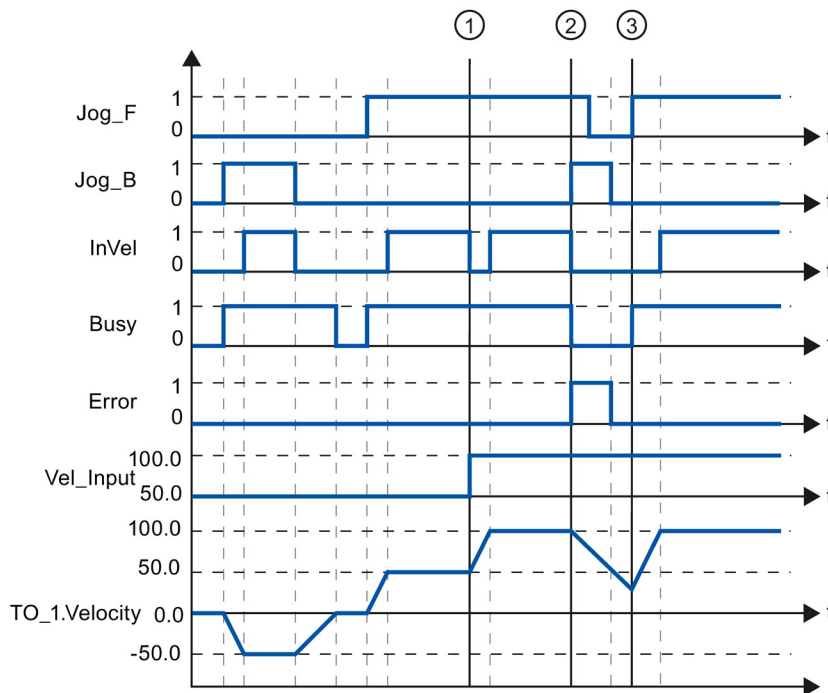
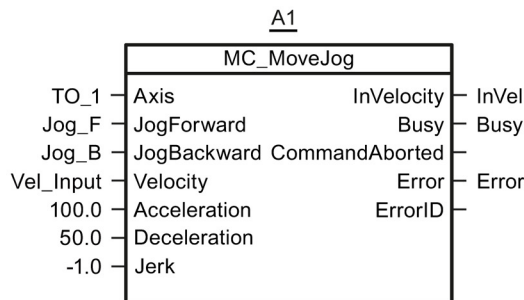
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.1.3.2 MC_MoveJog: Function chart V2

Function chart: Moving an axis in jog mode



The axis is moved in the negative direction in jog mode via "Jog_B". When the setpoint velocity -50.0 is reached, this is signaled via "InVel" = TRUE. After "Jog_B" is reset, the axis is braked and brought to a standstill. Then the axis is moved in the positive direction via "Jog_F". When the setpoint velocity 50.0 is reached, this is signaled via "InVel" = TRUE.

At time ①, if "Jog_F" is set, the setpoint velocity is changed to 100.0 by means of "Vel_Input". Alternatively, you can also change the setpoint velocity via the velocity override. "InVel" is reset. The axis is being accelerated. When the new setpoint velocity 100.0 is reached, this is signaled via "InVel" = TRUE.

If "Jog_F" is set, "Jog_B" is likewise set at time ②. If both "Jog_F" and "Jog_B" are set, then the axis is braked with the last applicable deceleration. An error is indicated via "Error", and the "ErrorID" of the error 16#8007 (incorrect direction specification) is output.

This error is resolved by resetting the two inputs "Jog_F" and "Jog_B".

During the braking ramp, "Jog_F" is set at time ③. The axis is accelerated to the last configured velocity. When the setpoint velocity 100.0 is reached, this is signaled via "InVel" = TRUE.

11.1.4 MC_MoveVelocity

11.1.4.1 MC_MoveVelocity: Move axes at predefined velocity V2

Description

With the Motion Control instruction "MC_MoveVelocity", you can move an axis with a constant velocity.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis/synchronous axis:
A velocity is specified in the "Velocity" parameter.
- Speed axis:
A speed is specified at the "Velocity" parameter.

Applies to

- Synchronous axis
- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveVelocity" is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_MoveVelocity" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_MoveVelocity" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_SpeedAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Velocity	INPUT	LREAL	100.0	Setpoint speed / setpoint speed for the motion process ("Velocity" = 0.0 is permitted)	
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)	
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)	
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used. Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)	
Direction	INPUT	INT	0	Direction of rotation of the axis	
				0	The sign of the velocity specified at the "Velocity" parameter defines the direction of rotation.
				1	Positive direction of rotation Value of "Velocity" is used.
				2	Negative direction of rotation Value of "Velocity" is used.

Parameter	Declaration	Data type	Default value	Description	
Current	INPUT	BOOL	FALSE	Maintain current velocity	
				FALSE	Disabled The values of parameters "Velocity" and "Direction" are taken into account.
				TRUE	Enabled The values at the parameters "Velocity" and "Direction" are not taken into account. The current velocity and direction at function start are retained. When the axis resumes motion at the velocity that was current at function start, the "InVelocity" parameter returns the value TRUE.
InVelocity	OUTPUT	BOOL	FALSE	TRUE	The setpoint velocity / setpoint speed was reached and will be maintained.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred during execution of the job. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"	

Behavior with setpoint velocity / setpoint speed zero (Velocity" = 0.0)

An "MC_MoveVelocity" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the setpoint velocity / setpoint speed zero is reached, the parameter "InVelocity" will indicate the value TRUE.

Under "Technology object > Diagnostics > Status and error bits > Motion status", "constant velocity" and "standstill" will be displayed (<TO>.StatusWord.X12 (ConstantVelocity); <TO>.StatusWord.X7 (Standstill)).

The parameters "InVelocity" and "Busy" show the value TRUE, until the "MC_MoveVelocity" job is overridden by another Motion Control job.

Moving an axis with constant velocity / speed

Proceed as follows to move an axis with constant velocity / speed:

1. Check the requirements indicated above.
2. At the parameter "Velocity", specify the velocity / speed, with which the axis should be moved.
3. Start the "MC_MoveVelocity" job with a positive edge at the parameter "Execute".

The current motion state is indicated in "Busy", "InVelocity" and "Error".

If the "InVelocity" parameter shows the value TRUE, then the setpoint velocity / setpoint speed was reached. The axis continues moving at this constant velocity. The parameters "InVelocity" and "Busy" show the value TRUE, until the "MC_MoveVelocity" job is overridden by another Motion Control job.

Note

Behavior when changing the override

If the velocity / speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), then the "InVelocity" parameter is reset during the acceleration or deceleration. When the newly calculated velocity / speed is reached ("Velocity" × "Override" %), then "InVelocity" is reset.

Additional information

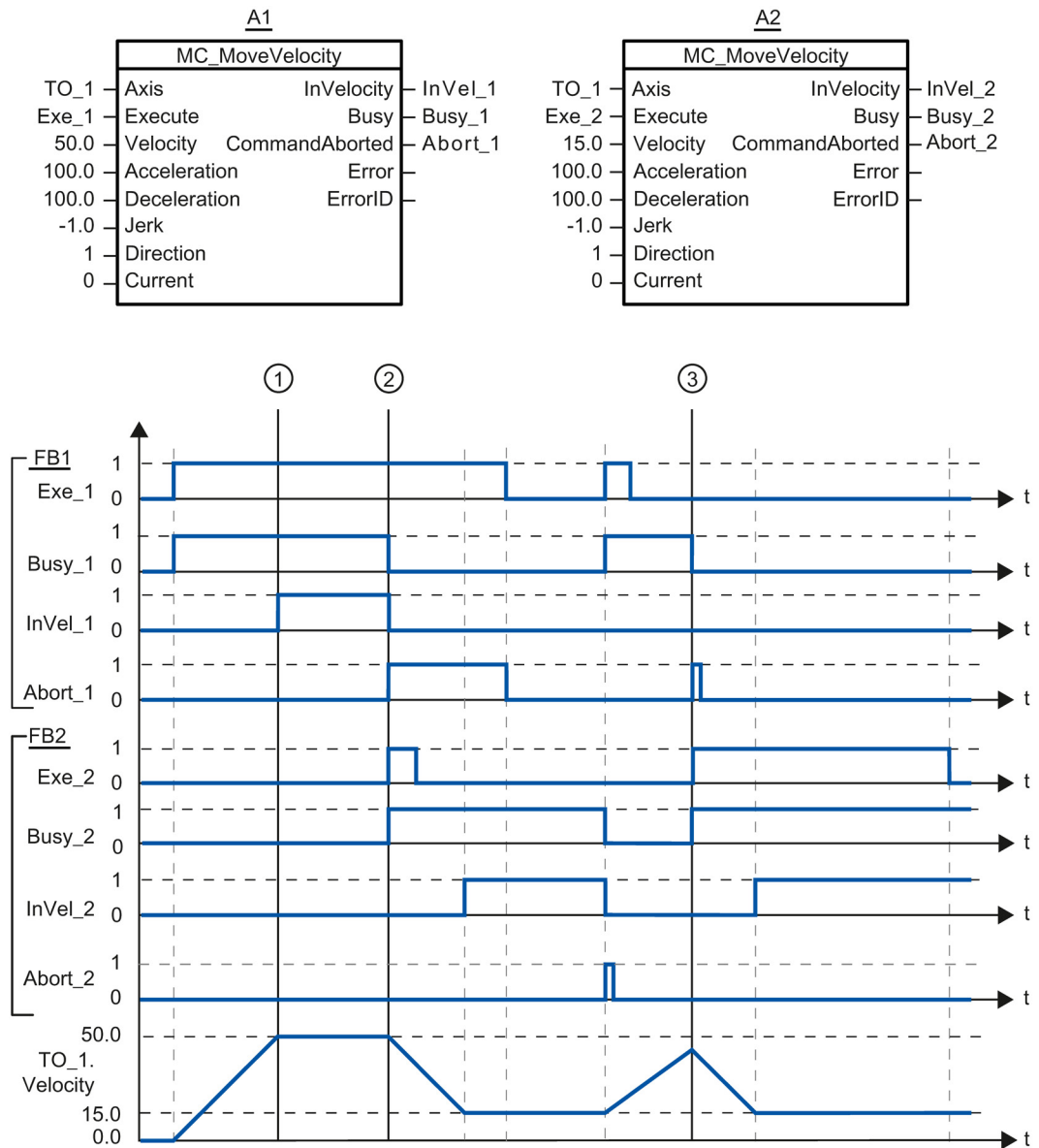
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.1.4.2 MC_MoveVelocity: Function chart V2

Function chart: Moving an axis with specification of velocity, and the response to an overriding job



A "MC_MoveVelocity" job (A1) initiated via "Exe_1" accelerates the axis and signals at time ① via "InVel_1" that the setpoint velocity 50.0 has been reached.

At time ②, the task is overridden via another "MC_MoveVelocity" job (A2). The abort is signaled via "Abort_1". When the new setpoint velocity 15.0 is reached, this is signaled via "InVel_2". The axis then continues moving at the constant velocity 15.0.

The running "MC_MoveVelocity" job (A2) is overridden by another "MC_MoveVelocity" job (A1). The abort is signaled via "Abort_2". The axis is accelerated to the new setpoint velocity 50.0. Before the setpoint velocity is reached, the current "MC_MoveVelocity" job (A1) is overridden at time ③ by another "MC_MoveVelocity" job (A2). The abort is signaled via "Abort_1". When the new setpoint velocity 15.0 is reached, this is signaled via "InVel_2". The axis then continues moving at the constant velocity 15.0.

11.1.5 MC_MoveRelative

11.1.5.1 MC_MoveRelative: Relative positioning of axes V2

Description

With the Motion Control instruction "MC_MoveRelative", you can move an axis relative to the position that exists at the beginning of job processing.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Synchronous axis
- Positioning axis

Requirements

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveRelative" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_MoveRelative" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_MoveRelative" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_Positioning Axis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Distance	INPUT	LREAL	0.0	Distance for the positioning process (negative or positive)
Velocity	INPUT	LREAL	-1.0	Setpoint velocity for the positioning Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The velocity configured in "Technology object > Configuration > Advanced parameters > Default dynamics" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Tech- nology object > Configuration > Extended param- eters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Tech- nology object > Configuration > Extended param- eters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE Target position reached
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.

Parameter	Declaration	Data type	Default value	Description
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Moving an axis relative to the starting position

Proceed as follows to move an axis relative to the starting position:

1. Check the requirements indicated above.
2. Specify distance to be moved in the "Distance" parameter.
3. Start the "MC_MoveRelative" job with a positive edge at the parameter "Execute".

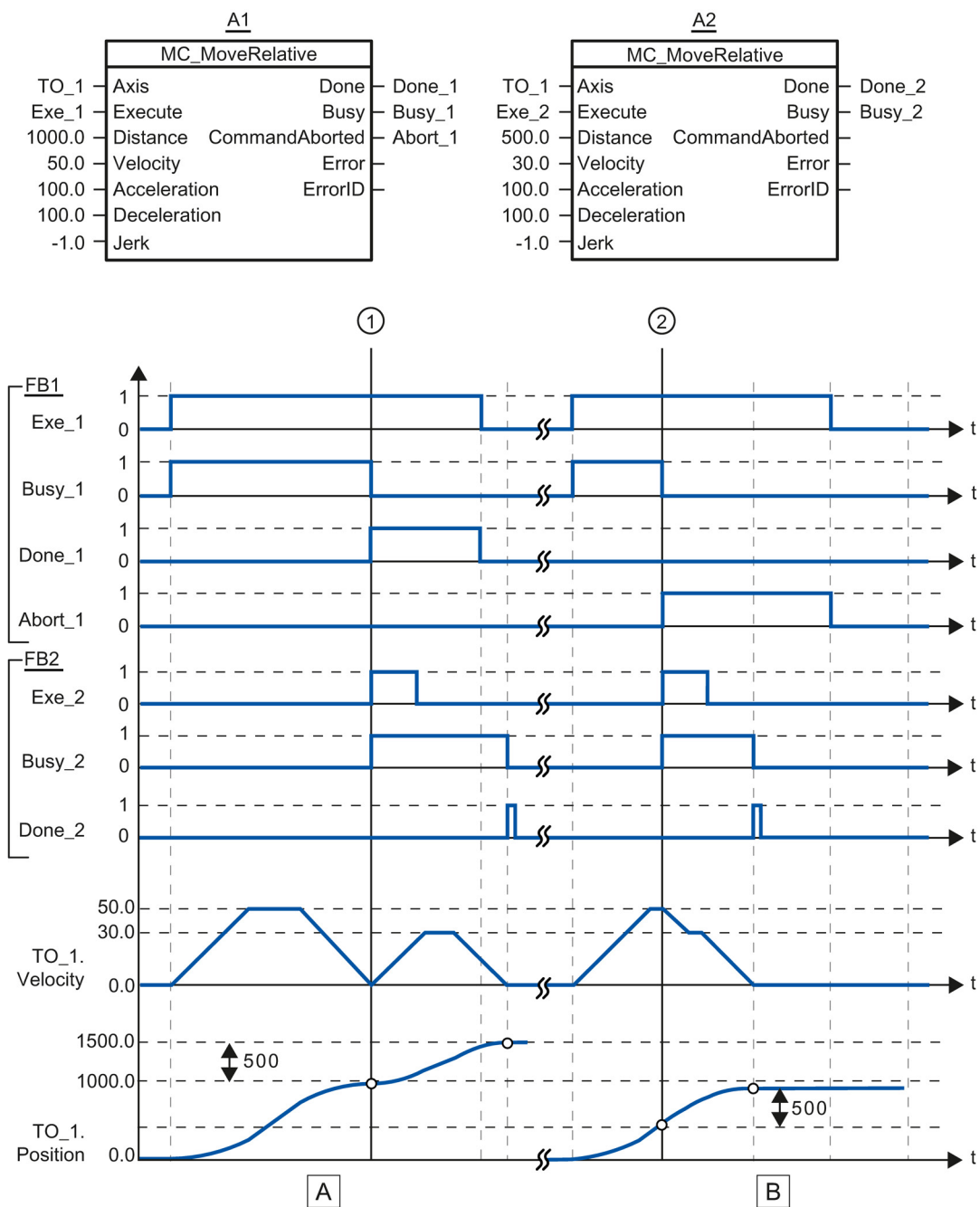
The current motion state is indicated in "Busy", "Done" and "Error".

See also

Error ID (Page 386)

11.1.5.2 MC_MoveRelative: Function chart V2

Function chart: Relative positioning of an axis, and the response to an overriding job



Section A	The axis is moved by an "MC_MoveRelative" job (A1) by the distance ("Distance") 1000.0 (the starting position here is 0.0). When the axis reaches the target position, this is signaled at time ① via "Done_1". At this time ①, another "MC_MoveRelative" job (A2) with distance 500.0 is started. When the axis reaches the new target position, this is signaled via "Done_2". Since "Exe_2" was previously reset, "Done_2" is applied only to one cycle.
Section B	A running "MC_MoveRelative" job (A1) is overridden by another "MC_MoveRelative" job (A2). The abort is signaled at time ② via "Abort_1". The axis is then moved at the new velocity by the distance ("Distance") 500.0. When the new target position is reached, this is signaled via "Done_2".

11.1.6 MC_MoveAbsolute

11.1.6.1 MC_MoveAbsolute: Absolute positioning of axes V2

Description

With the Motion Control instruction "MC_MoveAbsolute", you can move an axis to an absolute position.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Synchronous axis
- Positioning axis

Requirements

- The technology object has been configured correctly.
- The technology object is enabled.
- The technology object is homed.

Override response

The "MC_MoveAbsolute" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_MoveAbsolute" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_MoveAbsolute" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Positioning Axis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Position	INPUT	REAL	0.0	Absolute target position	
Velocity	INPUT	LREAL	-1.0	Setpoint velocity for the positioning Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The velocity configured in "Technology object > Configuration > Advanced parameters > Default dynamics" is used. (<TO>.DynamicDefaults.Velocity)	
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)	
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)	
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)	
Direction	INPUT	INT	3	Direction of rotation of the axis Is only evaluated with "modulo" enabled. "Technology object > Configuration > Basic parameters > Enable modulo	
				1	Positive direction of rotation
				2	Negative direction of rotation
				3	Shortest path
Done	OUTPUT	BOOL	FALSE	TRUE Target position reached.	

Parameter	Declaration	Data type	Default value	Description
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Moving an axis to an absolute position

Proceed as follows to move an axis to an absolute position:

1. Check the requirements indicated above.
2. Specify the desired target position at the "Position" parameter.
3. Start the "MC_MoveAbsolute" job with a positive edge at the parameter "Execute".

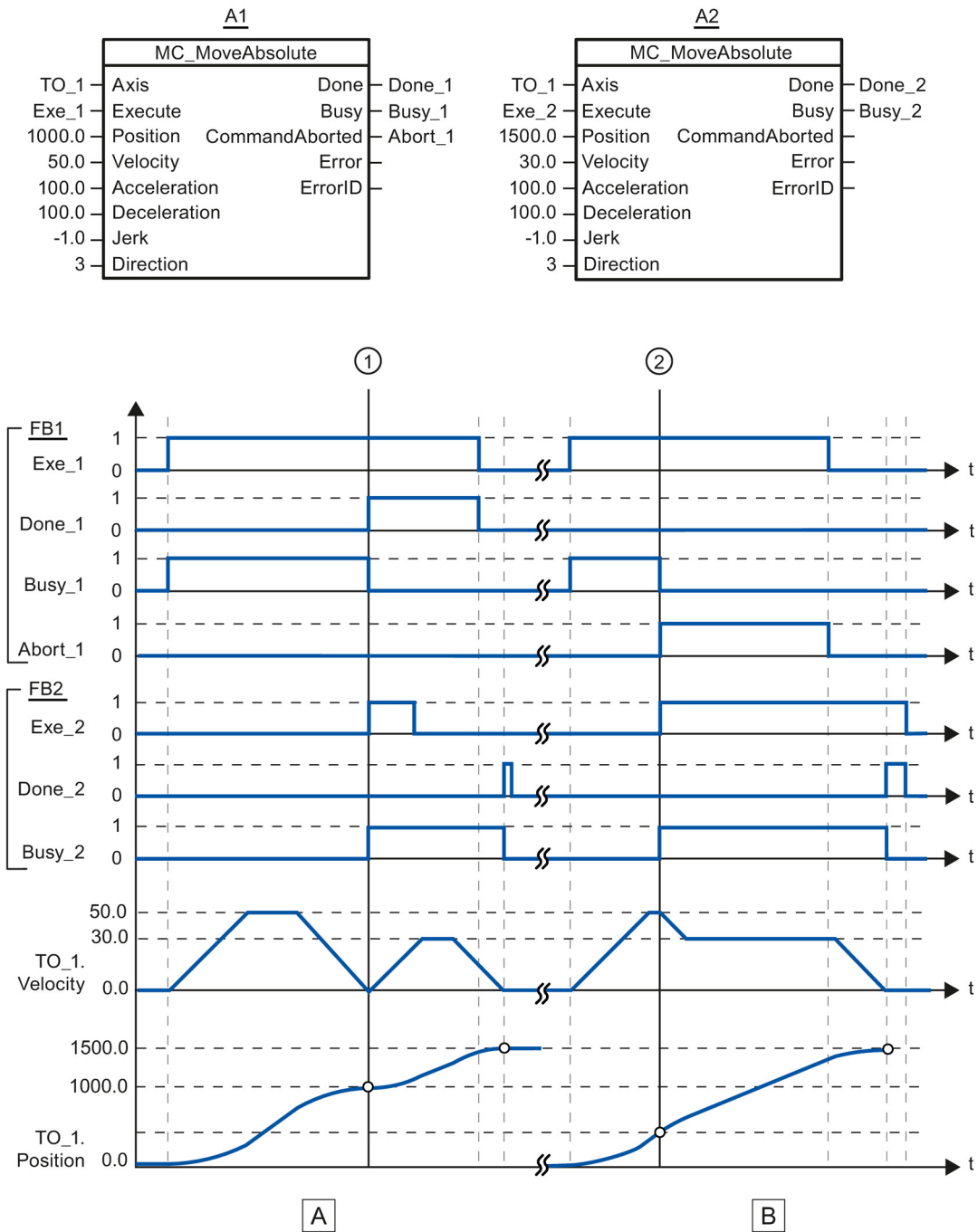
The current motion state is indicated in "Busy", "Done" and "Error".

See also

Error ID (Page 386)

11.1.6.2 MC_MoveAbsolute: Function chart V2

Function chart: Absolute positioning of an axis, and the response to an overriding job



Section A	An axis is moved to absolute position 1000.0 with an "MC_MoveAbsolute" job (A1). When the axis reaches the target position, this is signaled at time ① via "Done_1". At this time ①, another "MC_MoveAbsolute" job (A2) with target position 1500.0 is started. When the axis reaches the target position 1500.0, this is signaled via "Done_2". Since "Exe_2" was previously reset, "Done_2" is applied only to one cycle.
Section B	A running "MC_MoveAbsolute" job (A1) is overridden at time ② by another "MC_MoveAbsolute" job (A2). The abort is signaled via "Abort_1". The axis is braked to the changed velocity and moved to the new target position 1500.0. When the new target position is reached, this is signaled via "Done_2".

11.1.7 MC_MoveSuperimposed

11.1.7.1 MC_MoveSuperimposed: Superimposed positioning of axes V2

Description

With the Motion Control instruction "MC_MoveSuperimposed", you can start a relative positioning motion which is superimposed on a running basic motion.

Dynamic behavior during movement is defined with the parameters "VelocityDiff", "Jerk", "Acceleration" and "Deceleration". The dynamic values are added to the values of the basic motion. The duration of the basic motion is not extended by a superimposed motion.

The dynamic of the total axis motion is the sum of the dynamic values of the basic motion and the superimposed motion.

The behavior of the total motion depends on the type of basic motion:

- The basic motion is a single-axis motion:
 - The maximum dynamic of the superimposed motion is the difference between the current dynamic values of the basic motion and the dynamic limits.
 - The entire motion is limited to the configured dynamic limits.
- The basic motion is a synchronous motion:
 - The maximum dynamic of the superimposed motion is the difference between the current dynamic values of the basic motion and the dynamic limits.
 - The synchronous motion of the following axis is not limited to the dynamic limits of the following axis.
 - A "MC_MoveSuperimposed" job on a lead axis in synchronous operation affects the lead axis and the following axis.
 - A "MC_MoveSuperimposed" job on a following axis in synchronous operation only affects the following axis.

It is always the dynamic of the total motion that is displayed in the technology data block and in the TIA Portal.

Applies to

- Synchronous axis
- Positioning axis

Requirements

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveSuperimposed" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Starting a "MC_MoveSuperimposed" job aborts an active "MC_MoveSuperimposed" job.

Parameters

The following table shows the parameters of the "MC_MoveSuperimposed" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_PositioningAxis	-	Axis technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Distance	INPUT	LREAL	0.0	Additional travel distance for the superimposing positioning operation (negative or positive)
VelocityDiff	INPUT	LREAL	-1.0	Maximum velocity deviation compared to the running motion Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The velocity configured in "Technology object > Configuration > Advanced parameters > Default dynamics" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE Superimposed positioning complete
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.

Parameter	Declaration	Data type	Default value	Description
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	0	Error ID (Page 386) for parameter "Error"

Starting superimposed positioning motion

To start a superimposed positioning motion with the "MC_MoveSuperimposed" Motion Control instruction, follow these steps:

1. Check the requirements indicated above.
2. Specify the additional distance to be moved in the "Distance" parameter.
3. Start the "MC_MoveSuperimposed" job with a positive edge at the parameter "Execute".

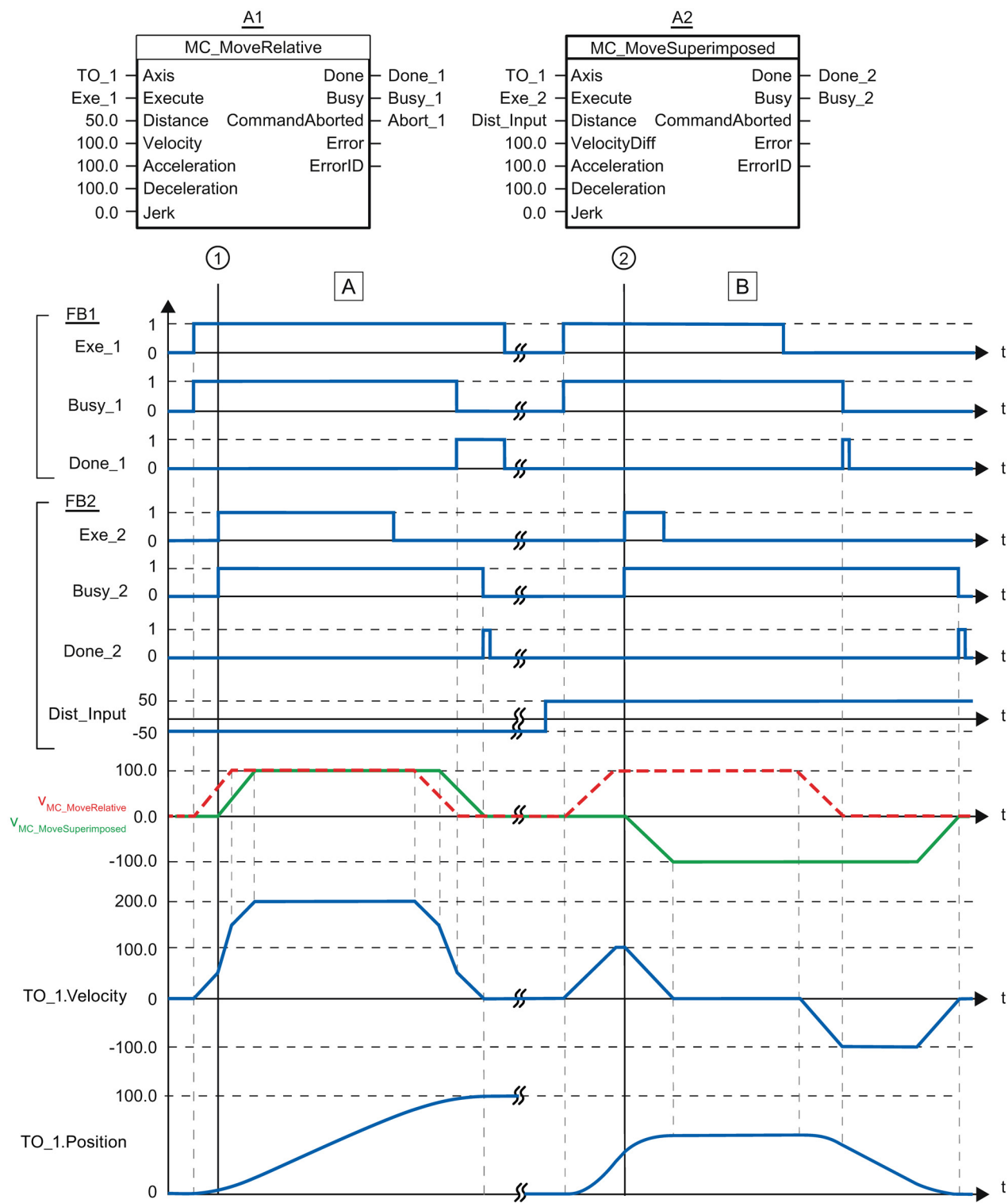
The current motion state is indicated in "Busy", "Done" and "Error".

See also

Error ID (Page 386)

11.1.7.2 MC_MoveSuperimposed: Function chart V2

Function chart: Superimposed positioning of axes



Section A	Using "Exe_1", an "MC_MoveRelative" job with a distance of 50.0 is initiated. At the point in time ①, using "Exe_2", a MC_MoveSuperimposed job with a distance of 50.0 is initiated. The axis is traversed with the added dynamic values of both jobs with the distance $50 + 50 = 100.0$. When the axis reaches the target position, "Done_2" is signaled.
Section B	Using "Exe_1", an "MC_MoveRelative" job with a distance of 50.0 is initiated. At the point in time ②, using "Exe_2", a MC_MoveSuperimposed job with a distance of -50.0 is initiated. The axis is traversed with the added dynamic values of both jobs with the distance $50.0 - 50.0 = 0.0$. When the axis reaches the target position, "Done_2" is signaled.

11.1.8 MC_GearIn

11.1.8.1 MC_GearIn: Start gearing V2

Description

With the Motion Control instruction "MC_GearIn", you can start a relative gearing between a leading axis and a following axis.

Dynamic behavior of the following axis during synchronization is defined with the parameters "Jerk", "Acceleration", and "Deceleration" .

You specify the gear ratio as the relationship between two integers (numerator/denominator) with the parameters "RatioNumerator" and "RatioDenominator". You can change the gear ratio during operation by placing a new "MC_GearIn" job. Transition processes are executed with the specified dynamic values.

The numerator of the gear ratio is specified as positive or negative. This results in the following response:

- **Positive gear ratio:**
The leading and following axes move in the same direction.
- **Negative gear ratio:**
The following axis rotates in the opposite direction of the leading axis.

You can start synchronous operation when the leading axis is at a standstill or when it is in motion.

A position offset can occur between leading axis and following axis during synchronization. This position offset depends on the start time of the "MC_GearIn" and the duration of the synchronization process. The position offset is not compensated.

Applies to

- Synchronous axis

Requirements

- The technology object has been configured correctly.
- The leading axis is a positioning axis or synchronous axis.
- The following axis is a synchronous axis.
- The leading axis is specified as possible leading axis in the configuration of the following axis in "Technology object > Configuration > Master value interconnections".
- The following axis is enabled.

Override response

The "MC_GearIn" job is aborted by:

- Disabling the following axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_GearIn" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Disabling the leading axis with "MC_Power.Enable" = FALSE does not abort synchronous operation. The following axis follows the leading axis even during the braking ramp and after the leading axis is enabled again.

Parameter

The following table shows the parameters of the "MC_GearIn" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Master	InOut	TO_PositioningAxis	-	Leading axis technology object
Slave	InOut	TO_SynchronousAxis	-	Following axis technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
RatioNumerator	INPUT	DINT	1	Gear ratio numerator Permitted integer values: -2147483648 to 2147483648 (value 0 not permitted)
RatioDenominator	INPUT	DINT	1	Gear ratio denominator Permitted integer values: 1 to 2147483648
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
InGear	OUTPUT	BOOL	FALSE	TRUE Synchronous operation reached The following axis is synchronized and moves synchronously to the leading axis.
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.

Parameter	Declaration	Data type	Default value	Description
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	0	Error ID (Page 386) for parameter "Error"

Starting synchronous operation

To start synchronous operation with the "MC_GearIn" Motion Control instruction, follow these steps:

1. Check the requirements indicated above.
2. Specify the leading axis, the following axis and the gear ratio at the corresponding parameters.
3. Start the "MC_GearIn" job with a positive edge at the parameter "Execute".

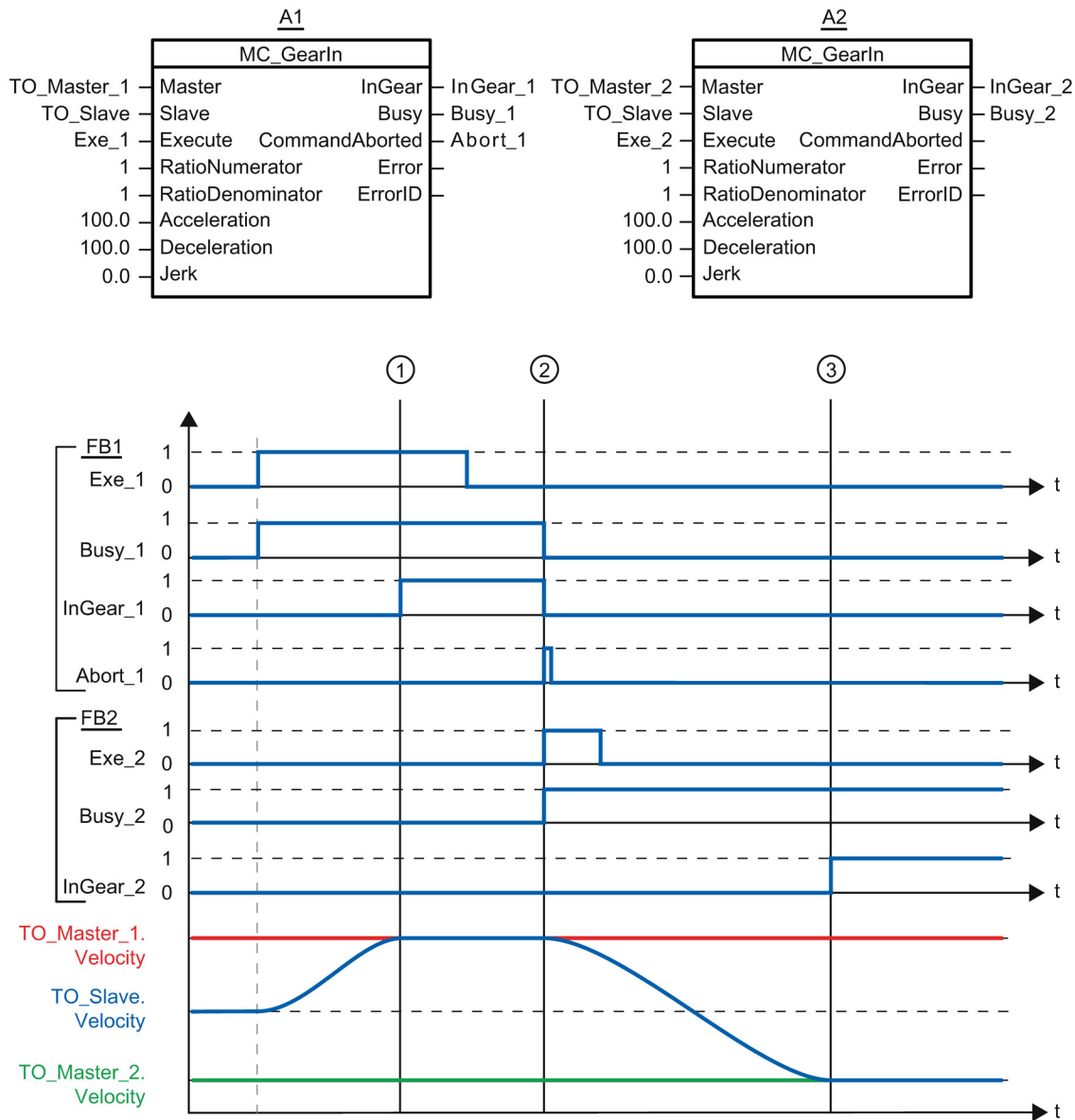
The following axis is synchronized to the master value of the leading axis. If the "InGear" parameter shows the value TRUE, the following axis is synchronized and moves synchronously to the leading axis. The parameters "InGear" and "Busy" show the value TRUE until the "MC_GearIn" job is overridden by another Motion Control job.

See also

Error ID (Page 386)

11.1.8.2 MC_GearIn: Function chart V2

Function chart: Synchronizing and switching the master value



Using "Exe_1", an "MC_GearIn" job (A1) is initiated. The following axis (TO_Slave) is synchronized to the leading axis (TO_Master_1). "InGear_1" signals at time ① that the following axis is synchronized and moves synchronously to the leading axis.

At time ②, synchronous operation is overridden by another "MC_GearIn" job (A2). The abort is signaled via "Abort_1". The following axis is synchronized to the new leading axis (TO_Master_2). "InGear_2" signals at time ③ that the following axis is synchronized and moves synchronously to the leading axis.

11.1.9 MC_Halt

11.1.9.1 MC_Halt: Stop axes V2

Description

With the Motion Control instruction "MC_Halt", you can brake an axis to a standstill.

Dynamic behavior during the braking process is defined with the parameters "Jerk" and "Deceleration".

Applies to

- Synchronous axis
- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_Halt" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job

Starting a "MC_Halt" job aborts the following active Motion Control jobs:

- "MC_Home" job "Mode" = 3, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job
- "MC_GearIn" job
- "MC_MoveSuperimposed" job

Parameters

The following table shows the parameters of the "MC_Halt" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_SpeedAxis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE Zero velocity reached
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Braking an axis with "MC_Halt"

Proceed as follows to decelerate an axis to a standstill:

1. Check the requirements indicated above.
2. Supply the parameters "Deceleration" and "Jerk" with the desired values.
3. Start the "MC_Halt" job with a positive edge at the parameter "Execute".

The current motion state is indicated in "Busy", "Done" and "Error". The standstill of the axis is indicated under "Technology object > Diagnostics > Status and error bits > Motion status > Standstill" (<TO>.StatusWord.X7 (Standstill)).

Additional information

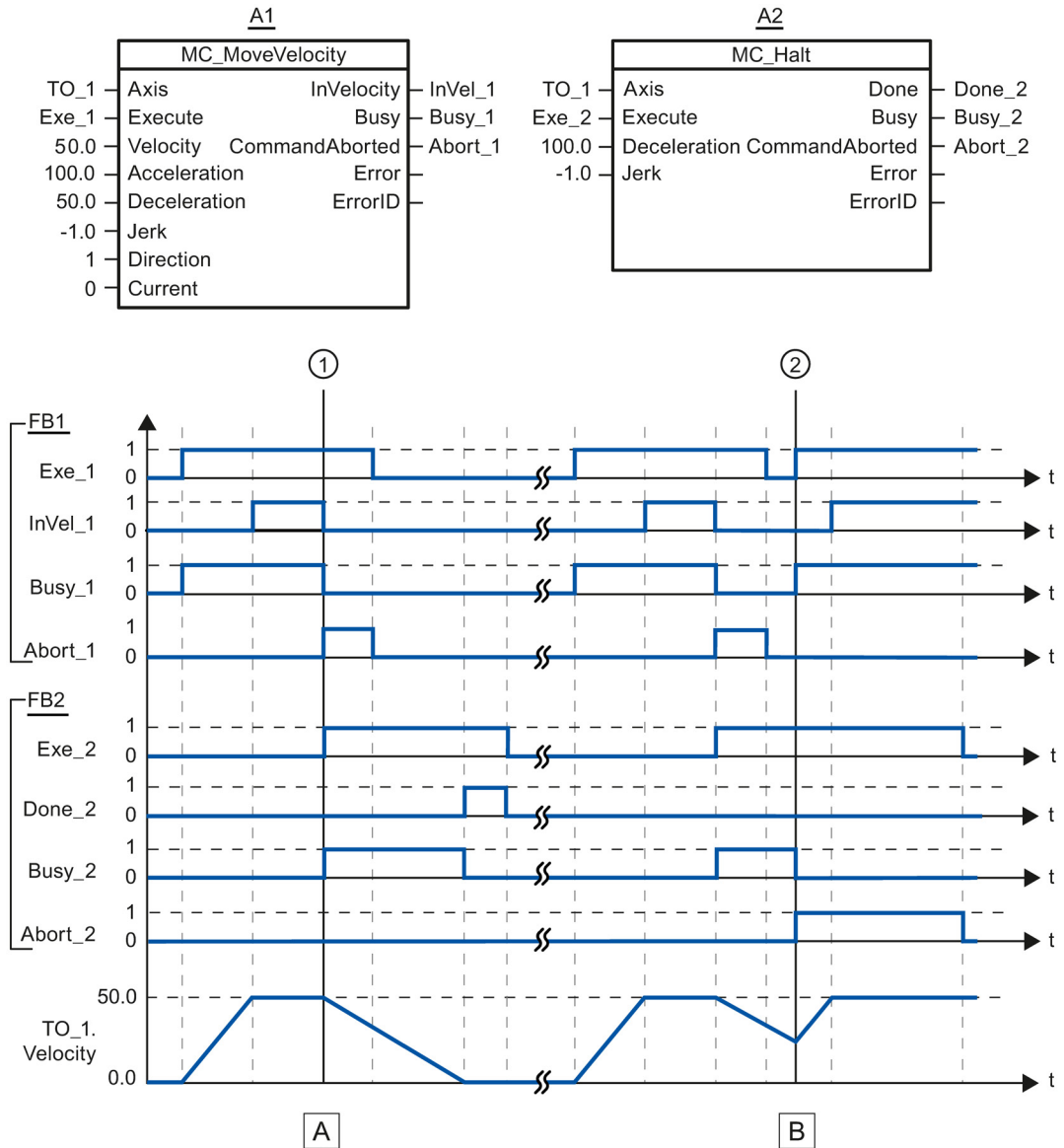
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.1.9.2 MC_Halt: Function chart V2

Function chart: Stopping an axis, and the response to an overriding job



Section A	An axis is moved with an "MC_MoveVelocity" job (A1). When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". At time ①, the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job termination is signaled via "Abort_1". The axis is braked to a standstill. Successful completion of the "MC_Halt" job is signaled via "Done_2".
Section B	The axis is moved with an "MC_MoveVelocity" job (A1). When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". Next the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job termination is signaled via "Abort_1". During the braking process the "MC_Halt" job is overridden at time ② by an "MC_MoveVelocity" job (A1). The job termination is signaled via "Abort_2". When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". The axis is then moved with constant velocity.

11.1.10 MC_Reset

11.1.10.1 MC_Reset: Acknowledge alarms, restart technology objects V2

Description

All technology alarms that can be acknowledged in the user program are acknowledged with the Motion Control instruction "MC_Reset". Acknowledgment also resets the "Error" and "Warning" bits in the technology data block.

Technology objects are reinitialized (restarted) using the Motion Control instruction "MC_Reset" with "Restart" = TRUE. Upon restart of the technology object, the new configuration data are applied in the technology data block.

Applies to

- Synchronous axis
- Positioning axis
- Speed axis
- External encoder

Requirements

- The cause of the error for a pending technology alarm has been resolved.
- For a restart, the technology object must be disabled.
("MC_Power.Status" = FALSE and "MC_Power.Busy" = FALSE)

Override response

- Parameter "Restart" = FALSE:
Processing of the instruction "MC_Reset" can be aborted by other Motion Control jobs. The MC_Reset job does not abort any running Motion Control jobs.
- Parameter "Restart" = TRUE:
The processing of the instruction "MC_Reset" with parameter "Restart" = TRUE cannot be aborted by any other Motion Control job.

Parameters

The following table shows the parameters of the "MC_Reset" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_Axis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Restart	INPUT	BOOL	FALSE	TRUE "Restart" Reinitialization of the technology object and acknowledgment of pending technology alarms. The technology object is reinitialized with the configured start values.
				FALSE Acknowledgement of queued technology alarms.
Done	OUTPUT	BOOL	FALSE	TRUE Error has been acknowledged. Restart has been executed.
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
Command Aborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Acknowledging technology alarms

To acknowledge technology alarms, follow these steps:

1. Check the requirements indicated above.
2. Set the parameter "Restart" = FALSE.
3. Start the acknowledgement of the error with a positive edge at parameter "Execute".

If the Done parameter shows the value TRUE, then the error was acknowledged.

Note

Acknowledging with "Restart" = FALSE

If only the technology alarms are to be acknowledged, set "Restart" = FALSE. The technology object cannot be used during a restart.

Restarting a technology object

Proceed as follows to restart a technology object:

1. Check the requirements indicated above.
2. Set the parameter "Restart" = TRUE.
3. Perform the restart with a positive edge at the input parameter "Execute".

If the "Done" parameter shows the value TRUE, then the restart of the technology object has been completed.

Additional information on a restart can be found in the Restarting Technology Objects (Page 197) section.

See also

Error ID (Page 386)

11.2 S7-1500 Motion Control V1

11.2.1 MC_Power

11.2.1.1 MC_Power: Enable, disable technology objects V1

Description

The Motion Control instruction "MC_Power" is used to enable and disable technology objects.

Applies to

- Positioning axis
- Speed axis
- External encoder

Requirements

- The technology object has been configured correctly.

Override response

- A MC_Power job cannot be aborted by any other Motion Control job.
- A MC_Power job with the parameter Enable = TRUE enables a technology object, but does not thereby abort any other Motion Control instructions.
- Disabling the technology object (parameter "Enable" = FALSE) aborts all Motion Control jobs at the corresponding technology object in accordance with the selected "StopMode". This process cannot be aborted by the user.

Parameters

The following table shows the parameters of the "MC_POWER" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Axis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	The technology object is enabled.
				FALSE	The technology object is disabled. All current jobs at the technology object are aborted in accordance with the configured "StopMode".
StopMode	INPUT	INT	0	Not applicable to the external encoder technology object. If you disable a technology object with a falling edge at the Enable parameter, then the axis decelerates in accordance with the selected "StopMode".	
				0	Emergency stop When the technology object is disabled, the axis brakes to a standstill without any jerk limitation, using the emergency stop deceleration configured in Technology object > Configuration > Extended parameters > Emergency stop ramp. Enabling is then removed. (<TO>.DynamicDefaults. EmergencyDeceleration)
				1	Immediate stop When a technology object is disabled, the setpoint zero is output, and the enabling is removed. The axis is braked depending on the configuration in the drive, and is brought to a standstill.
				2	Stop with maximum dynamic values When the technology object is disabled, the axis brakes to a standstill using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic limits". The configured maximum jerk is taken into account at the same time. Enabling is then removed. (<TO>.DynamicLimits.MaxDeceleration; <TO>.DynamicLimits.MaxJerk)
Status	OUTPUT	BOOL	FALSE	Technology object enable status	
				FALSE	Disabled - A positioning axis or speed axis does not accept any Motion Control jobs. - Speed control and position control are not active. - The actual values of the technology object are not checked for validity.
				TRUE	Enabled - An enabled positioning axis or speed axis accepts Motion Control jobs. - Speed control and positioning control are active. - The actual values of the technology object are valid.

Parameter	Declaration	Data type	Default value	Description
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred in Motion Control instruction MC_Power. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Enabling technology objects

To enable a technology object, set the Enable parameter to TRUE.

If the Status parameter shows the value TRUE , then the technology object is enabled.

If an axis is in motion when the technology object is enabled (actual velocity is present), then the axis brakes to the setpoint zero, using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic limits" (<TO>.DynamicLimits.MaxDeceleration). This braking ramp can be overridden by Motion Control jobs.

Note

Automatic enabling after acknowledgement of a technology alarm

If the technology object is disabled due to a technology alarm, then it will automatically be enabled again after the cause has been eliminated and the alarm has been acknowledged. This requires the Enable parameter to have retained the value TRUE during this process.

Disabling technology objects

To disable a technology object, set the Enable parameter to FALSE.

If an axis is in motion, then it will be braked to a standstill according to the selected "StopMode".

If the "Busy" and "Status" parameters show the value FALSE , then the disabling of the technology object has been completed.

Drive connection by means of PROFIdrive

When coupling a drive with PROFIdrive, the setpoint, enabling, and drive status are transmitted via the PROFIdrive frame.

- **Enable technology object and drive**

The parameter ""Enable" = TRUE" is used to enable the technology object. The drive is enabled according to the PROFIdrive standard.

If the tag <TO>.StatusDrive.InOperation shows the value TRUE , then the drive is ready to execute setpoints. The "Status" parameter is set to the value TRUE .

- **Disable technology object and drive**

With the parameter "Enable" = FALSE, the "Status" parameter is set to the value FALSE, and the axis is braked according to the selected "StopMode". The drive is disabled according to the PROFIdrive standard.

Analog drive connection

The setpoint is output via an analog output. Optionally, you can configure an enabling signal via digital output (<TO>.Actor.Interface.EnableDriveOutput), and a readiness signal via digital input (<TO>.Actor.Interface.DriveReadyInput).

- **Enable technology object and drive**

With the parameter "Enable" = TRUE, the enabling output ("Enable drive output") is set.

If the drive reports back the readiness signal via the ready input ("Drive ready input"), then the "Status" parameter and the technology object's <TO>.StatusDrive.InOperation tag are set to TRUE, and the setpoint is switched at the analog output.

- **Disable technology object and drive**

With the parameter "Enable" = FALSE, the "Status" parameter is set to the value FALSE, and the axis is braked according to the selected "StopMode". When the setpoint zero is reached, the enabling output is set to FALSE.

Additional information

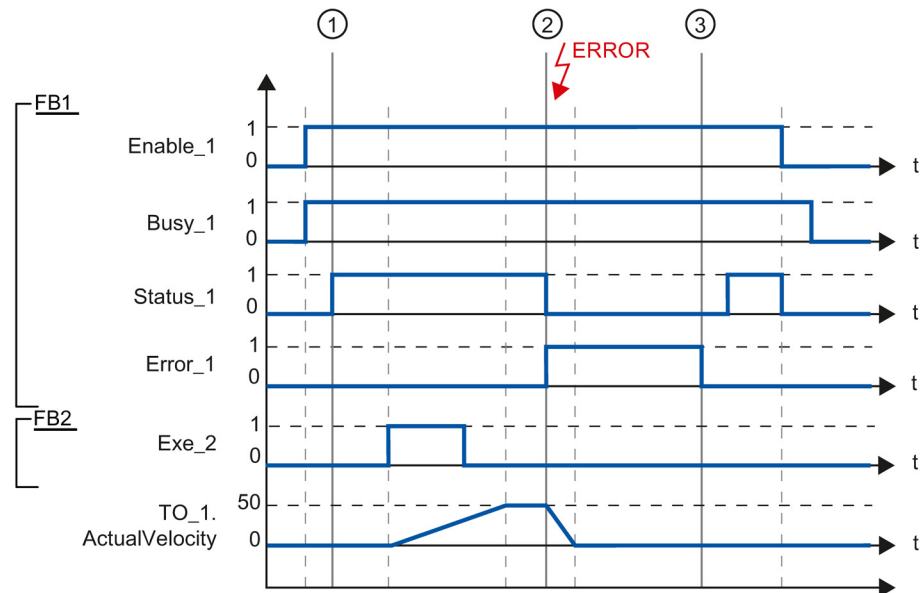
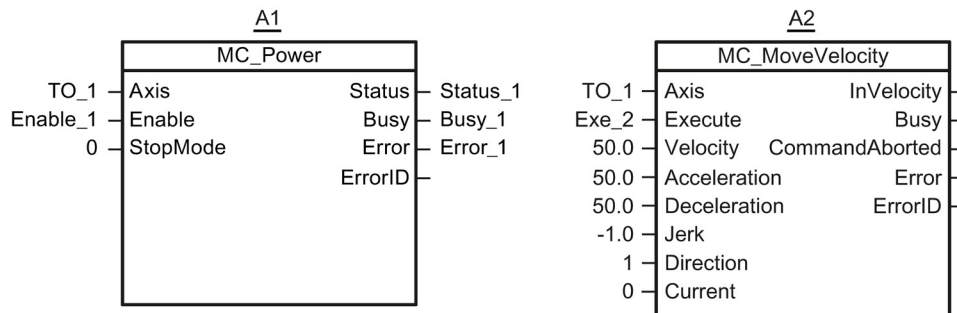
Additional information on enabling and disabling technology objects and drives can be found in the appendix, MC_Power Function Charts (Page 388).

See also

Error ID (Page 386)

11.2.1.2 MC_Power: Function chart V1

Function chart: Enabling a technology object, and example for alarm response



A technology object is enabled with "Enable_1= TRUE". Successful enabling can be read from "Status_1" at time ①. The axis will then move with an "MC_MoveVelocity" job (A2). The velocity profile of the axis can be read from "Velocity Axis_1".

At time ② an error occurs in the technology object, which results in the disabling of the technology object (alarm response: Remove enable). The axis is braked depending on the configuration in the drive, and is brought to a standstill. When the technology object is disabled, Status_1 is reset. Since the axis was not disabled using "Enable_1" = FALSE, the selected "StopMode" does not apply. The cause of the error is corrected and the alarm is acknowledged at time ③.

Since "Enable_1" is still set, the technology object is enabled again. Successful enabling can be read from "Status_1". Next the technology object is disabled with "Enable_1" = FALSE.

11.2.2 MC_Home

11.2.2.1 MC_Home: Home technology objects, set home position V1

Description

With the Motion Control instruction "MC_Home", you create the relationship between the position in the technology object and the mechanical position. The position value in the technology object is assigned to a homing mark at the same time. This homing mark represents a known mechanical position.

The homing process occurs according to the mode selected with the "HomingMode" parameter, and the configuration under "Technology object > Configuration > Extended parameters > Homing".

The preset values under "Technology object > Configuration > Extended parameters > Dynamic default values" are used for the dynamic values Acceleration, Deceleration and Jerk.

Applies to

- Positioning axis
- External encoder

The following table shows which modes are possible with each of the technology objects:

Operating mode	Positioning axis with incremental encoder	Positioning axis with absolute encoder	External incremental encoder	External absolute encoder
Active homing (HomingMode = 4, 5)	X	-	-	-
Passive homing (HomingMode = 2, 3, 8)	X	-	X	-
Setting a positioning value ("HomingMode" = 0)	X	X	X	X
Relative shift of the actual value ("HomingMode" = 1)	X	X	X	X
Homing absolute encoder ("HomingMode" = 6, 7)	-	X	-	X

Requirement

- The technology object has been configured correctly.
- "HomingMode" = 2, 3, 4, 5, 8
The technology object must be enabled.
- "HomingMode" = 0, 1, 2, 6, 7
The encoder values must be valid. (<TO>.StatusSensor[n].State = 2)

Override response

- An MC_Home job for passive homing is aborted by:
 - Disabling the technology object by means of "MC_Power.Enable" = FALSE
 - "MC_Home" job with parameter "HomingMode" = 4, 5, 9
- An "MC_Home" job for passive homing does not abort any other Motion Control jobs.
- An "MC_Home" job for active homing is aborted by:
 - Disabling the technology object with "MC_Power.Enable" = FALSE
 - "MC_Home" job "HomingMode" = 4, 5
 - "MC_Halt" job
 - "MC_MoveAbsolute" job
 - "MC_MoveRelative" job
 - "MC_MoveVelocity" job
 - "MC_MoveJog" job
- An "MC_Home" job for active homing aborts the following running Motion Control jobs.
 - "MC_Home" job with parameter "HomingMode" = 2, 3, 4, 5
 - "MC_Halt" job
 - "MC_MoveAbsolute" job
 - "MC_MoveRelative" job
 - "MC_MoveVelocity" job
 - "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_Home" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Axis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Position	INPUT	LREAL	0.0	The specified value is used according to the selected "HomingMode".	
HomingMode	INPUT	INT	4	Operating mode	
				0	Direct homing (absolute) The current position of the technology object is set to the value of parameter "Position".
				1	Direct homing (relative) The current position of the technology object is shifted by the value of parameter "Position".
				2	Passive homing When the homing mark is detected, the actual value is set to the value of the "Position" parameter.
				3	Passive homing ("Position" parameter has no effect) When the homing mark is detected, the actual value is set to the home position configured under "Technology object > Configuration > Extended parameters > Homing > Passive homing". (<TO>.Homing.HomePosition)
				4	Active homing The TO positioning axis performs a homing movement according to the configuration. After the completion of the movement, the axis is positioned at the value of the "Position" parameter.
5	Active homing ("Position" parameter has no effect) The TO positioning axis performs a homing movement according to the configuration. After completion of the movement, the axis is positioned at the home position configured under "Technology object > Configuration > Extended parameters > Homing > Active homing". (<TO>.Homing.HomePosition)				

Parameter	Declaration	Data type	Default value	Description
				6 Absolute encoder adjustment (relative) The current position is shifted by the value of the parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[n].AbsEncoderOffset)
				7 Absolute encoder adjustment (absolute) The current position is set to the value of the parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[n].AbsEncoderOffset)
				8 Passive homing (without reset) Functions like "HomingMode" 2, with the difference that the "homed" status is not reset when the function is enabled.
				9 Canceling passive homing A running job for passive homing is aborted.
Done	OUTPUT	BOOL	FALSE	TRUE Job is completed
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Resetting the "Homed" status

The "Homed" status of a technology object is reset under the following conditions (<TO>.StatusWord.X5 (HomingDone)):

- **Technology objects with incremental actual values:**
 - Starting an "MC_Home" job with "HomingMode" = 2, 3, 4, 5
(After successful completion of the homing operation, the "Homed" status is reset.)
 - Error in the encoder system, or encoder failure
 - Restart of the technology object
 - After POWER OFF -> POWER ON of the CPU
 - Memory reset
 - Modification of the encoder configuration
- **Technology objects with absolute actual values:**
 - Restoration of the CPU factory settings
 - Modification of the encoder configuration
 - Replacement of the CPU

Homing a technology object with "HomingMode" = 1..8

To home a technology object, follow these steps:

1. Check the requirements indicated above.
2. Specify the desired homing function in the "HomingMode" parameter.
3. Initialize the necessary parameters with values, and start the homing operation with a positive edge at the "Execute" parameter.

If the "Done" parameter shows the value TRUE, then the "MC_Home" job has been completed according to the selected "HomingMode". The "Homed" status of the technology object is indicated under "Technology object > Diagnostics > Status and error bits > Motion status > Homed" (<TO>.StatusWord.X5 (HomingDone)).

Termination of a passive homing process with "HomingMode" = 9

With "HomingMode" = 9, the technology object is not homed. If a running "MC_Home" job for passive homing ("HomingMode" = 2, 3, 8) is overridden by another "MC_Home" job with "HomingMode" = 9, then the running job is terminated with the parameter "CommandAborted" = TRUE. The overriding job with "HomingMode" = 9 signals successful execution with the parameter "Done" = TRUE.

Additional information

An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.2.3 MC_MoveJog

11.2.3.1 MC_MoveJog: Move axes in jog mode V1

Description

With the Motion Control instruction "MC_MoveJog", you can move an axis in jog mode. Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis:
A velocity is specified in the "Velocity" parameter.
- Speed axis:
A speed is specified at the "Velocity" parameter.

Applies to

- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveJog" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Starting a "MC_MoveJog" job aborts the following active Motion Control jobs:

- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_MoveJog" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_SpeedAxis	-	Technology object
JogForward	INPUT	BOOL	FALSE	As long as the parameter is TRUE, the axis moves in the positive direction at the velocity specified in parameter "Velocity".
JogBackward	INPUT	BOOL	FALSE	As long as the parameter is TRUE, the axis moves in the negative direction at the velocity specified in parameter "Velocity".
Velocity	INPUT	LREAL	100.0	Setpoint speed / setpoint speed for the motion process Value > 0.0: The specified value is used. Value < 0.0: The specified value is used. ("Velocity" = 0.0 is permitted)
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used. Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
InVelocity	OUTPUT	BOOL	FALSE	TRUE The setpoint velocity / setpoint speed was reached and will be maintained.
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Behavior with setpoint velocity / setpoint speed zero (Velocity" = 0.0)

An "MC_MoveJog" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the setpoint velocity / setpoint speed zero is reached, the parameter "InVelocity" will indicate the value TRUE.

Under "Technology object > Diagnostics > Status and error bits > Motion status", "constant velocity" and "standstill" will be displayed (<TO>.StatusWord.X12 (ConstantVelocity); <TO>.StatusWord.X7 (Standstill)).

Moving an axis in jog mode

Proceed as follows to move an axis in jog mode:

1. Check the requirements indicated above.
2. Move the axis in the positive direction with "JogForward", or in the negative direction with "JogBackward".

The current motion state is indicated in "Busy", "InVelocity" and "Error".

Note

Behavior when changing the override

If the velocity / speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), then the "InVelocity" parameter is reset during the acceleration or deceleration. When the newly calculated velocity is reached ("Velocity" × "Override" %), then "InVelocity" is set again.

Additional information

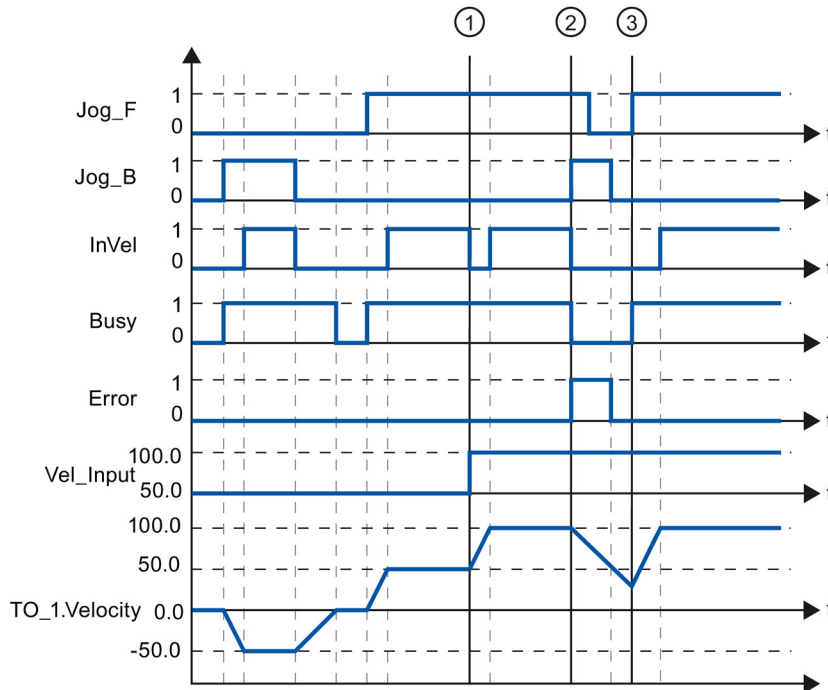
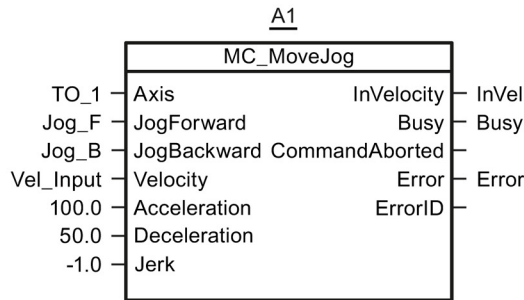
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.2.3.2 MC_MoveJog: Function chart V1

Function chart: Moving an axis in jog mode



The axis is moved in the negative direction in jog mode via "Jog_B". When the setpoint velocity -50.0 is reached, this is signaled via "InVel" = TRUE. After "Jog_B" is reset, the axis is braked and brought to a standstill. Then the axis is moved in the positive direction via "Jog_F". When the setpoint velocity 50.0 is reached, this is signaled via "InVel" = TRUE.

At time ①, if "Jog_F" is set, the setpoint velocity is changed to 100.0 by means of "Vel_Input". Alternatively, you can also change the setpoint velocity via the velocity override. "InVel" is reset. The axis is being accelerated. When the new setpoint velocity 100.0 is reached, this is signaled via "InVel" = TRUE.

If "Jog_F" is set, "Jog_B" is likewise set at time ②. If both "Jog_F" and "Jog_B" are set, then the axis is braked with the last applicable deceleration. An error is indicated via "Error", and the "ErrorID" of the error 16#8007 (incorrect direction specification) is output.

This error is resolved by resetting the two inputs "Jog_F" and "Jog_B".

During the braking ramp, "Jog_F" is set at time ③. The axis is accelerated to the last configured velocity. When the setpoint velocity 100.0 is reached, this is signaled via "InVel" = TRUE.

11.2.4 MC_MoveVelocity

11.2.4.1 MC_MoveVelocity: Move axes at predefined specified velocity V1

Description

With the Motion Control instruction "MC_MoveVelocity", you can move an axis with a constant velocity.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis:
A velocity is specified in the "Velocity" parameter.
- Speed axis:
A speed is specified at the "Velocity" parameter.

Applies to

- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveVelocity" is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Starting a "MC_MoveVelocity" job aborts the following active Motion Control jobs:

- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_MoveVelocity" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_SpeedAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Velocity	INPUT	LREAL	100.0	Setpoint speed / setpoint speed for the motion process ("Velocity" = 0.0 is permitted)	
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)	
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)	
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used. Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)	
Direction	INPUT	INT	0	Direction of rotation of the axis	
				0	The sign of the velocity specified at the "Velocity" parameter defines the direction of rotation.
				1	Positive direction of rotation Value of "Velocity" is used.
				2	Negative direction of rotation Value of "Velocity" is used.

Parameter	Declaration	Data type	Default value	Description	
Current	INPUT	BOOL	FALSE	Maintain current velocity	
				FALSE	Disabled The values of parameters "Velocity" and "Direction" are taken into account.
				TRUE	Enabled The values at the parameters "Velocity" and "Direction" are not taken into account. The current velocity and direction at function start are retained. When the axis resumes motion at the velocity that was current at function start, the "InVelocity" parameter returns the value TRUE.
InVelocity	OUTPUT	BOOL	FALSE	TRUE	The setpoint velocity / setpoint speed was reached and will be maintained.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred during execution of the job. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000		Error ID (Page 386) for parameter "Error"

Behavior with setpoint velocity / setpoint speed zero (Velocity" = 0.0)

An "MC_MoveVelocity" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the setpoint velocity / setpoint speed zero is reached, the parameter "InVelocity" will indicate the value TRUE.

Under "Technology object > Diagnostics > Status and error bits > Motion status", "constant velocity" and "standstill" will be displayed (<TO>.StatusWord.X12 (ConstantVelocity); <TO>.StatusWord.X7 (Standstill)).

The parameters "InVelocity" and "Busy" show the value TRUE, until the "MC_MoveVelocity" job is overridden by another Motion Control job.

Moving an axis with constant velocity / speed

Proceed as follows to move an axis with constant velocity / speed:

1. Check the requirements indicated above.
2. At the parameter "Velocity", specify the velocity / speed, with which the axis should be moved.
3. Start the "MC_MoveVelocity" job with a positive edge at the parameter "Execute".

The current motion state is indicated in "Busy", "InVelocity" and "Error".

If the "InVelocity" parameter shows the value TRUE, then the setpoint velocity / setpoint speed was reached. The axis continues moving at this constant velocity. The parameters "InVelocity" and "Busy" show the value TRUE, until the "MC_MoveVelocity" job is overridden by another Motion Control job.

Note

Behavior when changing the override

If the velocity / speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), then the "InVelocity" parameter is reset during the acceleration or deceleration. When the newly calculated velocity / speed is reached ("Velocity" × "Override" %), then "InVelocity" is reset.

Additional information

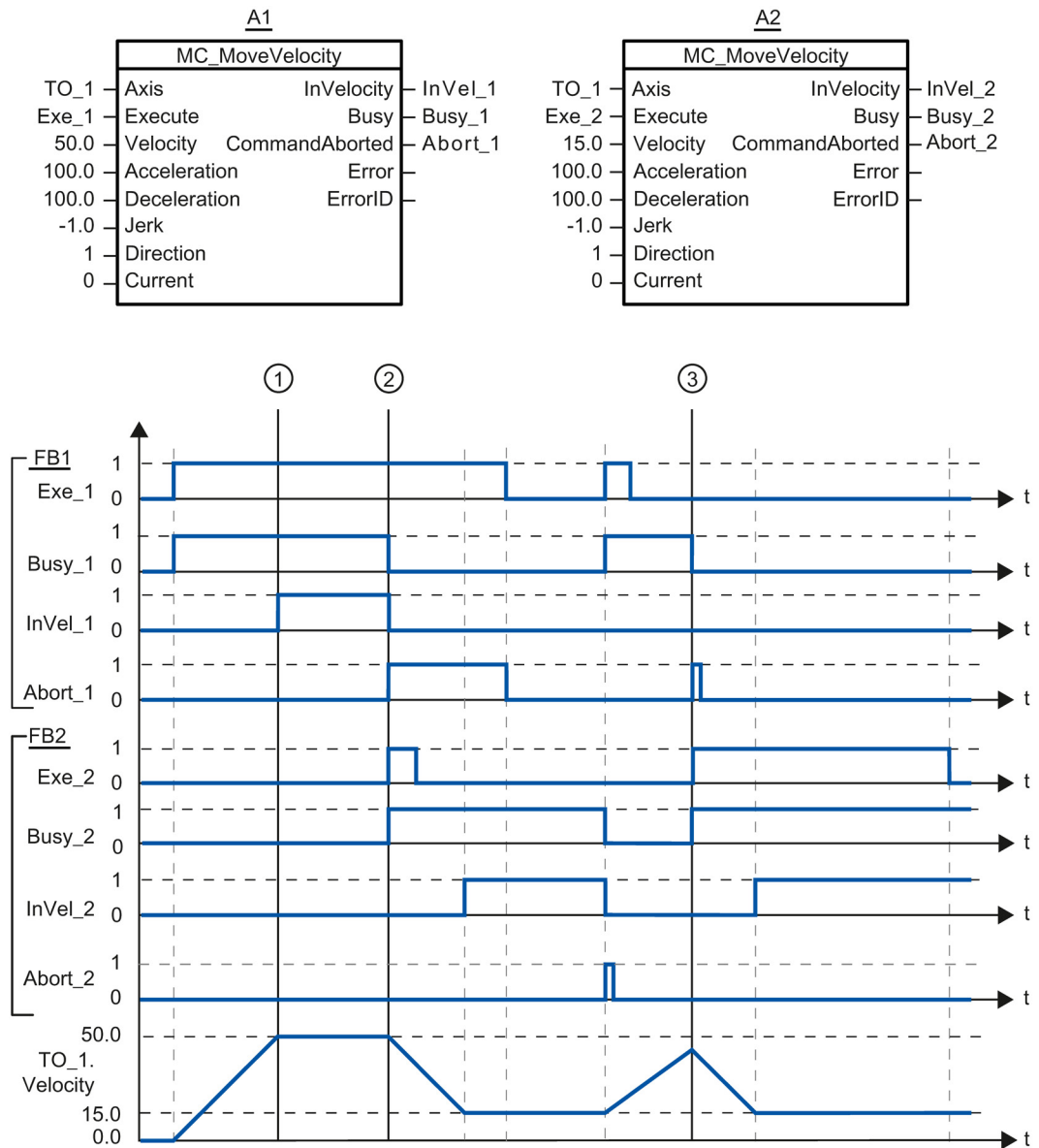
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.2.4.2 MC_MoveVelocity: Function chart V1

Function chart: Moving an axis with specification of velocity, and the response to an overriding job



A "MC_MoveVelocity" job (A1) initiated via "Exe_1" accelerates the axis and signals at time ① via "InVel_1" that the setpoint velocity 50.0 has been reached.

At time ②, the task is overridden via another "MC_MoveVelocity" job (A2). The abort is signaled via "Abort_1". When the new setpoint velocity 15.0 is reached, this is signaled via "InVel_2". The axis then continues moving at the constant velocity 15.0.

The running "MC_MoveVelocity" job (A2) is overridden by another "MC_MoveVelocity" job (A1). The abort is signaled via "Abort_2". The axis is accelerated to the new setpoint velocity 50.0. Before the setpoint velocity is reached, the current "MC_MoveVelocity" job A1) is overridden at time ③ by another "MC_MoveVelocity" job A2). The abort is signaled via "Abort_1". When the new setpoint velocity 15.0 is reached, this is signaled via "InVel_2". The axis then continues moving at the constant velocity 15.0.

11.2.5 MC_MoveRelative

11.2.5.1 MC_MoveRelative: Relative positioning of axes V1

Description

With the Motion Control instruction "MC_MoveRelative", you can move an axis relative to the position that exists at the beginning of job processing.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Positioning axis

Requirements

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_MoveRelative" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Starting a "MC_MoveRelative" job aborts the following active Motion Control jobs:

- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_MoveRelative" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_Positioning Axis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Distance	INPUT	LREAL	0.0	Distance for the positioning process (negative or positive)
Velocity	INPUT	LREAL	-1.0	Setpoint velocity for the positioning Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The velocity configured in "Technology object > Configuration > Advanced parameters > Default dynamics" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE Target position reached
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.

Parameter	Declaration	Data type	Default value	Description
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Moving an axis relative to the starting position

Proceed as follows to move an axis relative to the starting position:

1. Check the requirements indicated above.
2. Specify distance to be moved in the "Distance" parameter.
3. Start the "MC_MoveRelative" job with a positive edge at the parameter "Execute".

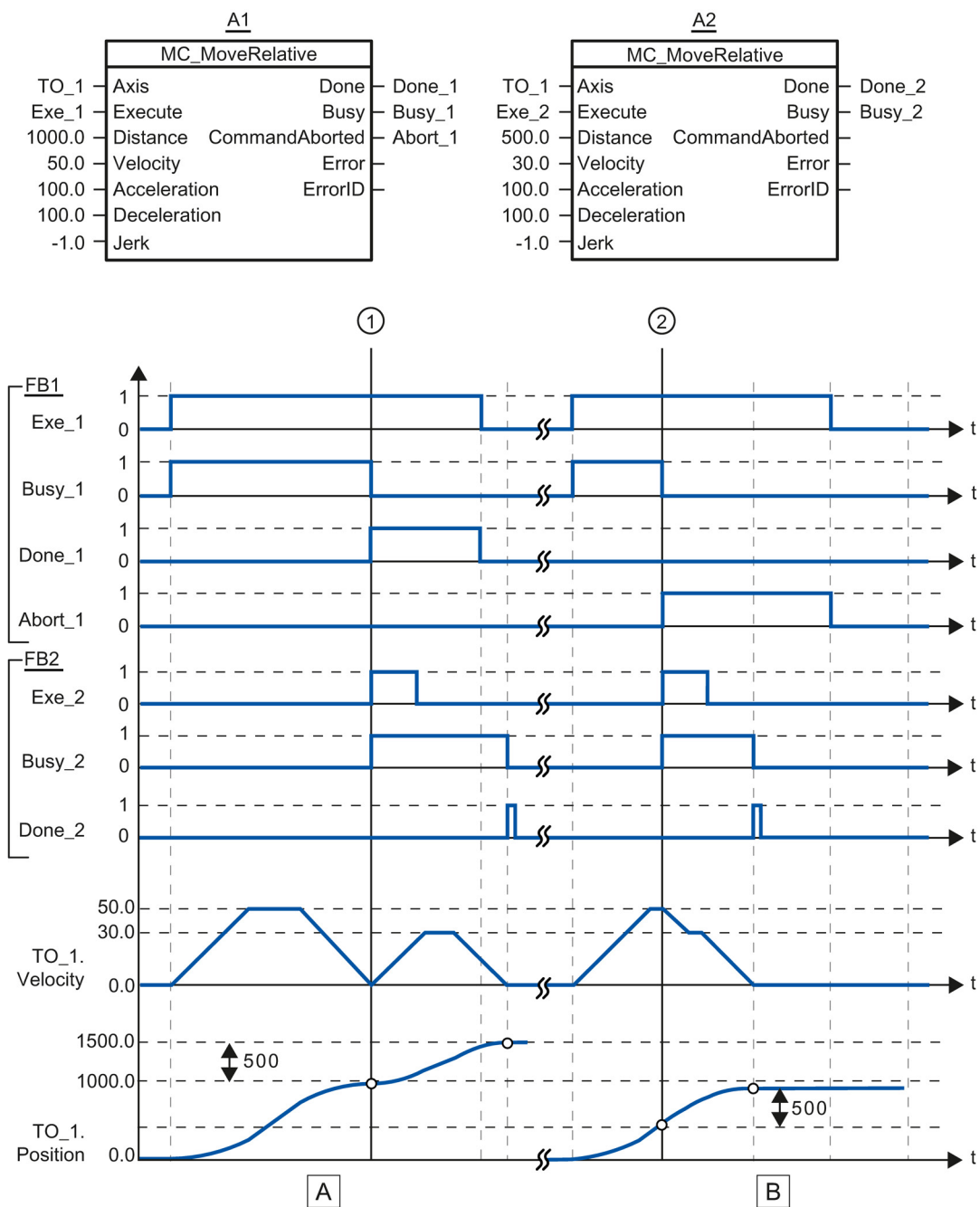
The current motion state is indicated in "Busy", "Done" and "Error".

See also

Error ID (Page 386)

11.2.5.2 MC_MoveRelative: Function chart V1

Function chart: Relative positioning of an axis, and the response to an overriding job



Section A	The axis is moved by an "MC_MoveRelative" job (A1) by the distance ("Distance") 1000.0 (the starting position here is 0.0). When the axis reaches the target position, this is signaled at time ① via "Done_1". At this time ①, another "MC_MoveRelative" job (A2) with distance 500.0 is started. When the axis reaches the new target position, this is signaled via "Done_2". Since "Exe_2" was previously reset, "Done_2" is applied only to one cycle.
Section B	A running "MC_MoveRelative" job (A1) is overridden by another "MC_MoveRelative" job (A2). The abort is signaled at time ② via "Abort_1". The axis is then moved at the new velocity by the distance ("Distance") 500.0. When the new target position is reached, this is signaled via "Done_2".

11.2.6 MC_MoveAbsolute

11.2.6.1 MC_MoveAbsolute: Absolute positioning of axes V1

Description

With the Motion Control instruction "MC_MoveAbsolute", you can move an axis to an absolute position.

Dynamic behavior during movement is defined with the parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Positioning axis

Requirements

- The technology object has been configured correctly.
- The technology object is enabled.
- The technology object is homed.

Override response

The "MC_MoveAbsolute" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Starting a "MC_MoveAbsolute" job aborts the following active Motion Control jobs:

- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_MoveAbsolute" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description	
Axis	InOut	TO_Positioning Axis	-	Technology object	
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge	
Position	INPUT	REAL	0.0	Absolute target position	
Velocity	INPUT	LREAL	-1.0	Setpoint velocity for the positioning Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The velocity configured in "Technology object > Configuration > Advanced parameters > Default dynamics" is used. (<TO>.DynamicDefaults.Velocity)	
Acceleration	INPUT	LREAL	-1.0	Acceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)	
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)	
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)	
Direction	INPUT	INT	3	Direction of rotation of the axis Is only evaluated with "modulo" enabled. "Technology object > Configuration > Basic parameters > Enable modulo	
				1	Positive direction of rotation
				2	Negative direction of rotation
				3	Shortest path
Done	OUTPUT	BOOL	FALSE	TRUE Target position reached.	

Parameter	Declaration	Data type	Default value	Description
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Moving an axis to an absolute position

Proceed as follows to move an axis to an absolute position:

1. Check the requirements indicated above.
2. Specify the desired target position at the "Position" parameter.
3. Start the "MC_MoveAbsolute" job with a positive edge at the parameter "Execute".

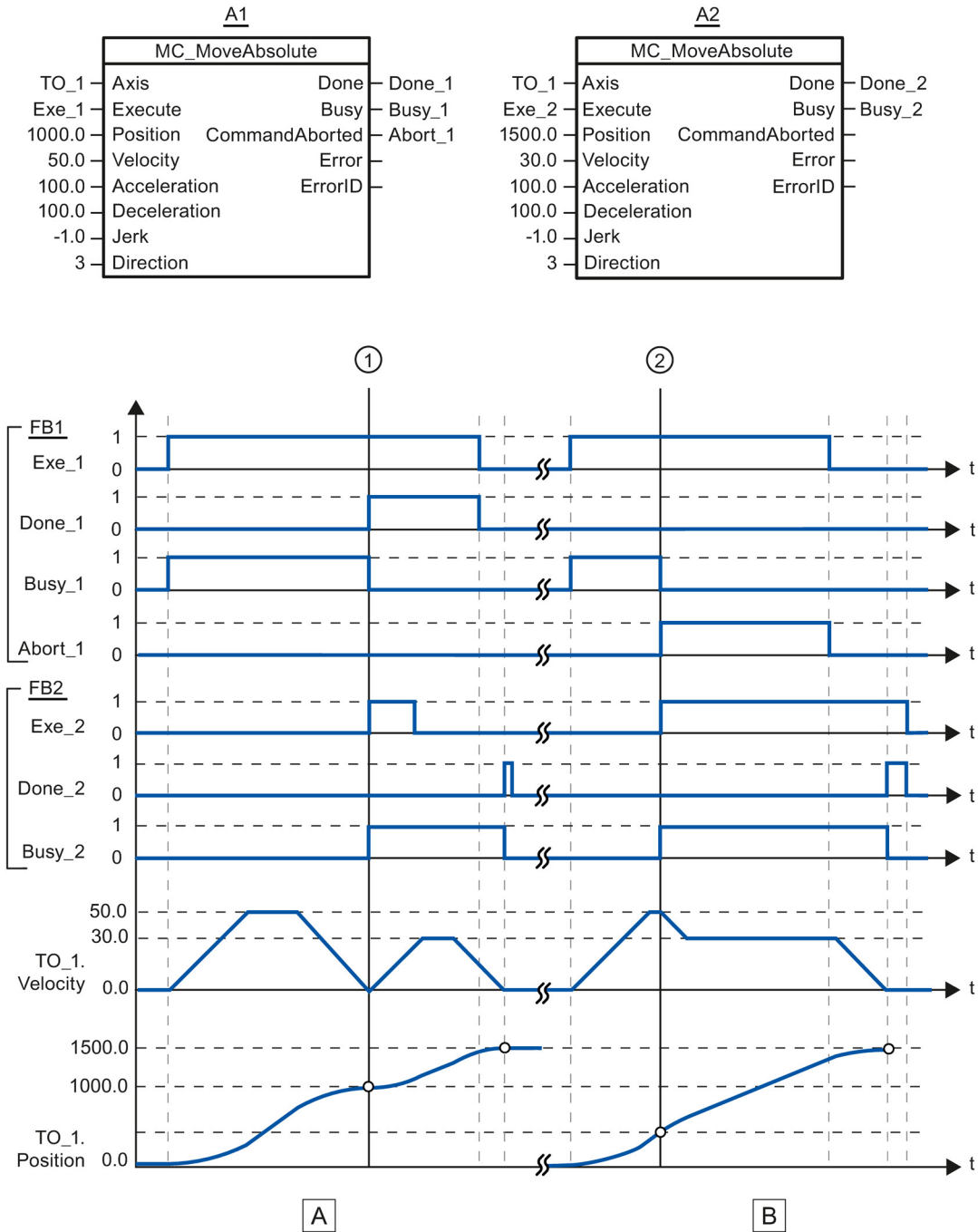
The current motion state is indicated in "Busy", "Done" and "Error".

See also

Error ID (Page 386)

11.2.6.2 MC_MoveAbsolute: Function chart V1

Function chart: Absolute positioning of an axis, and the response to an overriding job



Section A	An axis is moved to absolute position 1000.0 with an "MC_MoveAbsolute" job (A1). When the axis reaches the target position, this is signaled at time ① via "Done_1". At this time ①, another "MC_MoveAbsolute" job (A2) with target position 1500.0 is started. When the axis reaches the target position 1500.0, this is signaled via "Done_2". Since "Exe_2" was previously reset, "Done_2" is applied only to one cycle.
Section B	A running "MC_MoveAbsolute" job (A1) is overridden at time ② by another "MC_MoveAbsolute" job (A2). The abort is signaled via "Abort_1". The axis is braked to the changed velocity and moved to the new target position 1500.0. When the new target position is reached, this is signaled via "Done_2".

11.2.7 MC_Halt

11.2.7.1 MC_Halt: Stop axes V1

Description

With the Motion Control instruction "MC_Halt", you can brake an axis to a standstill.

Dynamic behavior during the braking process is defined with the parameters "Jerk" and "Deceleration".

Applies to

- Positioning axis
- Speed axis

Requirement

- The technology object has been configured correctly.
- The technology object is enabled.

Override response

The "MC_Halt" job is aborted by:

- Disabling the axis with "MC_Power.Enable" = FALSE
- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Starting a "MC_Halt" job aborts the following active Motion Control jobs:

- "MC_Home" job "HomingMode" = 4, 5
- "MC_Halt" job
- "MC_MoveAbsolute" job
- "MC_MoveRelative" job
- "MC_MoveVelocity" job
- "MC_MoveJog" job

Parameters

The following table shows the parameters of the "MC_Halt" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_SpeedAxis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Deceleration	INPUT	LREAL	-1.0	Deceleration Value > 0.0: The specified value is used. Value = 0.0: not permitted Value < 0.0: The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk Value > 0.0: Constant-acceleration velocity profile; the specified jerk is used Value = 0.0: Trapezoid velocity profile Value < 0.0: The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE Zero velocity reached
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Braking an axis with "MC_Halt"

Proceed as follows to decelerate an axis to a standstill:

1. Check the requirements indicated above.
2. Supply the parameters "Deceleration" and "Jerk" with the desired values.
3. Start the "MC_Halt" job with a positive edge at the parameter "Execute".

The current motion state is indicated in "Busy", "Done" and "Error". The standstill of the axis is indicated under "Technology object > Diagnostics > Status and error bits > Motion status > Standstill" (<TO>.StatusWord.X7 (Standstill)).

Additional information

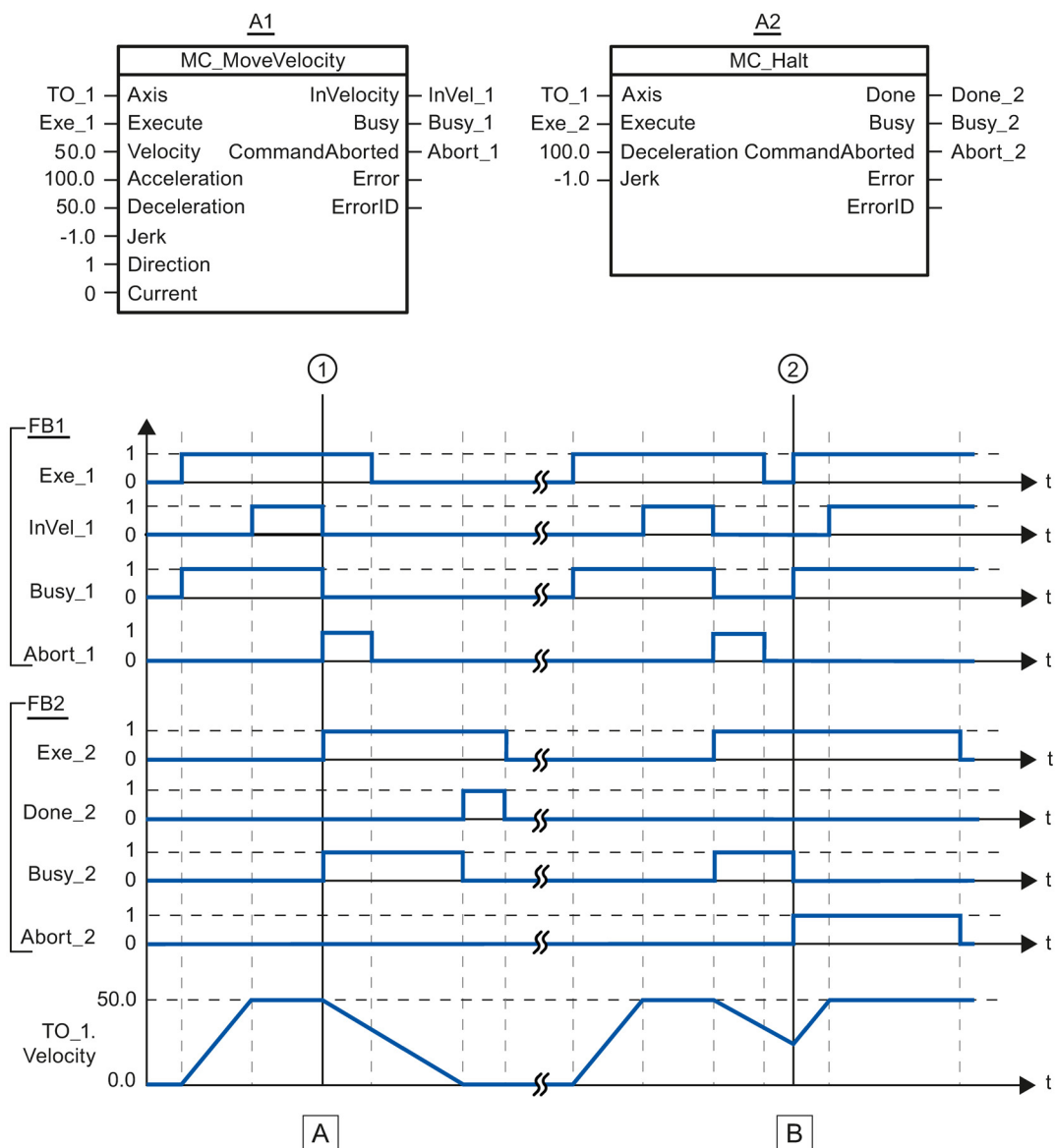
An option for the evaluation of the individual status bits can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

See also

Error ID (Page 386)

11.2.7.2 MC_Halt: Function chart V1

Function chart: Stopping an axis, and the response to an overriding job



<p>Section A</p>	<p>An axis is moved with an "MC_MoveVelocity" job (A1). When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". At time ①, the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job termination is signaled via "Abort_1". The axis is braked to a standstill. Successful completion of the "MC_Halt" job is signaled via "Done_2".</p>
<p>Section B</p>	<p>The axis is moved with an "MC_MoveVelocity" job (A1). When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". Next the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job termination is signaled via "Abort_1". During the braking process the "MC_Halt" job is overridden at time ② by an "MC_MoveVelocity" job (A1). The job termination is signaled via "Abort_2". When the setpoint velocity 50.0 is reached, this is signaled via "InVel_1". The axis is then moved with constant velocity.</p>

11.2.8 MC_Reset

11.2.8.1 MC_Reset: Acknowledge alarms, restart technology objects V1

Description

All technology alarms that can be acknowledged in the user program are acknowledged with the Motion Control instruction "MC_Reset". Acknowledgment also resets the "Error" and "Warning" bits in the technology data block.

Technology objects are reinitialized (restarted) using the Motion Control instruction "MC_Reset" with "Restart" = TRUE. Upon restart of the technology object, the new configuration data are applied in the technology data block.

Applies to

- Positioning axis
- Speed axis
- External encoder

Requirements

- The cause of the error for a pending technology alarm has been resolved.
- For a restart, the technology object must be disabled.
("MC_Power.Status" = FALSE and "MC_Power.Busy" = FALSE)

Override response

- Parameter "Restart" = FALSE:
Processing of the instruction "MC_Reset" can be aborted by other Motion Control jobs. The MC_Reset job does not abort any running Motion Control jobs.
- Parameter "Restart" = TRUE:
The processing of the instruction "MC_Reset" with parameter "Restart" = TRUE cannot be aborted by any other Motion Control job.

Parameters

The following table shows the parameters of the "MC_Reset" Motion Control instruction:

Parameter	Declaration	Data type	Default value	Description
Axis	InOut	TO_Axis	-	Technology object
Execute	INPUT	BOOL	FALSE	Start of the job with a positive edge
Restart	INPUT	BOOL	FALSE	TRUE "Restart" Reinitialization of the technology object and acknowledgment of pending technology alarms. The technology object is reinitialized with the configured start values.
				FALSE Acknowledgement of queued technology alarms.
Done	OUTPUT	BOOL	FALSE	TRUE Error has been acknowledged. Restart has been executed.
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE During execution the job was aborted by another job.
Error	OUTPUT	BOOL	FALSE	TRUE An error occurred during execution of the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID (Page 386) for parameter "Error"

Acknowledging technology alarms

To acknowledge technology alarms, follow these steps:

1. Check the requirements indicated above.
2. Set the parameter "Restart" = FALSE.
3. Start the acknowledgement of the error with a positive edge at parameter "Execute".

If the Done parameter shows the value TRUE, then the error was acknowledged.

Note

Acknowledging with "Restart" = FALSE

If only the technology alarms are to be acknowledged, set "Restart" = FALSE. The technology object cannot be used during a restart.

Restarting a technology object

Proceed as follows to restart a technology object:

1. Check the requirements indicated above.
2. Set the parameter "Restart" = TRUE.
3. Perform the restart with a positive edge at the input parameter "Execute".

If the "Done" parameter shows the value TRUE, then the restart of the technology object has been completed.

Additional information on a restart can be found in the Restarting Technology Objects (Page 197) section.

See also

Error ID (Page 386)

Appendix

A.1 Tags of the technology object SpeedAxis

A.1.1 Legend

Tag	Name of the tag	
Data type	Data type of the tag	
Values	Value range of the tag - minimum value to maximum value If no specific value is shown, the value range limits of the relevant data type apply or the information under "Description".	
W	Effectiveness of changes in the technology data block	
	DIR	Immediate: Changes to the value are made with a direct assignment and are immediately effective.
	RES	Restart: Changes to the start value in load memory are made using the extended instruction "WRIT_DBL" (write to DB in load memory). Changes will not take effect until after restart of the technology object.
	RON	Read only: The tag cannot and must not be changed.
Description	Description of the tag	

L - Linear specification R - Rotary specification

Access to the tags is with "<TO>.<tag name>". The placeholder <TO> represents the name of the technology object.

A.1.2 Actual values and setpoints (speed axis)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
Velocity	LREAL	-	RON	Setpoint velocity / setpoint speed
ActualSpeed	LREAL	-	RON	Actual speed of the motor (with analog setpoint = 0.0)
Acceleration	LREAL	-	RON	Setpoint acceleration

A.1.3 Variable simulation (speed axis)

The tag structure <TO>.Simulation.<tag name> contains the configuration for the simulation signal. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
Simulation.	STRUCT			
Mode	DINT	-	RES	Simulation mode 0: no simulation, normal operation 1: Simulation mode

A.1.4 Actor tags (speed axis)

The tag structure <TO>.Actor.<tag name> contains the controller-side configuration for the drive.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
Actor.	STRUCT			
Type	DINT	-	RON	Drive connection 1: PROFIdrive frame 0: Analog output
InverseDirection	BOOL	-	RES	Inversion of the setpoint FALSE: no TRUE: yes
Interface.	STRUCT			
AddressIn	UDINT	0 to 65535	RON	Input address for the PROFIdrive frame
AddressOut	UDINT	0 to 65535	RON	Output address for the PROFIdrive frame or the analog setpoint
Telegram	UDINT	-	RON	PROFIdrive frame of the drive 1: NSET (16 bit), NACT (16 bit) 2: NSET (32 bit), NACT (32 bit), signs of life 3: NSET (32 bit), NACT (32 bit), actual encoder value, signs of life 5: NSETP (32-bit), NACT (32-bit), actual encoder value, sign-of-life, DSC (NSET - setpoint speed, NACT - actual speed value)

Tag	Data type	Values	W	Description
EnableDriveOutput	BOOL	-	RON	"Enable output" for analog drives FALSE: disabled TRUE: enabled
EnableDriveOutputAddress	UDINT	0 to 65535	RON	Byte number for the "enable output"
EnableDriveOutputBitNumber	UDINT	0 to 7	RON	Bit number for the "enabling output"
DriveReadyInput	BOOL	-	RON	"Ready input" for analog drives The analog drive signals its readiness to receive setpoint speeds. FALSE: disabled TRUE: enabled
DriveReadyInputAddress	UDINT	0 to 65535	RON	Byte number for the "ready input"
DriveReadyInputBitNumber	UDINT	0 to 7	RON	Bit number for the "ready input"
DriveParameter.				
ReferenceSpeed	LREAL	0.0 to 1.0E12	RES	Reference value (100%) for the setpoint speed of the drive (N-set) The setpoint speed is transmitted in the PROFIdrive frame as a standardized value from -200% to 200% of the "ReferenceSpeed". For setpoint specification via an analog output, the analog output can be operated in the range from -117% to 117%, insofar as the drive permits this.
MaxSpeed	LREAL	0.0 to 1.0E12	RES	Maximum value for the setpoint speed of the drive (N-set) (PROFIdrive: $\text{MaxSpeed} \leq 2 \times \text{ReferenceSpeed}$ Analog setpoint: $\text{MaxSpeed} \leq 1.17 \times \text{ReferenceSpeed}$)

A.1.5 LoadGear tags (speed axis)

The tag structure <TO>.LoadGear.<tag name> contains the configuration for the load gear.

Tags

Legend (Page 321)

Tag	Data type	Value range	W	Description
LoadGear.				
Numerator	UDINT	1 to 4294967295	RES	Load gear counter
Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.1.6 DynamicLimits tags (speed axis)

The tag structure <TO>.DynamicLimits.<tag name> contains the configuration of the dynamic limits. During Motion Control, no dynamic values greater than the dynamic limits are permitted. If you have specified greater values in a Motion Control instruction, then motion is performed using the dynamic limits, and a warning is indicated (alarm 501 to 503 - Dynamic values were limited).

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
DynamicLimits.	STRUCT			
MaxVelocity	LREAL	0.0 to 1.0E12	RES	Maximum permissible velocity of the axis
MaxAcceleration	LREAL	0.0 to 1.0E12	DIR	Maximum permissible acceleration of the axis
MaxDeceleration	LREAL	0.0 to 1.0E12	DIR	Maximum permissible deceleration of the axis
MaxJerk	LREAL	0.0 to 1.0E12	DIR	Maximum permissible jerk on the axis

A.1.7 DynamicDefaults tags (speed axis)

The tag structure <TO>.DynamicDefaults.<tag name> contains the configuration of the dynamic defaults. These settings will be used, if you specify a dynamic value less than 0.0 in a Motion Control instruction (exceptions: MC_MoveJog.Velocity, MC_MoveVelocity.Velocity). Changes to the dynamic defaults will be applied with the next rising edge at the "Execute" parameter of a Motion Control instruction.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
DynamicDefaults.	STRUCT			
Velocity	LREAL	0.0 to 1.0E12	DIR	Default velocity
Acceleration	LREAL	0.0 to 1.0E12	DIR	Default acceleration
Deceleration	LREAL	0.0 to 1.0E12	DIR	Default deceleration
Jerk	LREAL	0.0 to 1.0E12	DIR	Default jerk
EmergencyDeceleration	LREAL	0.0 to 1.0E12	DIR	Emergency stop deceleration

A.1.8 Override tags (speed axis)

The tag structure <TO>.Override.<tag name> contains the configuration for the override parameters. The override parameters are used to apply a correction percentage to default values. An override change takes effect immediately, and is performed with the dynamic settings in effect in the Motion Control instruction.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
Override.	STRUCT			
Velocity	LREAL	0.0 to 200.0%	DIR	Velocity or speed override Percentage correction of the velocity/speed

A.1.9 StatusDrive tags (speed axis)

The tag structure <TO>.StatusDrive.<tag name> indicates the status of the drive.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
StatusDrive.	STRUCT			
InOperation	BOOL	-	RON	Operational status of the drive FALSE: Drive not ready. Setpoints will not be executed. TRUE: Drive ready. Setpoints can be executed.
CommunicationOK	BOOL	-	RON	Cyclic BUS communication between controller and drive FALSE: Not established TRUE: Established
Error	BOOL	-	RON	FALSE: No error at the drive TRUE: Error at the drive

A.1.10 StatusWord tag (speed axis)

The <TO>.StatusWord tag contains the status information of the technology object.

Notes on the evaluation of the individual bits (e.g. bit 0, "Enable") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 321)

Tag	Data type	Values	W	Description
Status-Word	DWORD	-	RON	Status data of the technology object
Bit 0	-	-	-	"Enable" Enable status 0: Technology object disabled 1: Technology object enabled
Bit 1	-	-	-	"Error" 0: No error present 1: Error present
Bit 2	-	-	-	"RestartActive" 0: No "Restart" active 1: "Restart" active. The technology object is being reinitialized.
Bit 3	-	-	-	"OnlineStartValuesChanged" 0: "Restart" tag unchanged 1: Change to "Restart" tag. For the changes to be applied, the technology object must be reinitialized.
Bit 4	-	-	-	"ControlPanelActive" Axis control panel 0: disabled 1: enabled
Bit 5	-	-	-	Reserved
Bit 6	-	-	-	"Done" 0: Motion job in process, or axis control panel enabled 1: No motion job in process and axis control panel disabled
Bit 7	-	-	-	Reserved
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	"JogCommand" 0: No "MC_MoveJog" frame active 1: "MC_MoveJog" job active
Bit 10	-	-	-	"VelocityCommand" 0: No "MC_MoveVelocity" job active 1: "MC_MoveVelocity" job active
Bit 11	-	-	-	Reserved

Tag	Data type	Values	W	Description
Bit 12	-	-	-	"ConstantVelocity" 0: The axis accelerates or decelerates. 1: Velocity setpoint reached. The axis is traversing at this constant velocity or is at a standstill.
Bit 13	-	-	-	"Accelerating" 0: No acceleration process active 1: Acceleration process active
Bit 14	-	-	-	"Decelerating" 0: No deceleration process active 1: Deceleration process active
Bit 15... Bit 31	-	-	-	Reserved

A.1.11 ErrorWord tag (speed axis)

The <TO>.ErrorWord tag indicates errors at the technology object (technology alarms).

Notes on the evaluation of the individual bits (e.g. bit 3 "CommandNotAccepted") can be found in the section Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 321)

Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" System error
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in the user program in a motion control instruction, or in its use
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4	-	-	-	"DriveFault" Error in the drive
Bit 5	-	-	-	Reserved
Bit 6	-	-	-	"DynamicError" Specified dynamic values are limited to permissible values.
Bit 7	-	-	-	"CommunicationFault" Communication error Missing or faulty communication.
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	Reserved
Bit 11	-	-	-	Reserved
Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.1.12 ErrorDetail tags (speed axis)

The tag structure <TO>.ErrorDetail.<tag name> contains the alarm number and the effective local alarm reaction to the technology alarm that is currently pending at the technology object.

A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
ErrorDetail.	STRUCT			
Number	UDINT	-	RON	Alarm number
Reaction	DINT	0 to 5	RON	Effective alarm reaction 0: No reaction 1: Stop with current dynamic values 2 Stop with maximum dynamic values 3: Stop with emergency stop ramp 4: Remove enable 5: Follow-up setpoints For the external encoder technology object, only alarm reactions 0 and 4 are possible.

A.1.13 WarningWord tag (speed axis)

The <TO>.WarningWord tag indicates pending warnings at the technology object.

Notes on the evaluation of the individual bits (e.g. bit 11, "FollowingErrorWarning") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 321)

Tag	Data type	Values	W	Description
Warning-Word	DWORD	-	RON	
Bit 0	-	-	-	Reserved
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or several configuration parameters are adjusted internally.
Bit 2	-	-	-	Reserved
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	Reserved
Bit 6	-	-	-	"DynamicError" Specified dynamic values are limited to permissible values.
Bit 7... Bit 31	-	-	-	Reserved

A.1.14 ControlPanel tags (speed axis)

The tag structure <TO>.ControlPanel.<tag name> contains no application-relevant data. This tag structure is internally used.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
ControlPanel.	STRUCT			
Input.	STRUCT			
Command.	ARRAY [1..2] OF STRUCT			
ReqCounter	UDINT	-	DIR	-
Type	UDINT	-	DIR	-
Position	LREAL	-	DIR	-
Velocity	LREAL	-	DIR	-
Acceleration	LREAL	-	DIR	-
Deceleration	LREAL	-	DIR	-
Jerk	LREAL	-	DIR	-
Param	LREAL	-	DIR	-
TimeOut	LREAL	-	DIR	-
EsLifeSign	UDINT	-	DIR	-
Output.	STRUCT			
Command.	ARRAY [1..2] OF STRUCT			
AckCounter	UDINT	-	RON	-
Error	BOOL	-	RON	-
ErrorID	UDINT	-	RON	-
Done	BOOL	-	RON	-
Aborted	BOOL	-	RON	-
RTLLifeSign	UDINT	-	RON	-

A.1.15 InternalToTrace tags (speed axis)

The tag structure <TO>.InternalToTrace.<tag name> contains no application-relevant data. This tag structure is internally used.

Tags

Legend (Page 321)

Tag	Data type	Values	W	Description
InternalToTrace.	ARRAY [1..4] OF STRUCT			
Id	DINT	-	DIR	-
Value	LREAL	-	RON	-

A.2 Tags of the positioning axis/synchronous axis technology object

A.2.1 Legend

Tag	Name of the tag	
Data type	Data type of the tag	
Values	Value range of the tag - minimum value to maximum value If no specific value is shown, the value range limits of the relevant data type apply or the information under "Description".	
W	Effectiveness of changes in the technology data block	
	DIR	Immediate: Changes to the value are made with a direct assignment and are immediately effective.
	RES	Restart: Changes to the start value in load memory are made using the extended instruction "WRIT_DBL" (write to DB in load memory). Changes will not take effect until after restart of the technology object.
	RON	Read only: The tag cannot and must not be changed.
Description	Description of the tag	

L - Linear specification R - Rotary specification

Access to the tags is with "<TO>.<tag name>". The placeholder <TO> represents the name of the technology object.

A.2.2 Actual values and setpoints (positioning axis/synchronous axis)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Position	LREAL	-	RON	Setpoint position
Velocity	LREAL	-	RON	Setpoint velocity / setpoint speed
ActualPosition	LREAL	-	RON	Actual position
ActualVelocity	LREAL	-	RON	Actual velocity
ActualSpeed	LREAL	-	RON	Actual speed of the motor (with analog setpoint = 0.0)
Acceleration	LREAL	-	RON	Setpoint acceleration
ActualAcceleration	LREAL	-	RON	Actual acceleration

A.2.3 Simulation tag (positioning axis / synchronous axis)

The tag structure <TO>.Simulation.<tag name> contains the configuration for the simulation signal. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Simualtion.	STRUCT			
Mode	DINT	-	RES	Simulation mode 0: no simulation, normal operation 1: Simulation mode

A.2.4 Actor tags (positioning axis/synchronous axis)

The tag structure <TO>.Actor.<tag name> contains the controller-side configuration for the drive.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Actor.	STRUCT			
Type	DINT	-	RON	Drive connection 1: PROFIdrive frame 0: Analog output
InverseDirection	BOOL	-	RES	Inversion of the setpoint FALSE: no TRUE: yes
Interface.	STRUCT			
AddressIn	UDINT	0 to 65535	RON	Input address for the PROFIdrive frame
AddressOut	UDINT	0 to 65535	RON	Output address for the PROFIdrive frame or the analog setpoint
Telegram	UDINT	-	RON	PROFIdrive frame of the drive 1: NSET (16 bit), NACT (16 bit) 2: NSET (32 bit), NACT (32 bit), signs of life 3: NSET (32 bit), NACT (32 bit), actual encoder value, signs of life 5: NSETP (32-bit), NACT (32-bit), actual encoder value, sign-of-life, DSC (NSET - setpoint speed, NACT - actual speed value)
EnableDriveOutput	BOOL	-	RON	"Enable output" for analog drives FALSE: disabled TRUE: enabled
EnableDriveOutputAddress	UDINT	0 to 65535	RON	Byte number for the "enable output"
EnableDriveOutputBitNumber	UDINT	0 to 7	RON	Bit number for the "enabling output"
DriveReadyInput	BOOL	-	RON	"Ready input" for analog drives The analog drive signals its readiness to receive setpoint speeds. FALSE: disabled TRUE: enabled
DriveReadyInputAddress	UDINT	0 to 65535	RON	Byte number for the "ready input"
DriveReadyInputBitNumber	UDINT	0 to 7	RON	Bit number for the "ready input"

A.2 Tags of the positioning axis/synchronous axis technology object

Tag		Data type	Values	W	Description
	DriveParameter.				
	ReferenceSpeed	LREAL	0.0 to 1.0E12	RES	Reference value (100%) for the setpoint speed of the drive (N-set) The setpoint speed is transmitted in the PROFIdrive frame as a standardized value from -200% to 200% of the "ReferenceSpeed". For setpoint specification via an analog output, the analog output can be operated in the range from -117% to 117%, insofar as the drive permits this.
	MaxSpeed	LREAL	0.0 to 1.0E12	RES	Maximum value for the setpoint speed of the drive (N-set) (PROFIdrive: $\text{MaxSpeed} \leq 2 \times \text{ReferenceSpeed}$ Analog setpoint: $\text{MaxSpeed} \leq 1.17 \times \text{ReferenceSpeed}$)

See also

Evaluating the technology data block (Page 173)

A.2.5 Sensor[n] tags (positioning axis/synchronous axis)

The tag structure <TO>.Sensor[n].<tag name> contains the controller end configuration for the encoder, and the configuration for active and passive homing.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Sensor[n].	ARRAY [1..1] OF STRUCT			
Type	DINT	-	RES	Encoder type 0: Incremental 1: Absolute 2: Cyclically absolute
InverseDirection	BOOL	-	RES	Inversion of the actual value FALSE: no TRUE: yes
System	DINT	-	RES	Encoder system 0: Linear encoder 1: Rotary encoder
MountingMode	DINT	-	RES	Mounting type of the encoder 0: Incremental 1: Absolute 2: External
Interface.				
AddressIn	UDINT	0 to 65535	RON	Input address for the PROFIdrive frame
AddressOut	UDINT	0 to 65535	RON	Output address for the PROFIdrive frame
Telegram	UDINT	-	RON	PROFIdrive frame of the encoder 3: Actual values via drive frame (NSET (32 bit), NACT (32 bit), actual encoder value, signs of life) 5: Actual values from drive frame (NSETP (32-bit), NACT (32-bit), actual encoder value, sign-of-life, DSC) 81: Actual values via your own encoder telegram (actual encoder value, signs of life) 83: Actual values via your own encoder telegram (NACT (32 bit), actual encoder value, signs of life) For the technology object of external encoders, only frames 81 and 83 are valid. (NSET - setpoint speed, NACT - actual speed value)
Parameter.				
Resolution	LREAL	1.0E-12 to 1.0E12	RES	Resolution of a linear encoder (offset between two encoder pulses)
StepsPer Revolution	UDINT	1 to 8388608	RES	Increments per rotary encoder revolution

A.2 Tags of the positioning axis/synchronous axis technology object

Tag	Data type	Values	W	Description
FineResolution Xist1	UDINT	0 to 31	RES	Number of bits for fine resolution Gn_XIST1 (cyclic actual encoder value)
FineResolution Xist2	UDINT	0 to 31	RES	Number of bits for fine resolution Gn_XIST2 (absolute value of the encoder)
Determinable Revolutions	UDINT	0 to 8388608	RES	Number of differentiable encoder revolutions for a multi-turn absolute value encoder (For a single-turn absolute value encoder = 1; for an incremental encoder = 0)
DistancePer Revolution	LREAL	0.0 to 1.0E12	RES	Load distance per revolution of an externally mounted encoder
ActiveHoming.	STRUCT			
Mode	DINT	-	RES	Homing mode 0: Homing mark only 1: Homing mark and proximity switch 2: Digital input
SidelInput	BOOL	-	DIR	Side of the digital input for active homing: FALSE: Negative side TRUE: Positive side
Direction	DINT	-	DIR	Homing direction / homing mark approach direction 1: Positive homing direction 2: Negative homing direction
HomePosition Offset	LREAL	-1.0E12 to 1.0E12	DIR	Home position offset
Digital InputAddress	UDINT	0 to 65535	RON	Byte number of the digital input
DigitalInput BitNumber	UDINT	0 to 7	RON	Bit number of the digital input
PassiveHoming.	STRUCT			
Mode	DINT	-	RES	Homing mode 0: Homing mark only 1: Homing mark and proximity switch 2: Digital input
SidelInput	BOOL	-	DIR	Side of the digital input for passive homing: FALSE: Negative side TRUE: Positive side
Direction	DINT	-	DIR	Homing direction / homing mark approach direction 0: Current homing direction 1: Positive homing direction 2: Negative homing direction
DigitalInputAddress	UDINT	0 to 65535	RON	Byte number of the digital input
DigitalInput BitNumber	UDINT	0 to 7	RON	Bit number of the digital input

See also

Evaluating the technology data block (Page 173)

A.2.6 LoadGear tags (positioning axis/synchronous axis)

The tag structure <TO>.LoadGear.<tag name> contains the configuration for the load gear.

Tags

Legend (Page 332)

Tag	Data type	Value range	W	Description
LoadGear.	STRUCT			
Numerator	UDINT	1 to 4294967295	RES	Load gear counter
Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.2.7 Mechanics tags (positioning axis/synchronous axis)

The tag structure <TO>.Mechanics.<tag name> contains the configuration of the mechanics.

Tags

Legend (Page 332)

Tag	Data type	Value range	W	Description
Mechanics.	STRUCT			
LeadScrew	LREAL	0.0 to 1.0E12	RES	Leadscrew pitch

A.2.8 Properties tags (positioning axis/synchronous axis)

The tag structure <TO>.Properties.<tag name> contains the configuration for the axis or type of motion.

Tags

Legend (Page 332)

Tag	Data type	Value range	W	Description
Properties.	STRUCT			
MotionType	DINT	-	RON	Indication of axis or motion type: 0: Linear axis or motion 1: Rotary axis or motion

A.2.9 Modulo tags (positioning axis/synchronous axis)

The tag structure <TO>.Modulo.<tag name> contains the modulo configuration.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Modulo.	STRUCT			
Enable	BOOL	-	RES	FALSE: Modulo conversion disabled TRUE: Modulo conversion enabled When modulo conversion is enabled, a check is made for modulo length > 0.0
Length	LREAL	0.001 to 1.0E12	RES	Modulo length
StartValue	LREAL	-1.0E12 to 1.0E12	RES	Modulo start value

See also

Evaluating the technology data block (Page 173)

A.2.10 DynamicLimits tags (positioning axis/synchronous axis)

The tag structure <TO>.DynamicLimits.<tag name> contains the configuration of the dynamic limits. During Motion Control, no dynamic values greater than the dynamic limits are permitted. If you have specified greater values in a Motion Control instruction, then motion is performed using the dynamic limits, and a warning is indicated (alarm 501 to 503 - Dynamic values were limited).

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
DynamicLimits.	STRUCT			
MaxVelocity	LREAL	0.0 to 1.0E12	RES	Maximum permissible velocity of the axis
MaxAcceleration	LREAL	0.0 to 1.0E12	DIR	Maximum permissible acceleration of the axis
MaxDeceleration	LREAL	0.0 to 1.0E12	DIR	Maximum permissible deceleration of the axis
MaxJerk	LREAL	0.0 to 1.0E12	DIR	Maximum permissible jerk on the axis

See also

Evaluating the technology data block (Page 173)

A.2.11 DynamicDefaults tags (positioning axis/synchronous axis)

The tag structure <TO>.DynamicDefaults.<tag name> contains the configuration of the dynamic defaults. These settings will be used, if you specify a dynamic value less than 0.0 in a Motion Control instruction (exceptions: MC_MoveJog.Velocity, MC_MoveVelocity.Velocity). Changes to the dynamic defaults will be applied with the next rising edge at the "Execute" parameter of a Motion Control instruction.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
DynamicDefaults.	STRUCT			
Velocity	LREAL	0.0 to 1.0E12	DIR	Default velocity
Acceleration	LREAL	0.0 to 1.0E12	DIR	Default acceleration
Deceleration	LREAL	0.0 to 1.0E12	DIR	Default deceleration
Jerk	LREAL	0.0 to 1.0E12	DIR	Default jerk
EmergencyDeceleration	LREAL	0.0 to 1.0E12	DIR	Emergency stop deceleration

See also

Evaluating the technology data block (Page 173)

A.2.12 PositionLimits_SW tags (positioning axis/synchronous axis)

The tag structure <TO>.PositionLimits_SW.<tag name> contains the configuration for position monitoring with software limit switches. Software limit switches are used to limit the operating range of a positioning axis.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
PositionLimits_SW.	STRUCT			
Active	BOOL	-	DIR	FALSE: Monitoring disabled TRUE: Monitoring enabled
MinPosition	LREAL	-1.0E12 to 1.0E12	DIR	Position of negative software limit switches
MaxPosition	LREAL	-1.0E12 to 1.0E12	DIR	Position of positive software limit switches ("MaxPosition" > "MinPosition")

See also

Evaluating the technology data block (Page 173)

A.2.13 PositionLimits_HW tags (positioning axis/synchronous axis)

The tag structure <TO>.PositionLimits_HW.<tag name> contains the configuration for position monitoring with hardware limit switches. Hardware limit switches are used to limit the traversing range of a positioning axis.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
PositionLimits_HW.	STRUCT			
Active	BOOL	-	RES	FALSE: Monitoring disabled TRUE: Monitoring enabled With "Active", both (negative and positive) hardware limit switches are enabled or disabled.
MinSwitchLevel	BOOL	-	RES	Level selection for enabling of the negative hardware limit switch: FALSE: Lower level (low-enabled) TRUE: Upper level (high-enabled)
MinSwitchAddress	UDINT	0 to 65535	RON	Byte number for the negative hardware limit switch
MinSwitchBitNumber	UDINT	0 to 7	RON	Bit number for the negative hardware limit switch
MaxSwitchLevel	BOOL	-	RES	Level selection for enabling of the positive hardware limit switch: FALSE: Lower level (low-enabled) TRUE: Upper level (high-enabled)
MaxSwitchAddress	UDINT	0 to 65535	RON	Byte number for the positive hardware limit switch
MaxSwitchBitNumber	UDINT	0 to 7	RON	Bit number for the positive hardware limit switch

See also

Evaluating the technology data block (Page 173)

A.2.14 Homing tags (positioning axis/synchronous axis)

The tag structure <TO>.Homing.<tag name> contains the configuration for homing the TO.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Homing.	STRUCT			
AutoReversal	BOOL	-	RES	Reversal at the hardware limit switches FALSE: no TRUE: yes
ApproachDirection	BOOL	-	DIR	Direction of approach to the homing position switch FALSE: Negative side TRUE: Positive direction
ApproachVelocity	LREAL	L: 0.0 to 10000.0 mm/s R: 0.0 to 360000.0°/s	DIR	Approach velocity Velocity during active homing, with which the axis moves toward the proximity switch and toward home position.
ReferencingVelocity	LREAL	L: 0.0 to 1000.0 mm/s R: 0.0 to 36000.0°/s	DIR	Homing velocity Velocity during active homing, with which the axis is moved toward home position.
HomePosition	LREAL	-1.0E12 to 1.0E12	DIR	Home position

See also

Evaluating the technology data block (Page 173)

A.2.15 Override tags (positioning axis/synchronous axis)

The tag structure <TO>.Override.<tag name> contains the configuration for the override parameters. The override parameters are used to apply a correction percentage to default values. An override change takes effect immediately, and is performed with the dynamic settings in effect in the Motion Control instruction.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
Override.	STRUCT			
Velocity	LREAL	0.0 to 200.0%	DIR	Velocity or speed override Percentage correction of the velocity/speed

See also

Evaluating the technology data block (Page 173)

A.2.16 PositionControl tags (positioning axis/synchronous axis)

The tag structure <TO>.PositionControl.<tag name> contains the settings for position control.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
PositionControl.	STRUCT			
Kv	LREAL	0.0 to 2147480.0	DIR	Proportional gain in the position control ("Kv" > 0.0)
Kpc	LREAL	0.0 to 150.0%	DIR	Velocity pre-control in the position control Recommended setting: <ul style="list-style-type: none"> • Isochronous drive connection via PROFIdrive: 100.0% • Non-isochronous drive connection via PROFIdrive: 0.0 to 100.0% • Analog drive connection: 0.0 to 100.0%
EnableDSC	BOOL	-	RES	Dynamic Servo Control (DSC) FALSE: DSC disabled TRUE: DSC enabled DSC is only possible if frame 5 is used.

See also

Evaluating the technology data block (Page 173)

A.2.17 FollowingError tags (positioning axis/synchronous axis)

The tag structure <TO>.FollowingError.<tag name> contains the configuration for following error monitoring.

If the permissible following error is exceeded, then technology alarm 521 is output, and the technology object is disabled (alarm reaction: remove enable).

When the warning level is reached, a warning is output (technology alarm 522).

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
FollowingError.	STRUCT			
EnableMonitoring	BOOL	-	RES	FALSE: Following error monitoring disabled TRUE: Following error monitoring enabled
MinValue	LREAL	L: 0.0 to 1.0E12 R: 0.001 to 1.0E12	DIR	Permissible following error at velocities below the value of "MinVelocity".
MaxValue	LREAL	L: 0.0 to 1.0E12 R: 0.002 to 1.0E12	DIR	Maximum permissible following error, which may be reached at the maximum velocity.
MinVelocity	LREAL	0.0 to 1.0E12	DIR	"MinValue" is permissible below this velocity, and is held constant.
WarningLevel	LREAL	0.0 to 100.0	DIR	Warning level: Percentage value relative to the valid maximum following error.

See also

Evaluating the technology data block (Page 173)

A.2.18 PositionMonitoring tags (positioning axis/synchronous axis)

The tag structure <TO>.PositioningMonitoring.<tag name> contains the configuration for position monitoring at the end of a positioning motion.

If the actual position value at the end of a positioning motion is reached within the tolerance time and remains in the positioning window for the minimum dwell time, then <TO>.StatusWord.X5 (Done) is set in the technology data block. This completes a Motion Control job.

If the tolerance time is exceeded, then technology alarm 541 "Positioning monitoring" with supplemental value 1: "Target area not reached within the positioning tolerance time" will be indicated.

If the minimum dwell time is not met, then technology alarm 541 "Positioning monitoring" with supplemental value 2: "Target area exited within the minimum dwell time" will be indicated.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
PositioningMonitoring.	STRUCT			
ToleranceTime	LREAL	0.0 to 1.0E12	DIR	Tolerance time Maximum permitted duration from reaching velocity setpoint zero, until entrance into the positioning window.
MinDwellTime	LREAL	0.0 to 1.0E12	DIR	Minimum dwell time in the positioning window:
Window	LREAL	0.0 to 1.0E12	DIR	Positioning window

See also

Evaluating the technology data block (Page 173)

A.2.19 StandstillSignal tags (positioning axis/synchronous axis)

The tag structure <TO>.StandstillSignal.<tag name> contains the configuration for the standstill signal.

If the actual velocity value is below the velocity threshold, and does not exceed it during the minimum dwell time, then the standstill signal <TO>.StatusWord.X7 (Standstill) is set.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
StandstillSignal.	STRUCT			Configuration for the standstill signal
VelocityThreshold	LREAL	0.0 to 1.0E12	DIR	Velocity threshold If velocity is below this threshold, then the minimum dwell time begins.
MinDwellTime	LREAL	0.0 to 1.0E12	DIR	Minimum dwell time

See also

Evaluating the technology data block (Page 173)

A.2.20 StatusPositioning tags (positioning axis/synchronous axis)

The tag structure <TO>.StatusPositioning.<tag name> indicates the status of a positioning motion.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
StatusPositioning.	STRUCT			
Distance	LREAL	-	RON	Distance to the target position
TargetPosition	LREAL	-	RON	Target position
FollowingError	LREAL	-	RON	Current following error

See also

Evaluating the technology data block (Page 173)

A.2.21 StatusDrive tags (positioning axis/synchronous axis)

The tag structure <TO>.StatusDrive.<tag name> indicates the status of the drive.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
StatusDrive.	STRUCT			
InOperation	BOOL	-	RON	Operational status of the drive FALSE: Drive not ready. Setpoints will not be executed. TRUE: Drive ready. Setpoints can be executed.
CommunicationOK	BOOL	-	RON	Cyclic BUS communication between controller and drive FALSE: Not established TRUE: Established
Error	BOOL	-	RON	FALSE: No error at the drive TRUE: Error at the drive

See also

Evaluating the technology data block (Page 173)

A.2.22 StatusSensor[n] tags (positioning axis/synchronous axis)

The tag structure <TO>.StatusSensor[n].<tag name> indicates the status of the measuring system.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
StatusSensor[n].	ARRAY [1..1] OF STRUCT			
State	DINT	-	RON	Status of the actual encoder value: 0: "NOT_VALID (not valid) 1: "Waiting_FOR_VALID (waiting for valid status) 2: "VALID (valid)
CommunicationOK	BOOL	-	RON	Cyclic BUS communication between controller and encoder FALSE: Not established TRUE: Established
Error	BOOL	-	RON	FALSE: No error in the measuring system TRUE: Error in the measuring system.
AbsEncoderOffset	LREAL	-	RON	Home point offset to the value of an absolute value encoder. The value will be retentively stored in the CPU.

See also

Evaluating the technology data block (Page 173)

A.2.23 StatusSynchronizedMotion tags (synchronous axis)

The tag structure <TO>.StatusSynchronizedMotion.<tag name> indicates the status of the synchronous operation.

Tags

Legend (Page 332)

Tag	Data type	Value range	W	Description
StatusSynchronizedMotion.	STRUCT			
ActualMaster	DB_ANY	-	RON	When a "MC_GearIn" job is started, the number of the technology data block of the currently used leading axis is displayed. "ActualMaster" = 0 with disabled synchronous operation

See also

Synchronous operation (Page 73)

A.2.24 StatusWord tag (positioning axis/synchronous axis)

The <TO>.StatusWord tag contains the status information of the technology object.

Notes on the evaluation of the individual bits (e.g. bit 5, "HomingDone") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 332)

Tag	Data type	Values	W	Description
Status-Word	DWORD	-	RON	Status data of the technology object
Bit 0	-	-	-	"Enable" Enable status 0: Technology object disabled 1: Technology object enabled
Bit 1	-	-	-	"Error" 0: No error present 1: Error present
Bit 2	-	-	-	"RestartActive" 0: No "Restart" active 1: "Restart" active. The technology object is being reinitialized.
Bit 3	-	-	-	"OnlineStartValuesChanged" 0: "Restart" tag unchanged 1: Change to "Restart" tag. For the changes to be applied, the technology object must be reinitialized.
Bit 4	-	-	-	"ControlPanelActive" Axis control panel 0: disabled 1: enabled
Bit 5	-	-	-	"HomingDone" Homing status 0: Technology object not homed 1: Technology object homed
Bit 6	-	-	-	"Done" 0: Motion job in process, or axis control panel enabled 1: No motion job in process and axis control panel disabled
Bit 7	-	-	-	"Standstill" Standstill signal 0: Axis in motion 1: Axis at a standstill
Bit 8	-	-	-	"PositioningCommand" 0: No positioning job active 1: Positioning job active ("MC_MoveRelative", "MC_MoveAbsolute")
Bit 9	-	-	-	"JogCommand" 0: No "MC_MoveJog" frame active 1: "MC_MoveJog" job active

A.2 Tags of the positioning axis/synchronous axis technology object

Tag	Data type	Values	W	Description
Bit 10	-	-	-	"VelocityCommand" 0: No "MC_MoveVelocity" job active 1: "MC_MoveVelocity" job active
Bit 11	-	-	-	"HomingCommand" 0: No "MC_Home" job in process 1: "MC_Home" job in process
Bit 12	-	-	-	"ConstantVelocity" 0: The axis accelerates or decelerates. 1: Velocity setpoint reached. The axis is traversing at this constant velocity or is at a standstill.
Bit 13	-	-	-	"Accelerating" 0: No acceleration process active 1: Acceleration process active
Bit 14	-	-	-	"Decelerating" 0: No deceleration process active 1: Deceleration process active
Bit 15	-	-	-	"SWLimitMinActive" 0: Negative software limit switch not reached 1: Negative software limit switch reached or exceeded
Bit 16	-	-	-	"SWLimitMaxActive" 0: Positive software limit switch not reached 1: Positive software limit switch reached or exceeded
Bit 17	-	-	-	"HWLimitMinActive" 0: Negative hardware limit switch not reached 1: Negative Hardware limit switch reached or exceeded
Bit 18	-	-	-	"HWLimitMaxActive" 0: Positive hardware limit switch not reached 1: Positive hardware limit switch reached or exceeded
Bit 19	-	-	-	Reserved
Bit 20	-	-	-	Reserved
Bit 21	-	-	-	Positioning axis technology object: Reserved Synchronous axis technology object: "Synchronizing" 0: The axis does not synchronize to a master value. 1: The axis synchronizes to a master value.
Bit 22	-	-	-	Positioning axis technology object: Reserved Synchronous axis technology object: "Synchronous" 0: The axis does not move synchronously to a master value. 1: The axis moves synchronously to a master value.

Tag	Data type	Values	W	Description
Bit 23	-	-	-	"SuperimposedMotionCommand" 0: No superimposed motion active 1: Superimposed motion active
Bit 24... Bit 31	-	-	-	Reserved

See also

Evaluating the technology data block (Page 173)

A.2.25 ErrorWord tag (positioning axis/synchronous axis)

The <TO>.ErrorWord tag indicates errors at the technology object (technology alarms).

Notes on the evaluation of the individual bits (e.g. bit 3, CommandNotAccepted) can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 332)

Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" System error
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in the user program in a motion control instruction, or in its use
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4	-	-	-	"DriveFault" Error in the drive
Bit 5	-	-	-	"SensorFault" Error in the encoder system
Bit 6	-	-	-	"DynamicError" Specified dynamic values are limited to permissible values.
Bit 7	-	-	-	"CommunicationFault" Communication error Missing or faulty communication.

Tag	Data type	Values	W	Description
Bit 8	-	-	-	"SWLimit" Software limit switch reached or overshoot.
Bit 9	-	-	-	"HWLimit" Hardware limit switch reached or overshoot.
Bit 10	-	-	-	"HomingFault" Error during homing process The homing cannot be completed.
Bit 11	-	-	-	"FollowingErrorFault" Following error limits exceeded
Bit 12	-	-	-	"PositioningFault" Positioning error
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14	-	-	-	Positioning axis technology object: Reserved Synchronous axis technology object: "SynchronousError" Error during synchronous operation The leading axis specified at the Motion Control instruction "MC_GearIn" was not configured as a possible leading axis.
Bit 15... Bit 31	-	-	-	Reserved

See also

Evaluating the technology data block (Page 173)

A.2.26 ErrorDetail tags (positioning axis/synchronous axis)

The tag structure <TO>.ErrorDetail.<tag name> contains the alarm number and the effective local alarm reaction to the technology alarm that is currently pending at the technology object.

A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
ErrorDetail.	STRUCT			
Number	UDINT	-	RON	Alarm number
Reaction	DINT	0 to 5	RON	Effective alarm reaction 0: No reaction 1: Stop with current dynamic values 2 Stop with maximum dynamic values 3: Stop with emergency stop ramp 4: Remove enable 5: Follow-up setpoints For the external encoder technology object, only alarm reactions 0 and 4 are possible.

See also

Evaluating the technology data block (Page 173)

Technology alarms (Page 215)

A.2.27 WarningWord tag (positioning axis/synchronous axis)

The <TO>.WarningWord tag indicates pending warnings at the technology object.

Notes on the evaluation of the individual bits (e.g. bit 11, "FollowingErrorWarning") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 332)

Tag	Data type	Values	W	Description
Warning-Word	DWORD	-	RON	
Bit 0	-	-	-	Reserved
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or several configuration parameters are adjusted internally.
Bit 2	-	-	-	Reserved
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	Reserved
Bit 6	-	-	-	"DynamicError" Specified dynamic values are limited to permissible values.
Bit 7	-	-	-	Reserved
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	Reserved
Bit 11	-	-	-	"FollowingErrorWarning" Warning level of the following error monitoring reached / exceeded
Bit 12... Bit 31	-	-	-	Reserved

See also

Evaluating the technology data block (Page 173)

A.2.28 ControlPanel tags (positioning axis/synchronous axis)

The tag structure <TO>.ControlPanel.<tag name> contains no application-relevant data. This tag structure is internally used.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
ControlPanel.	STRUCT			
Input.	STRUCT			
Command.	ARRAY [1..2] OF STRUCT			
ReqCounter	UDINT	-	DIR	-
Type	UDINT	-	DIR	-
Position	LREAL	-	DIR	-
Velocity	LREAL	-	DIR	-
Acceleration	LREAL	-	DIR	-
Deceleration	LREAL	-	DIR	-
Jerk	LREAL	-	DIR	-
Param	LREAL	-	DIR	-
TimeOut	LREAL	-	DIR	-
EsLifeSign	UDINT	-	DIR	-
Output.	STRUCT			
Command.	ARRAY [1..2] OF STRUCT			
AckCounter	UDINT	-	RON	-
Error	BOOL	-	RON	-
ErrorID	UDINT	-	RON	-
Done	BOOL	-	RON	-
Aborted	BOOL	-	RON	-
RTLLifeSign	UDINT	-	RON	-

See also

Evaluating the technology data block (Page 173)

A.2.29 InternalToTrace tags (positioning axis/synchronous axis)

The tag structure <TO>.InternalToTrace.<tag name> contains no application-relevant data. This tag structure is internally used.

Tags

Legend (Page 332)

Tag	Data type	Values	W	Description
InternalToTrace.	ARRAY [1..4] OF STRUCT			
Id	DINT	-	DIR	-
Value	LREAL	-	RON	-

See also

Evaluating the technology data block (Page 173)

A.3 Tags of the technology object external encoder

A.3.1 Legend

Tag	Name of the tag	
Data type	Data type of the tag	
Values	Value range of the tag - minimum value to maximum value If no specific value is shown, the value range limits of the relevant data type apply or the information under "Description".	
W	Effectiveness of changes in the technology data block	
	DIR	Immediate: Changes to the value are made with a direct assignment and are immediately effective.
	RES	Restart: Changes to the start value in load memory are made using the extended instruction "WRIT_DBL" (write to DB in load memory). Changes will not take effect until after restart of the technology object.
RON	Read only: The tag cannot and must not be changed.	
Description	Description of the tag	

L - Linear specification R - Rotary specification

Access to the tags is with "<TO>.<tag name>". The placeholder <TO> represents the name of the technology object.

A.3.2 Actual values and setpoints (external encoder)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
ActualPosition	LREAL	-	RON	Actual position
ActualVelocity	LREAL	-	RON	Actual velocity
ActualAcceleration	LREAL	-	RON	Actual acceleration

A.3.3 Sensor tags (external encoder)

The tag structure <TO>.Sensor.<tag name> contains the CPU-side configuration for the encoder, and the configuration for active and passive homing.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
Sensor.	STRUCT			
Type	DINT	-	RES	Encoder type 0: Incremental 1: Absolute 2: Cyclically absolute
InverseDirection	BOOL	-	RES	Inversion of the actual value FALSE: no TRUE: yes
System	DINT	-	RES	Encoder system 0: Linear encoder 1: Rotary encoder
MountingMode	DINT	-	RES	Mounting type of the encoder 0: Incremental 1: Absolute 2: External

A.3 Tags of the technology object external encoder

Tag	Data type	Values	W	Description
Interface.				
AddressIn	UDINT	0 to 65535	RON	Input address for the PROFIdrive frame
AddressOut	UDINT	0 to 65535	RON	Output address for the PROFIdrive frame
Telegram	UDINT	-	RON	PROFIdrive frame of the encoder 3: Actual values via drive frame (NSET (32 bit), NACT (32 bit), actual encoder value, signs of life) 5: Actual values from drive frame (NSETP (32-bit), NACT (32-bit), actual encoder value, sign-of-life, DSC) 81: Actual values via your own encoder telegram (actual encoder value, signs of life) 83: Actual values via your own encoder telegram (NACT (32 bit), actual encoder value, signs of life) For the technology object of external encoders, only frames 81 and 83 are valid. (NSET - setpoint speed, NACT - actual speed value)
Parameter.				
Resolution	LREAL	1.0E-12 to 1.0E12	RES	Resolution of a linear encoder (offset between two encoder pulses)
StepsPer Revolution	UDINT	1 to 8388608	RES	Increments per rotary encoder revolution
FineResolution Xist1	UDINT	0 to 31	RES	Number of bits for fine resolution Gn_XIST1 (cyclic actual encoder value)
FineResolution Xist2	UDINT	0 to 31	RES	Number of bits for fine resolution Gn_XIST2 (absolute value of the encoder)
Determinable Revolutions	UDINT	0 to 8388608	RES	Number of differentiable encoder revolutions for a multi-turn absolute value encoder (For a single-turn absolute value encoder = 1; for an incremental encoder = 0)
DistancePer Revolution	LREAL	0.0 to 1.0E12	RES	Load distance per revolution of an externally mounted encoder
PassiveHoming.				
Mode	DINT	-	RES	Homing mode 0: Homing mark only 1: Homing mark and proximity switch 2: Digital input
Sidelnput	BOOL	-	DIR	Side of the digital input for passive homing: FALSE: Negative side TRUE: Positive side
Direction	DINT	-	DIR	Homing direction / homing mark approach direction 0: Current homing direction 1: Positive homing direction 2: Negative homing direction
Digital InputAddress	UDINT	0 to 65535	RON	Byte number of the digital input
DigitalInput BitNumber	UDINT	0 to 7	RON	Bit number of the digital input

A.3.4 Mechanics tags (external encoder)

The tag structure <TO>.Mechanics.<tag name> contains the configuration of the mechanics.

Tags

Legend (Page 358)

Tag	Data type	Value range	W	Description
Mechanics.				
LeadScrew	LREAL	0.0 to 1.0E12	RES	Leadscrew pitch

A.3.5 LoadGear tags (external encoder)

The tag structure <TO>.LoadGear.<tag name> contains the configuration for the load gear.

Tags

Legend (Page 358)

Tag	Data type	Value range	W	Description
LoadGear.	STRUCT			
Numerator	UDINT	1 to 4294967295	RES	Load gear counter
Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.3.6 Properties tags (external encoder)

The tag structure <TO>.Properties.<tag name> contains the configuration for the axis or type of motion.

Tags

Legend (Page 358)

Tag	Data type	Value range	W	Description
Properties.				
MotionType	DINT	-	RON	Indication of axis or motion type: 0: Linear axis or motion 1: Rotary axis or motion

A.3.7 Modulo tags (external encoder)

The tag structure <TO>.Modulo.<tag name> contains the modulo configuration.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
Modulo.	STRUCT			
Enable	BOOL	-	RES	FALSE: Modulo conversion disabled TRUE: Modulo conversion enabled When modulo conversion is enabled, a check is made for modulo length > 0.0
Length	LREAL	0.001 to 1.0E12	RES	Modulo length
StartValue	LREAL	-1.0E12 to 1.0E12	RES	Modulo start value

A.3.8 Homing tags (external encoder)

The tag structure <TO>.Homing.<tag name> contains the configuration for homing the TO.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
Homing.	STRUCT			
HomePosition	LREAL	-1.0E12 to 1.0E12	DIR	Home position

A.3.9 StatusSensor tags (external encoder)

The tag structure <TO>.StatusSensor.<tag name> indicates the status of the measuring system.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
StatusSensor.	STRUCT			
State	DINT	-	RON	Status of the actual encoder value: 0: "NOT_VALID (not valid) 1: "Waiting_FOR_VALID (waiting for valid status) 2: "VALID (valid)
CommunicationOK	BOOL	-	RON	Cyclic BUS communication between controller and encoder FALSE: Not established TRUE: Established
Error	BOOL	-	RON	FALSE: No error in the measuring system TRUE: Error in the measuring system.
AbsEncoderOffset	LREAL	-	RON	Home point offset to the value of an absolute value encoder. The value will be retentively stored in the CPU.

A.3.10 StatusWord tag (external encoder)

The <TO>.StatusWord tag contains the status information of the technology object.

Notes on the evaluation of the individual bits (e.g. bit 5, "HomingDone") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 358)

Tag	Data type	Values	W	Description
Status-Word	DWORD	-	RON	Status data of the technology object
Bit 0	-	-	-	"Enable" Enable status 0: Technology object disabled 1: Technology object enabled
Bit 1	-	-	-	"Error" 0: No error present 1: Error present
Bit 2	-	-	-	"RestartActive" 0: No "Restart" active 1: "Restart" active. The technology object is being reinitialized.
Bit 3	-	-	-	"OnlineStartValuesChanged" 0: "Restart" tag unchanged 1: Change to "Restart" tag. For the changes to be applied, the technology object must be reinitialized.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	"HomingDone" Homing status 0: Technology object not homed 1: Technology object homed
Bit 6	-	-	-	"Done" 0: Motion job in process, or axis control panel enabled 1: No motion job in process and axis control panel disabled
Bit 7	-	-	-	Reserved
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	Reserved
Bit 11	-	-	-	"HomingCommand" 0: No "MC_Home" job in process 1: "MC_Home" job in process
Bit 12... Bit 31	-	-	-	Reserved

A.3.11 ErrorWord tag (external encoder)

The <TO>.ErrorWord tag indicates errors at the technology object (technology alarms).

Notes on the evaluation of the individual bits (e.g. bit 3 "CommandNotAccepted") can be found in the section Evaluating StatusWord, ErrorWord and WarningWord (Page 175).

Tag

Legend (Page 358)

Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" System error
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in the user program in a motion control instruction, or in its use
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	"SensorFault" Error in the encoder system.
Bit 6	-	-	-	Reserved
Bit 7	-	-	-	"CommunicationFault" Communication error Missing or faulty communication.
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	"HomingFault" Error during homing process The homing cannot be completed.
Bit 11	-	-	-	Reserved
Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.3.12 ErrorDetail tags (external encoder)

The tag structure <TO>.ErrorDetail.<tag name> contains the alarm number and the effective local alarm reaction to the technology alarm that is currently pending at the technology object.

A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
ErrorDetail.	STRUCT			
Number	UDINT	-	RON	Alarm number
Reaction	DINT	0 to 5	RON	Effective alarm reaction 0: No reaction 1: Stop with current dynamic values 2 Stop with maximum dynamic values 3: Stop with emergency stop ramp 4: Remove enable 5: Follow-up setpoints For the external encoder technology object, only alarm reactions 0 and 4 are possible.

A.3.13 WarningWord tag (external encoder)

The <TO>.WarningWord tag indicates pending warnings at the technology object.

Notes on the evaluation of the individual bits (e.g. bit 11, "FollowingErrorWarning") can be found in the Evaluating StatusWord, ErrorWord and WarningWord (Page 175) section.

Tag

Legend (Page 358)

Tag	Data type	Values	W	Description
Warning-Word	DWORD	-	RON	
Bit 0	-	-	-	Reserved
Bit 1	-	-	-	"ConfigurationFault" Configuration error One or several configuration parameters are adjusted internally.
Bit 2	-	-	-	Reserved
Bit 3	-	-	-	"CommandNotAccepted" Command cannot be executed. A Motion Control command cannot be executed, because necessary preconditions are not met.
Bit 4... Bit 31	-	-	-	Reserved

A.3.14 InternalToTrace tags (external encoder)

The tag structure <TO>.InternalToTrace.<tag name> contains no application-relevant data. This tag structure is internally used.

Tags

Legend (Page 358)

Tag	Data type	Values	W	Description
InternalToTrace.	ARRAY [1..4] OF STRUCT			
Id	DINT	-	DIR	-
Value	LREAL	-	RON	-

A.4 Technology alarms

A.4.1 Overview

The following table shows an overview of the technology alarms and the corresponding alarm reactions. When a technology alarm occurs, evaluate the entire indicated alarm text, in order to find the precise cause.

Legend

No.	Number of the technology alarm (corresponds to <TO>.ErrorDetail.Number)
Response	Effective alarm reaction (corresponds to <TO>.ErrorDetail.Reaction)
Error bit	Bit that is set in <TO>.ErrorWord when the technology alarm occurs
Warning bit	Bit that is set in <TO>.WarningWord when the technology alarm occurs
Restart	To acknowledge the technology alarm, the technology object must be reinitialized (restart).
Alarm text	Indicated alarm text (limited)

List of the technology alarms

No.	Response	Error bit	Warning bit	Restart	Alarm text
101	Remove enable	X1 (Configuration-Fault)	-	X	Error in the configuration.
104	Stop with maximum dynamic values	X1 (Configuration-Fault)	-	-	Error in the specification of software limit switches.
105	Remove enable	X1 (Configuration-Fault)	-	X	Configuration mode (drive/actuator).
106	Remove enable	X1 (Configuration-Fault)	-	X	Configuration error in the drive actuator driver.
107	Remove enable	X1 (Configuration-Fault)	-	X	Configuration error encoder.
108	Remove enable	X1 (Configuration-Fault)	-	X	Configuration error encoder driver.
109	Remove enable	X1 (Configuration-Fault)	-	-	Configuration error.
110	No reaction	-	X1 (Configuration-Fault)	-	Configuration is being internally adapted.
201	Remove enable	X0 (SystemFault)	-	-	Internal error.
202	No reaction	X0 (SystemFault)	-	-	Internal configuration error.
203	Remove enable	X0 (SystemFault)	-	-	Internal error. Please contact customer service.

No.	Response	Error bit	Warning bit	Restart	Alarm text
204	Remove enable	X0 (SystemFault)	-	-	Commissioning error.
304	Stop with emergency stop ramp	X2 (UserFault)	-	-	Limit value for velocity is zero.
305	Stop with emergency stop ramp	X2 (UserFault)	-	-	Limit value for acceleration/deceleration is zero.
306	Stop with emergency stop ramp	X2 (UserFault)	-	-	Limit value for jerk is zero.
307	Stop with maximum dynamic values	X2 (UserFault)	-	-	The numeric value range of the position was reached.
308	Remove enable	X2 (UserFault)	-	-	The numeric value range of the position was exceeded.
321	Stop with emergency stop ramp	X3 (Command-NotAccepted)	-	-	Axis is not homed.
322	No reaction	-	X3 (Command-NotAccepted)	-	Restart not performed.
323	No reaction	-	X3 (Command-NotAccepted)	-	MC_Home was not executed because this would result in the numerical value range being exceeded.
341	Remove enable	X10 (HomingFault)	-	-	Error in homing data.
342	Stop with emergency stop ramp	X10 (HomingFault)	-	-	Reference cam / encoder zero mark was not found.
401	Remove enable	X13 (Peripheral Error)	-	-	Error accessing logical address.
411	Remove enable	X5 (SensorFault)	-	-	Encoder at the logical address disrupted.
412	Remove enable	X5 (SensorFault)	-	-	Violation of the range limit for the incremental actual value.
421	Remove enable	X4 (DriveFault)	-	-	Drive/actuator at the logical address disrupted.
431	Remove enable	X7 (Communication-Fault)	-	-	Communication with device disrupted.
501	No reaction	-	X6 (DynamicError)	-	Programmed velocity limited.
502	No reaction	-	X6 (DynamicError)	-	Programmed acceleration/deceleration limited.
503	No reaction	-	X6 (DynamicError)	-	Programmed jerk limited.
504	No reaction	-	X6 (DynamicError)	-	Speed setpoint monitoring active.
521	Remove enable	X11 (Following ErrorFault)	-	-	Window of the following error monitoring exceeded.
522	No reaction	-	X11 (Following-ErrorWarning)	-	Warning level of the following error monitoring exceeded

No.	Response	Error bit	Warning bit	Restart	Alarm text
531	Remove enable	X9 (HWLimit)	-	-	<ul style="list-style-type: none"> Positive HW limit switch reached. Negative HW limit switch reached. Incorrect traverse direction with active hardware limit switch
531	Remove enable	X9 (HWLimit)	-	X	<ul style="list-style-type: none"> Hardware limit switch polarity is reversed, axis cannot be freed Both hardware limit switches are active, axis cannot be freed
533	Stop with maximum dynamic values	X8 (SWLimit)	-	-	Software limit switch reached.
534	Remove enable	X8 (SWLimit)	-	-	Software limit switch passed.
541	Remove enable	X12 (Positioning-Fault)	-	-	Positioning monitoring error.
550	Follow-up setpoints	X4 (DriveFault)	-	-	The drive performs a autonomous movement.
601	Stop with maximum dynamic values	X14 (Synchronous Error)	-	-	The lead axis specified at the MC_GearIn.Master parameter is not configured or not available.

See also

Technology alarms (Page 215)

A.4.2 Technology alarms 101-110

Technology alarm 101

Alarm reaction: Remove enable

Restart: required

Alarm text	Solution
Error in the configuration	
Faulty load gear factors.	Adjust the specified value.
Illegal value for the configuration data Actor.DriveParameter.MaxSpeed.	Adjust the specified value.
Illegal value for the configuration data DynamicLimits.MaxVelocity.	Adjust the specified value.
Illegal value for the configuration data maximum acceleration in DynamicLimits.MaxAcceleration.	Adjust the specified value.
The set leadscrew pitch is invalid. Illegal value in Mechanics.Leadscrew	Adjust the specified value.
Illegal combination of data for homing with incremental encoder.	Adjust the specified value.
The set mounting position of the encoder is invalid. Illegal value in Sensor.MountingMode.	Adjust the specified value.
The configuration of the measuring wheel circumference of the encoder is invalid. Illegal value in Sensor.Parameter.DistancePerRevolution.	Adjust the specified value.
The configuration for the resolution of the linear encoder is faulty. Illegal value in Sensor.Parameter.Resolution.	Adjust the specified value.
The set resolution of the encoder is invalid. Illegal value in Sensor.Parameter.StepsPerRevolution.	Adjust the specified value.
The set fine resolution for Gn_XIST1 is invalid. Illegal value in Sensor.Parameter.FineResolutionXist1.	Adjust the specified value.
The set fine resolution for Gn_XIST1 in Sensor.Parameter.FineResolutionXist1 is not consistent with the setting in PROFIdrive parameter P979.	Adjust the specified value.
Illegal value for the configuration data Actor.Interface.Telegram.	Adjust the specified value.
The set encoder type is invalid. Illegal value in Sensor.Type.	Adjust the specified value.
The set encoder system is invalid. Invalid value in Sensor.System.	Adjust the specified value.
The set home position offset is invalid. Illegal value in Sensor.ActiveHoming.HomePositionOffset.	Adjust the specified value.
Parameter of position monitoring faulty. Illegal value in PositioningMonitoring.Window.	Adjust the specified value.
Parameter of position monitoring faulty. Illegal value in PositioningMonitoring.Window.	Adjust the specified value.
The set home position offset is invalid. Illegal value in Sensor.ActiveHoming.Mode.	Adjust the specified value.
The set home position offset is invalid. Illegal value in Sensor.PassiveHoming.Mode.	Adjust the specified value.
The configuration of the PROFIdrive interface of the actual value is faulty. Illegal value in Sensor.Interface.Telegram.	Adjust the specified value.
Faulty controller factors.	Adjust the specified value.
Limit for standstill signal is faulty. Illegal value in StandStillSignal.VelocityThreshold.	Adjust the specified value.
Parameter of position monitoring faulty. Invalid value in PositioningMonitoring.ToleranceTime.	Adjust the specified value.
Illegal value in Actor.Type.	Adjust the specified value.
Inconsistent PROFIBUS parameterization; the sum of Ti and To is greater than one DP cycle clock.	Adjust the specified value.

Alarm text	Solution
Parameter of standstill monitoring faulty. Invalid value in StandStillSignal.MinDwellTime.	Adjust the specified value.
Parameter of the following error monitoring faulty. Illegal value in FollowingError.MaxValue.	Adjust the specified value.
Drive or message frame type not suitable for DSC.	Adjust the specified value.
Illegal value for the configuration data maximum jerk in DynamicLimits.MaxJerk.	Adjust the specified value.
Illegal value for the configuration data maximum deceleration in DynamicLimits.MaxAcceleration.	Adjust the specified value.
Illegal value in Modulo.Length.	Adjust the specified value.
Illegal value in Modulo.StartValue.	Adjust the specified value.
Illegal value in Actor.DriveParameter.ReferenceSpeed.	Adjust the specified value.
The set fine resolution for Gn_XIST2 is invalid. Illegal value in Sensor.Parameter.FineResolutionXist2.	Adjust the specified value.
The number of determinable encoder revolutions is invalid. Invalid value in Sensor.Parameter.DeterminableRevolutions.	Adjust the specified value.
The specified approach direction of the homing mark for passive homing is invalid. Invalid value in Sensor.PassiveHoming.Direction.	Adjust the specified value.
Illegal value in DynamicDefaults.Velocity.	Adjust the specified value.
Invalid value in DynamicDefaults.Acceleration.	Adjust the specified value.
Illegal value DynamicDefaults.Deceleration.	Adjust the specified value.
Illegal value in DynamicDefaults.Jerk.	Adjust the specified value.
Illegal value in DynamicDefaults.EmergencyDeceleration.	Adjust the specified value.
Illegal value in PositionLimits_SW.MinPosition.	Adjust the specified value.
Illegal value in PositionLimits_SW.MaxPosition.	Adjust the specified value.
The specified approach direction of the homing mark for active homing is invalid. Invalid value in Sensor.PassiveHoming.Direction.	Adjust the specified value.
Illegal value in Homing.ApproachVelocity.	Adjust the specified value.
Illegal value in Homing.ReferencingVelocity.	Adjust the specified value.
Illegal value in Homing.HomePosition.	Adjust the specified value.
Parameter of the following error monitoring faulty. Illegal value in FollowingError.MaxValue.	Adjust the specified value.
Parameter of the following error monitoring faulty. Illegal value in FollowingError.MinVelocity.	Adjust the specified value.
Parameter of the following error monitoring faulty. Illegal value in FollowingError.WarningLevel.	Adjust the specified value.
Controller parameter is incorrect. Illegal value of the pre-control factor PositionControl.Kpc	Adjust the specified value.
TimeOut parameter outside the permissible limits.	Adjust the specified value.
Simulation.Mode parameter outside the permissible limits.	Adjust the specified value.

Technology alarm 104

Alarm reaction: Stop with maximum dynamic values

Restart: Not required

Alarm text	Solution
Error in the specification of software limit switches.	
Negative switch greater than positive switch when axis is not modulo axis.	Change the position of the software limit switches.

Technology alarm 105

Alarm reaction: Remove enable

Restart: required

Alarm text	Solution
Configuration mode (drive/actuator).	
Configuration error.	Connect a suitable device. Check the device (I/Os). Compare the configuration in HW Config and the technology object.
The driver needs a smaller servo cycle clock.	Connect a suitable device. Check the device (I/Os). Compare the configuration in HW Config and the technology object.
Error in internal communication.	Check the project for consistency and reload it into the controller.

Technology alarm 106

Alarm reaction: Remove enable

Restart: required

Alarm text	Solution
Configuration error in the drive actuator driver.	
System has no communication with drive.	Internal system error. Check the project for consistency and reload it into the controller.
Actuator driver not initialized during ramp-up.	To release a technology object, the actuator drivers must be finished initializing. Initiate the job again later.

Technology alarm 107

Alarm reaction: Remove enable

Restart: required

Alarm text	Solution
Configuration error encoder.	
Configuration error.	Connect a suitable device. Check the device (I/Os). Compare the configuration in HW Config and the technology object.
The driver needs a smaller servo cycle clock.	
Error in internal communication.	Check the project for consistency and reload it into the controller.

Technology alarm 108

Alarm reaction: Remove enable

Restart: required

Alarm text	Solution
Configuration error encoder driver.	
System has no communication with encoder.	Internal system error. Check the project for consistency and reload it into the controller.
Encoder driver not initialized during ramp-up.	
	An attempt is being made to release an axis or encoder, although the driver is not finished initializing.

Technology alarm 109

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Configuration error.	Connect a suitable device. Check the device (I/Os). Compare the configuration in HW Config and the technology object.
Negative hardware limit switch.	
Positive hardware limit switch.	
Reference cam active homing.	
Reference cam passive homing.	
Enable drive bit analog drive interface	
Drive ready bit of the analog drive interface	

Technology alarm 110

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Configuration is being internally adapted.	
Illegal value for Actor.MaxSpeed (Actor.MaxSpeed greater than 2*Actor.Reference Speed; Actor.MaxSpeed is set to 2*Actor.Reference Speed.	Correct the reference value in the drive as well as in the configuration of the technology object on Actor.MaxSpeed/2. For the analog drive connection, correct the reference value in the drive as well as in the configuration of the technology object on Actor.MaxSpeed/1.17.
The delay time to reach the tolerance window of positioning monitoring (PositionMonitoring.ToleranceTime) is limited.	Change the configuration datum.
The emergency deceleration (DynamicDefaults.EmergencyDeceleration) is too low and is set to the minimum value possible.	

A.4.3 Technology alarms 201-204**Technology alarm 201**

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Internal error.	Contact the hotline.

Technology alarm 202

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Internal configuration error.	Contact the hotline.

Technology alarm 203

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Internal error. Please contact customer service.	Contact the hotline.

Technology alarm 204

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Commissioning error	
Sign-of-life failure between controller and TIA Portal.	Check the connection properties.

A.4.4 Technology alarms 304-342**Technology alarm 304**

Alarm reaction: Stop with emergency stop ramp

Restart: Not required

Alarm text	Solution
Limit value for velocity is zero.	Enter a non-zero value for the maximum speed (DynamicLimits.MaxVelocity) in the dynamic limits.

Technology alarm 305

Alarm reaction: Stop with emergency stop ramp

Restart: Not required

Alarm text	Solution
Limit value for acceleration/deceleration is zero.	
Acceleration	Enter a non-zero value for the maximum acceleration (DynamicLimits.MaxAcceleration) in the dynamic limits.
Deceleration	Enter a non-zero value for the maximum deceleration (DynamicLimits.MaxDeceleration) in the dynamic limits.

Technology alarm 306

Alarm reaction: Stop with emergency stop ramp

Restart: Not required

Alarm text	Solution
Limit value for jerk is zero.	Enter a non-zero value for the maximum jerk (DynamicLimits.MaxJerk) in the dynamic limits.

Technology alarm 307

Alarm reaction: Stop with maximum dynamic values

Restart: Not required

Alarm text	Solution
The numeric value range of the position was reached.	
Negative	Enable the "Modulo" setting for the technology object.
Positive	Enable the "Modulo" setting for the technology object.

Technology alarm 308

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
The numeric value range of the position was exceeded.	
Negative	Enable the "Modulo" setting for the technology object.
Positive	

Technology alarm 321

Alarm reaction: Stop with emergency stop ramp

Restart: Not required

Alarm text	Solution
Axis is not homed.	To perform absolute positioning, you need to home the technology object.

Technology alarm 322

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Restart not performed.	
The technology object is not ready for restart.	Download the project again.
Condition for restart of the technology object is not satisfied (e.g. technology object must be disabled).	Disable the technology object.

Technology alarm 323

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
MC_Home was not executed because this would result in the numerical value range being exceeded.	Enable the "Modulo" setting for the technology object. Enter a valid position value for the use of MC_Home instruction.

Technology alarm 341

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Error in homing data.	
The approach velocity is zero. Homing.ApproachVelocity.	Check the configuration for homing (Homing.Approach Velocity)
The homing velocity is zero. Homing.ReferencingVelocity.	Check the configuration for homing (Homing.ReferencingVelocity)

Technology alarm 342

Alarm reaction: Stop with emergency stop ramp

Restart: Not required

Alarm text	Solution
Reference cam / encoder zero mark was not found.	Connect a suitable device. Check the device (I/Os). Compare the configuration in HW Config and the technology object.

A.4.5 Technology alarms 401-431

Technology alarm 401

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Error accessing logical address.	
The requested logical address is invalid.	Connect a suitable device. Check the device (I/Os). Check the topological configuration in HW Config. Compare the configuration in HW Config and the technology object.
The requested logical output address is invalid.	
The requested logical output address is invalid.	

Technology alarm 411

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Encoder at the logical address disrupted.	
Alarm message from encoder.	Check the device in regard to function, connections and I/Os.
General hardware error of the encoder.	
Encoder dirty.	
Error reading the absolute value of the encoder.	Compare the encoder type in the drive or encoder parameter P979 with the configuration data of the technology object.
Zero mark monitoring of the encoder.	Encoder reports error for the zero mark monitoring (error code 0x0002 in Gx_XIST2, see PROFIDrive profile). Check the system for electromagnetic compatibility (EMC).
Encoder has gone in parking state.	Locate the cause of the error in the connected drive or encoder. Check whether the alarm was possibly triggered by a startup action on the drive or encoder.

Technology alarm 412

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Violation of the range limit for the incremental actual value.	
Range violation in positive direction.	Home the axis/encoder to a valid actual value range.
Range violation in negative direction.	
The change of the actual position in a position control clock cycle is greater than the modulo length.	Adjust the modulo length of the employed encoder.

Technology alarm 421

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Drive/actuator at the logical address disrupted.	Check the device in regard to function, connections and I/Os.
Alarm message from drive.	
PROFdrive: Drive signal "Control requested" failed.	
PROFdrive: Drive has shut down.	

Technology alarm 431

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Communication with device disrupted.	
PROFdrive: Drive at bus failed (station failure).	Check the device in regard to function, connections and I/Os.
PROFdrive: Signs of life of drive faulty.	Check the device in regard to function, connections and I/Os. Compare the clock parameters of HW Config (PROFIBUS line, slave OM for drive or encoder) and the execution system. Tmapc and servo must be configured in the same clock cycle time. (Incorrect parameterization is indicated by reason 0x0080)
PROFdrive: Encoder at bus failed (station failure).	Check the device in regard to function, connections and I/Os.
PROFdrive: Signs of life of encoder faulty.	Check the device in regard to function, connections and I/Os. Compare the clock parameters of HW Config (PROFIBUS line, slave OM for drive or encoder) and the execution system. Tmapc and servo must be configured in the same clock cycle time.

A.4.6 Technology alarms 501-550

Technology alarm 501

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Programmed velocity limited.	Check the value for the speed of the Motion Control instruction. Check the configuration of the dynamic limits.

Technology alarm 502

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Programmed acceleration/deceleration limited.	
Acceleration	Check the value for the acceleration of the Motion Control instruction. Check the configuration of the dynamic limits.
Deceleration	Check the value for the deceleration of the Motion Control instruction. Check the configuration of the dynamic limits.

Technology alarm 503

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Programmed jerk limited.	Check the value for the jerk of the Motion Control instruction. Check the configuration of the dynamic limits.

Technology alarm 504

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Speed setpoint monitoring active.	Check the mechanical configuration. Check the encoder connection. Check the configuration of the speed setpoint interface. Check the configuration of the control loop. Check the value for the maximum speed DynamicLimits.MaxVelocity. Enter a value \leq Actor.MaxSpeed for the "Velocity" parameter at the Motion Control instruction.

Technology alarm 521

Alarm reaction: Remove enable

Restart: Not required

Alarm text	Solution
Window of the following error monitoring exceeded.	Check the configuration of the control loop. Check the direction of the encoder. Check configuration of the following error monitoring.

Technology alarm 522

Alarm reaction: No reaction

Restart: Not required

Alarm text	Solution
Warning level of the following error monitoring exceeded	Check the configuration of the control loop. Check the direction of the encoder. Check configuration of the following error monitoring.

Technology alarm 531

Alarm reaction: Remove enable

Restart: See "Restart" column

Alarm text	Solution	Restart
Positive HW limit switch reached.	Acknowledge the alarm. Movements in the negative direction are allowed after acknowledgment.	-
Negative HW limit switch reached.	Acknowledge the alarm. Movements in the positive direction are allowed after acknowledgment.	-
Incorrect traverse direction with active hardware limit switch	The programmed motion direction is disabled due to the active hardware limit switch. Retract the axis in the opposite direction.	-
Hardware limit switch polarity is reversed, axis cannot be freed	Check the mechanical configuration of the hardware limit switch.	X
Both hardware limit switches are active, axis cannot be freed	Check the mechanical configuration of the hardware limit switch.	X

Technology alarm 533

Alarm reaction: Stop with maximum dynamic values

Restart: Not required

Alarm text	Solution
Software limit switch reached.	
Negative	.The software limit switch has been approached from an ongoing movement. Acknowledge the alarm. Move the axis in the positive direction away from the software limit switch.
Positive	The software limit switch has been approached from an ongoing movement. Acknowledge the alarm. Move the axis in the negative direction away from the software limit switch.

Technology alarm 534

Alarm reaction: Remove enable

Restart: Not required

Alarm text		Solution
Software limit switch passed.		
Negative		The software limit switch was exceeded. Acknowledge the alarm. Movements in the positive direction are allowed after acknowledgment.
Positive		The software limit switch was exceeded. Acknowledge the alarm. Movements in the negative direction are allowed after acknowledgment.

Technology alarm 541

Alarm reaction: Remove enable

Restart: Not required

Alarm text		Solution
Positioning monitoring error.		
Target range not reached.		The target range was not reached within the positioning tolerance time. Check the configuration of the positioning monitoring. Check configuration of the control loop..
Exit target range again.		The target area was exited within the minimum dwelling time. Check the configuration of the positioning monitoring. Check configuration of the control loop.

Technology alarm 550

Alarm reaction: Follow-up setpoints

Restart: Not required

Alarm text	Solution
The drive performs a autonomous movement.	When the SS2 signal is no longer present in the drive, the drive goes automatically into standby mode (<TO>.StatusDrive.InOperation = TRUE). Acknowledge the alarm. The technology object is automatically released after acknowledgment.

A.4.7 Technology alarm 601

Technology alarm 601

Alarm reaction: Stop with maximum dynamic values

Restart: Not required

Alarm text	Solution
The lead axis specified at the MC_GearIn.Master parameter is not configured or not available.	Specify all master value interconnections for the configuration required in operation for the synchronous axis technology object. If a restart is performed for a lead axis in synchronous operation, the alarm is displayed and the following axis is stopped with the maximum dynamic values. Acknowledge the alarm after restarting the lead axis and restart the synchronization.

A.5 Error ID

Errors in Motion Control instructions are reported by means of "Error" and "ErrorID" parameters.

Under the following conditions, "Error" = TRUE and "ErrorID" = 16#8xxx are indicated at the Motion Control instruction:

- Invalid status of the technology object, which prevents the execution of the job.
- Invalid parameter assignment of the Motion Control instruction, which prevents the execution of the job.
- As a result of the alarm reaction for an error at the technology object.

ErrorIDs and remedies

The following table lists all "ErrorIDs" that can be indicated in Motion Control instructions. Along with the cause of the error, the table lists corresponding troubleshooting routines:

ErrorID	Description	Solution
16#0000	No error	-
16#8001	A technology alarm (TO error) occurred while processing the Motion Control instruction.	In the technology data block, an error message is output at the "ErrorDetail.Number" tag. A list of the technology alarms and alarm reactions can be found in the appendix, Technology Alarms (Page 368).
16#8002	Invalid value in the "Axis" parameter.	Check the value in the "Axis" parameter
16#8003	Invalid velocity	Set a valid velocity value at parameter "Velocity".
16#8004	Invalid acceleration	Set a valid acceleration value at parameter "Acceleration".
16#8005	Invalid deceleration	Set a valid deceleration value at parameter "Deceleration".
16#8006	Invalid jerk	Set a valid jerk value at parameter "Jerk".
16#8007	Invalid direction	Set a valid directional value at parameter "Direction".
	When the axis is at a standstill, "Direction" = 4 (current direction) is not permitted.	
	Invalid input Both the "JogForward" and "JogBackward" parameters set to TRUE at the same time. The axis decelerates with the most recently valid deceleration.	Reset both the "JogForward" parameter and the "JogBackward" parameter.
16#8008	Invalid distance specification	Set a valid distance value at parameter "Distance".
16#8009	Invalid position specification	Set a valid position value at parameter "Position".
16#800A	Invalid operating mode	Set a valid operating mode at parameter "Mode".
16#800B	Invalid stop mode	Set a valid stop mode at parameter "StopMode".
16#800C	Only one instance of the "MC_Power" instruction is allowed per technology object.	A technology object was specified in several instances of the "MC_Power" instruction, in the "Axis" parameter. Ensure that the technology object is only specified in one "MC_Power" instruction.

ErrorID	Description	Solution
16#800D	Job not permitted in current mode. "Restart" is being executed.	Wait until the "Restart" of the technology object is complete.
16#800E	If the axis is activated, a "Restart" is not possible.	Before a "Restart", deactivate the technology object with "MC_Power.Enable"FALSE.
16#800F	The technology object is disabled. The job cannot be executed.	Enable the technology object with "MC_Power.Enable" = TRUE. Restart the job.
16#8010	Invalid homing mode for incremental encoder.	Absolute value adjustment is not possible with an incremental encoder ("Mode" = 6, 7). Start a homing process for an incremental encoder using parameter "Mode" = 0, 1, 2, 3, 5, 8, 10.
16#8011	Invalid homing mode for absolute encoder.	Passive and active homing ("Mode" = 2, 3, 5, 8, 10) are not possible for an absolute value encoder. Start a homing process for an absolute encoder using parameter "Mode" = 0, 1, 6, 7.
16#8012	Job cannot be executed - axis control panel is activated.	Return master control to the user program. Restart the job.
16#8013	The online connection between the CPU and the TIA Portal is down.	Check the online connection to the CPU.
16#8014	No internal job memory available.	The maximum number of motion control jobs has been reached. Reduce the number of jobs to be executed (parameter "Execute" = FALSE).
16#8015	Error acknowledgement with MC_Reset" not possible. Error in the configuration of the technology object.	Check the configuration of the technology object.
16#8016	The actual values are not valid.	The actual values must be valid in order to execute a MC_Home job. Check the status of the actual values. The "<TO>.StatusSensor[n].State" tag of the technology object must show the value 2 (valid).
16#8017	Invalid value for gear ratio numerator.	Set a valid value at parameter "RatioNumerator" for the gear ratio numerator. Permitted integer values: -2147483648 to 2147483648 (value 0 not permitted)
16#8018	Invalid value for gear ratio denominator.	Set a valid value at parameter "RatioDenominator" for the gear ratio denominator. Permitted integer values: 1 to 2147483648
16#8019	Job cannot be executed. The specified following axis is the original master value for the synchronous operation chain.	Recursive interconnections are not possible. A leading axis cannot be interconnected as following axis to its own master value. Set a valid following axis at parameter "Slave".
16#8FFF	Unspecified error	Please contact the Siemens agent at your local agency or branch. You will find information on whom to contact at: Contact information for Industry Automation and Drive Technologies (http://www.siemens.com/automation/partner)

See also

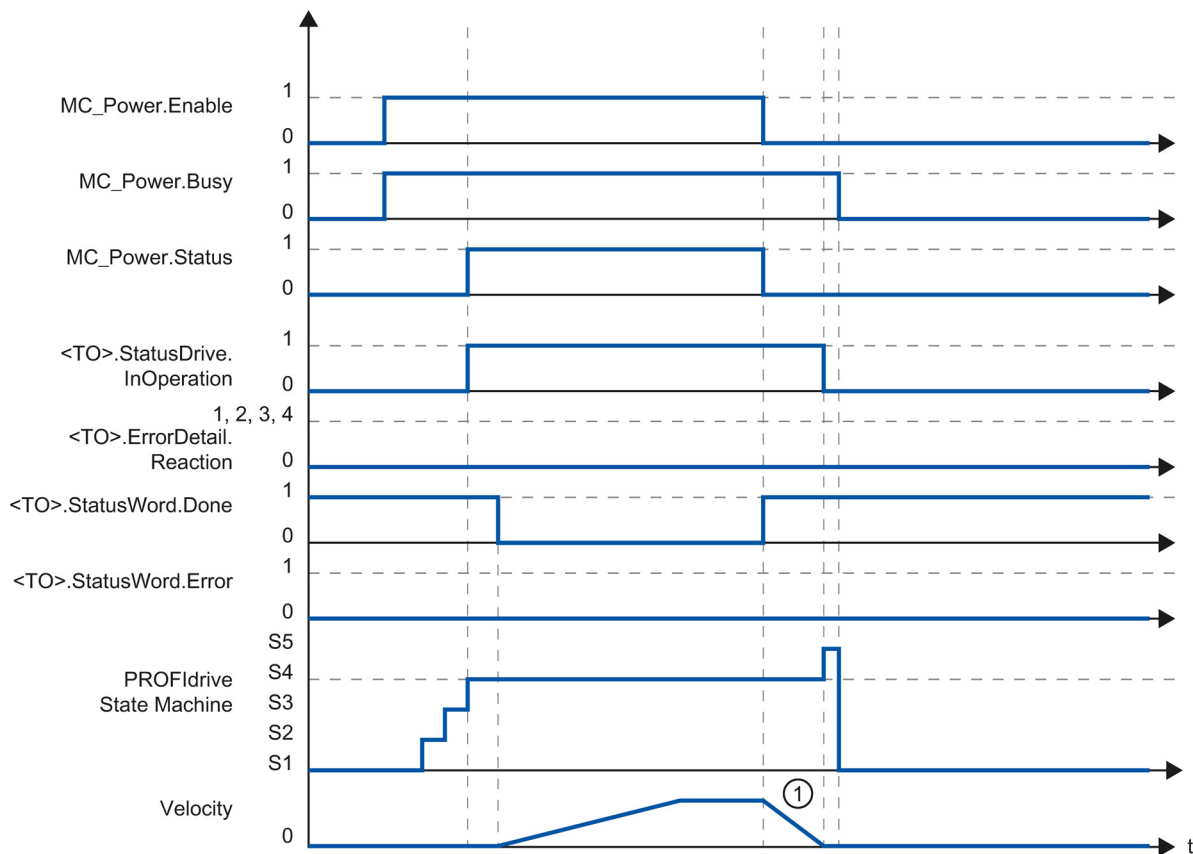
Errors in Motion Control instructions (Page 219)

A.6 MC_Power function chart

A.6.1 Drive connection via PROFIdrive

A.6.1.1 StopMode 0

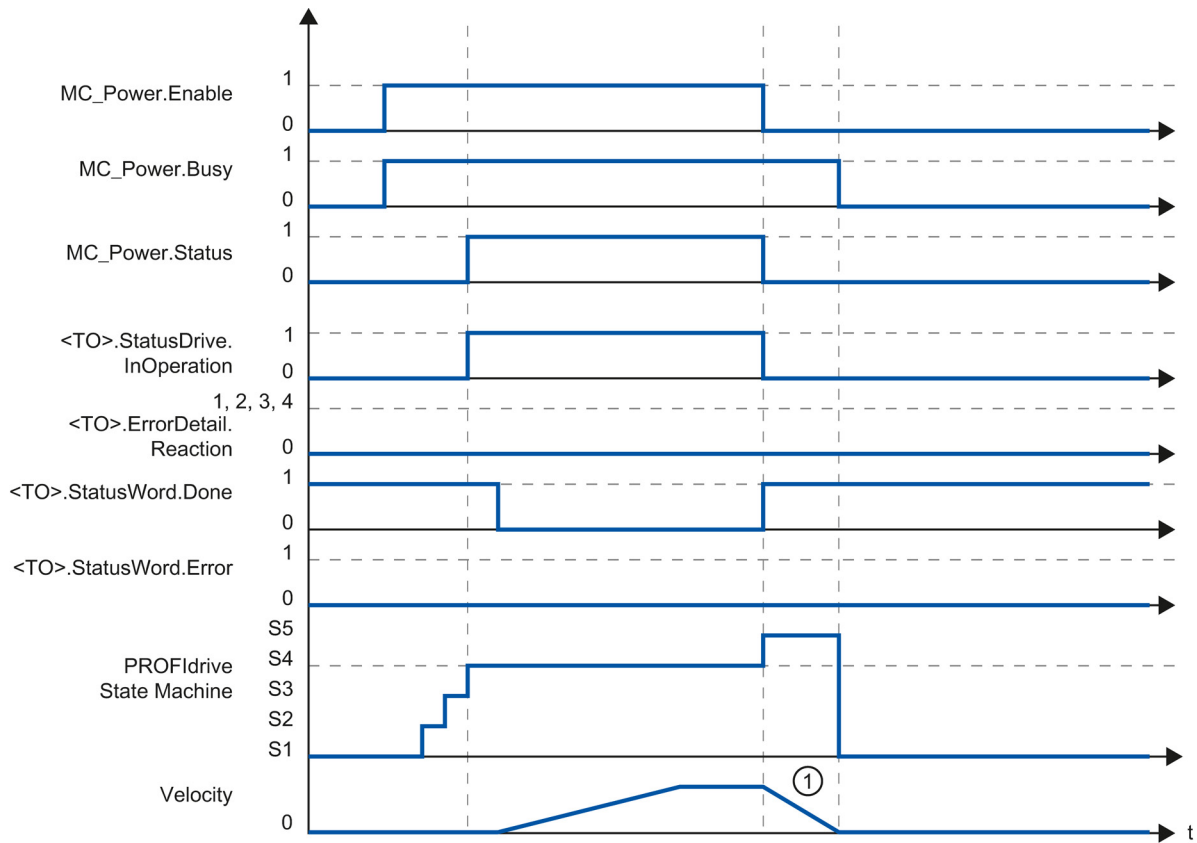
Function chart: Enabling a technology object and disabling with "StopMode" = 0



① The axis decelerates with the configured emergency stop deceleration.

A.6.1.2 StopMode 1

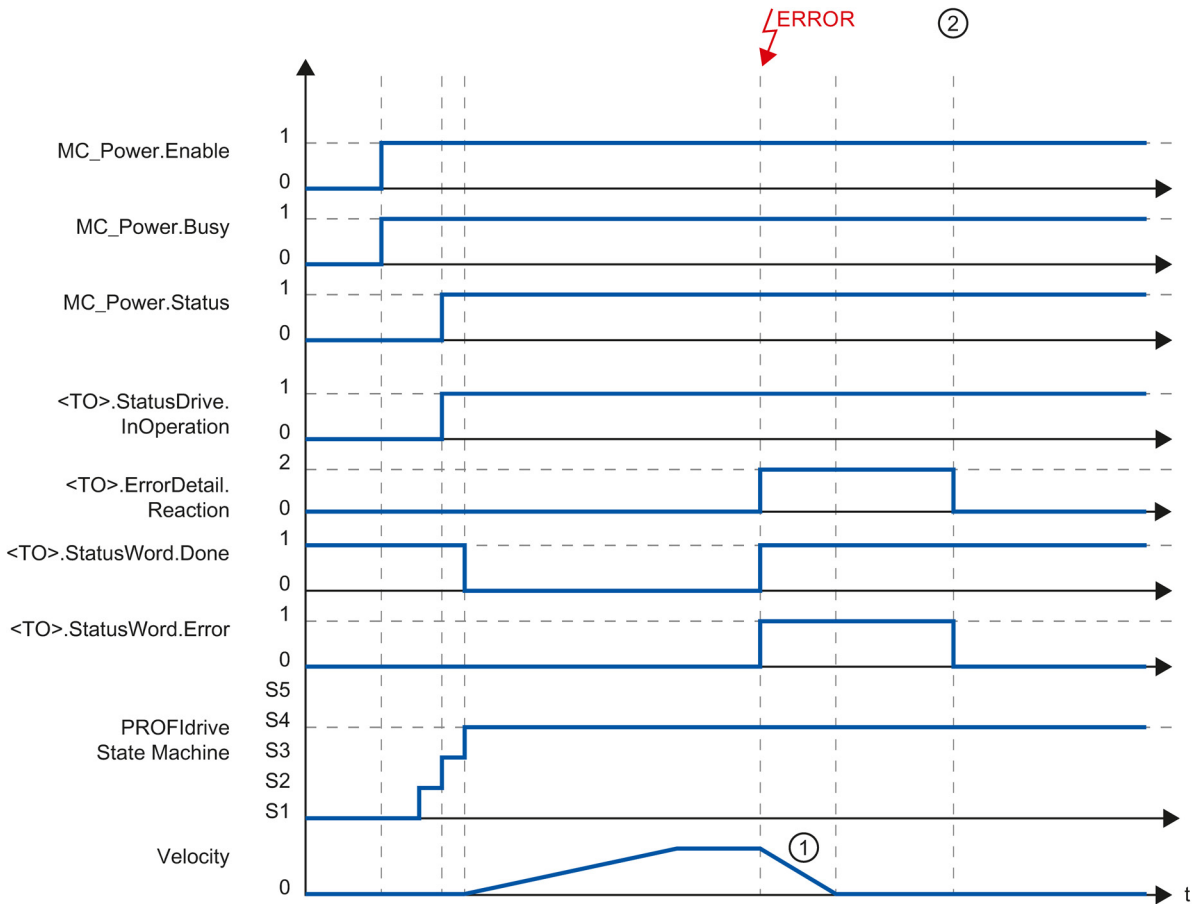
Function chart: Enabling a technology object and disabling with "StopMode" = 1



① The deceleration ramp depends on the configuration in the drive.

A.6.1.3 Alarm response "Stop with maximum dynamic values"

Function chart: Enabling a technology object and occurrence of a technology alarm with alarm response "Stop with maximum dynamic values"

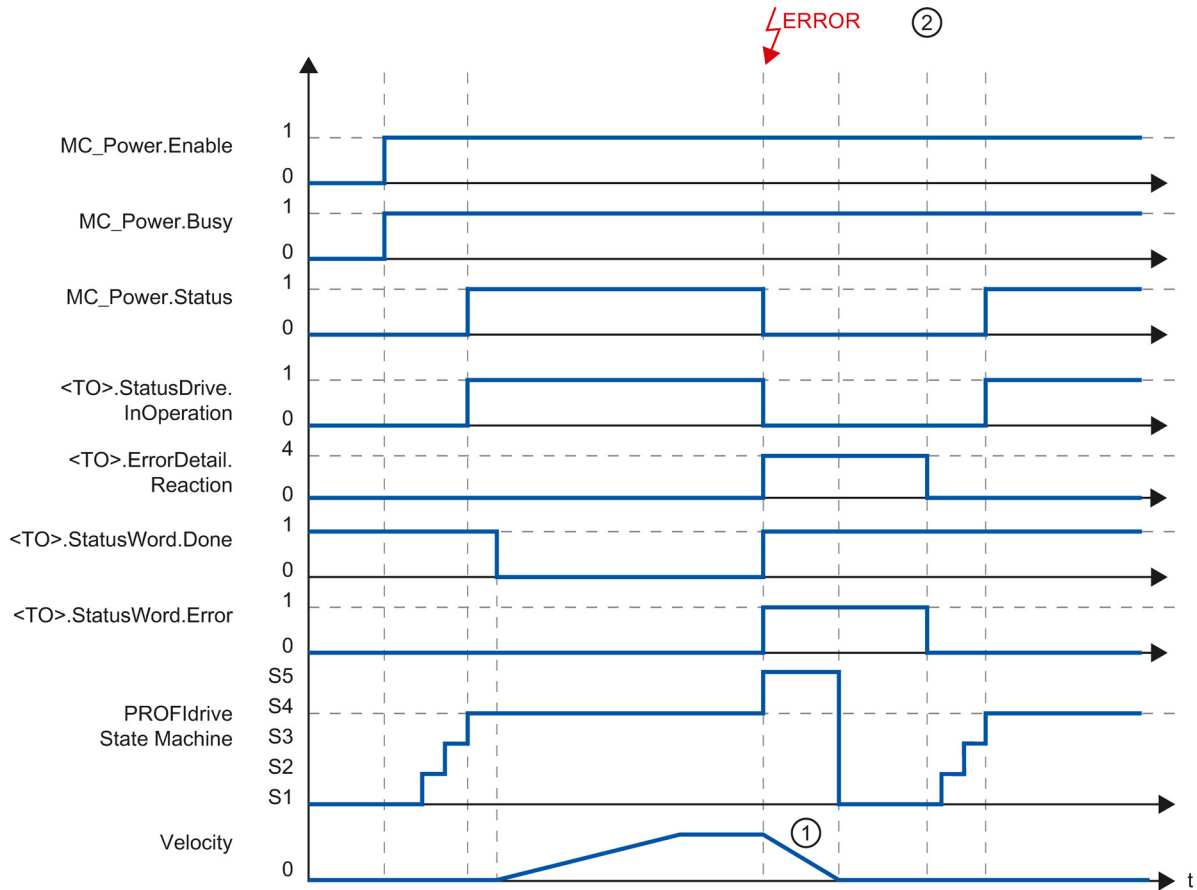


① The axis decelerates with the configured maximum deceleration.

② The technology alarm is acknowledged.

A.6.1.4 Alarm response "Remove enable"

Function chart: Enabling a technology object and occurrence of a technology alarm with alarm response "Remove enable"

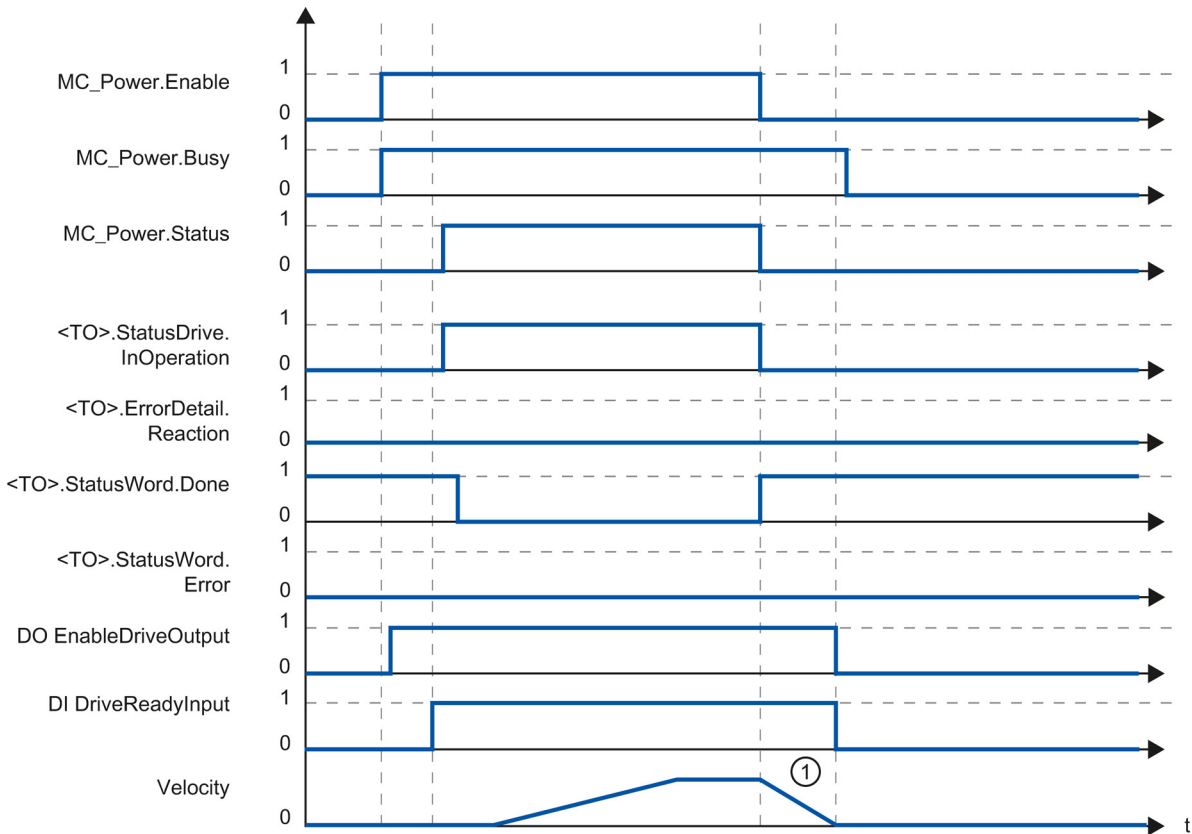


- ① The deceleration ramp depends on the configuration in the drive.
- ② The technology alarm is acknowledged at time ②.

A.6.2 Analog drive connection

A.6.2.1 StopMode 0

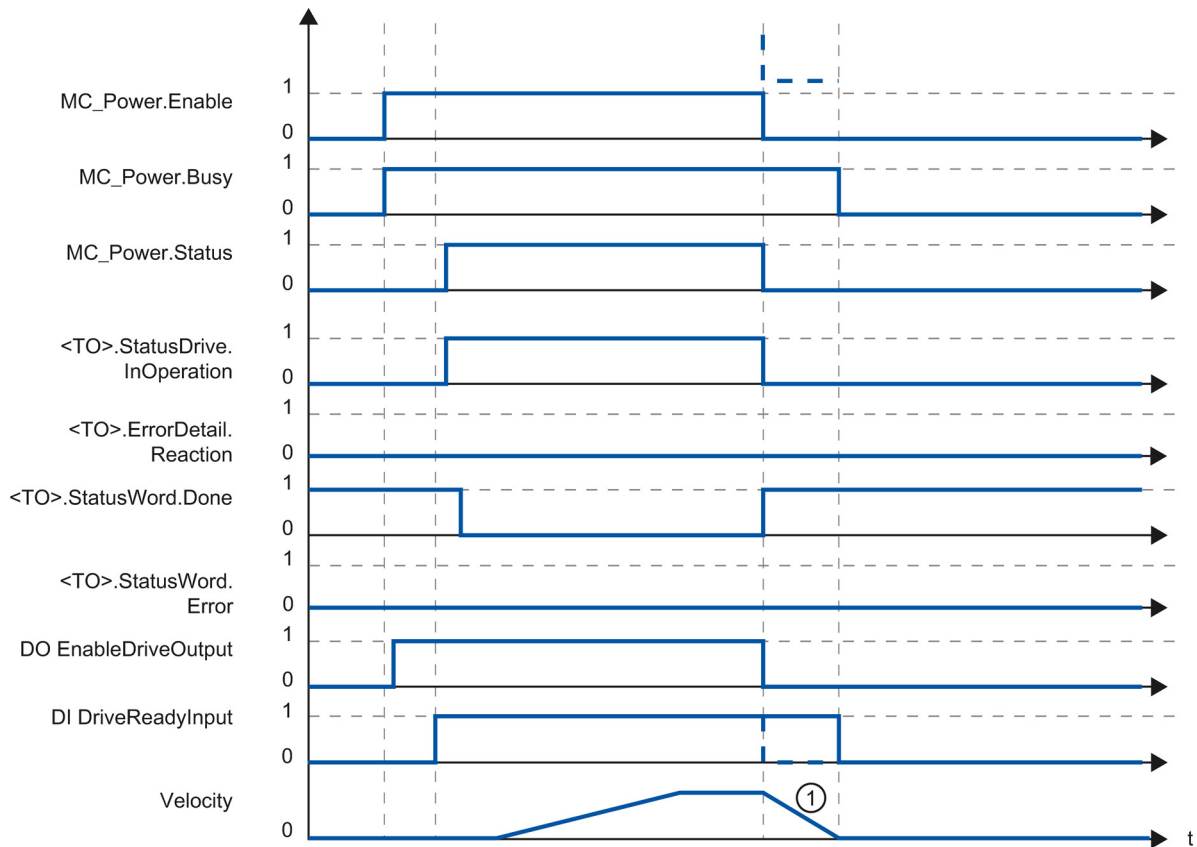
Function chart: Enabling a technology object and disabling with "StopMode" = 0



① The axis decelerates with the configured emergency stop deceleration.

A.6.2.2 StopMode 1

Function chart: Enabling a technology object and disabling with "StopMode" = 1



①

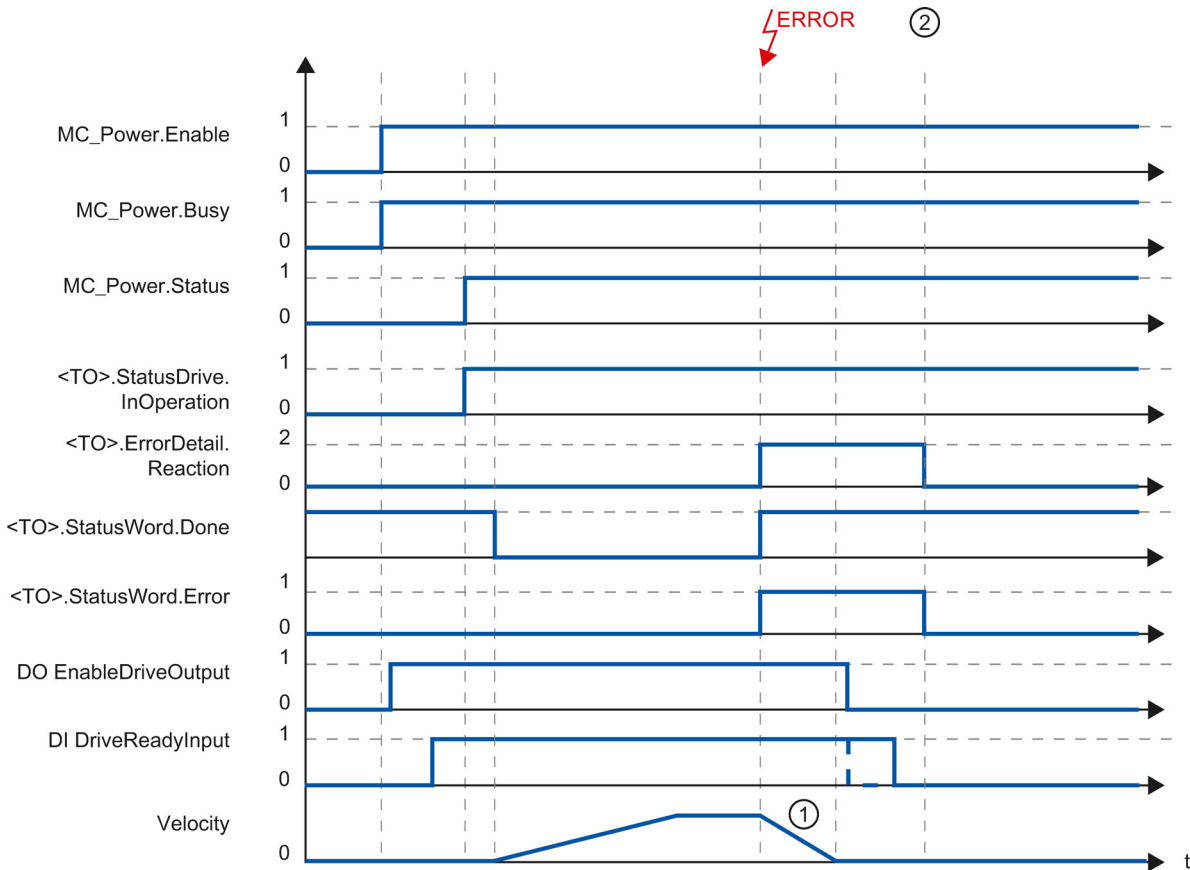
The deceleration ramp depends on the configuration in the drive.

- - - -

The behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

A.6.2.3 Alarm response "Stop with maximum dynamic values"

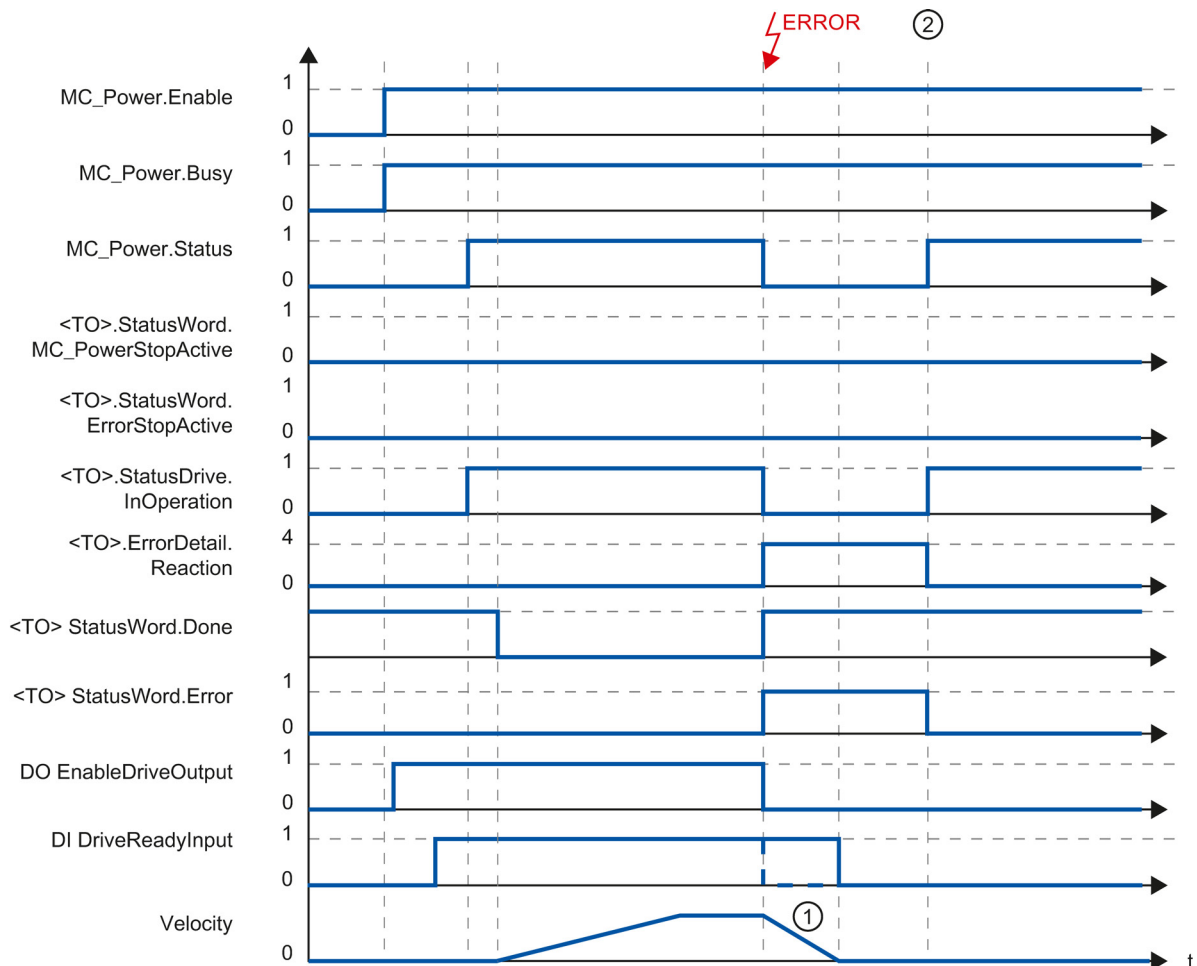
Function chart: Enabling a technology object and occurrence of a technology alarm with alarm response "Stop with maximum dynamic values"



- ① The axis decelerates with the configured maximum deceleration.
- ② The technology alarm is acknowledged at time ②.
- - - The behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

A.6.2.4 Alarm response "Remove enable"

Function chart: Enabling a technology object and occurrence of a technology alarm with alarm reaction "Remove enable"



- ① The deceleration ramp depends on the configuration in the drive.
- ② The technology alarm is acknowledged at time ②.
- - - The behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

A.7 SINAMICS drives

A.7.1 Homing SINAMICS drives with external zero marks

For SINAMICS drives with external zero marks, synchronization during homing must always occur on the left side of the external zero mark's signal. That is to say, with a positive direction of travel synchronization is done on a positive edge, and with a negative direction of travel synchronization is done on a negative edge.

By inverting the signal, synchronization can also be done on the right side of the signal of the external zero mark. The inversion can be configured in the drive using SINAMICS parameter P490.

Homing to an encoder zero mark or an external zero mark is configured in SINAMICS parameter P495.

Glossary

Absolute value encoder

Position encoder which outputs the position in the form of a digital numerical value. This numerical value is unique within the entire resolution range of the absolute value encoder.

Axis control panel

The axis control panel allows you to move the axis in manual mode, optimize the axis settings, and test the operation of the axis in your system.

Axis type

The axis type differs depending on the unit of measurement according to which the axis is positioned.

Depending on the execution of the mechanics, an axis is implemented as a linear axis or rotary axis:

- For linear axes, the position of the axis is specified as a linear measure, e.g. millimeters (mm).
- For rotary axes, the position of the axis is specified as an angular measure, e.g. degrees (°).

Communication processor (CP)

Module for expanded communications tasks covering special applications, for example in the area of security.

Communications module (CM)

Module for communications tasks which is used as an interface expansion of the CPU (for example PROFIBUS) or provides additional communications options (e.g. PtP) in an automation system.

Drive

The combination of motor (electric or hydraulic), actuator (converter, valve), control system, measuring system and supply (infeed, accumulator).

Dynamic Servo Control (DSC)

In drives that support DSC, you can optionally use the position controller in the drive. The position controller in the drive is usually implemented with a rapid speed-control cycle. This improves the control performance for digitally coupled drives.

Following error

The following error is the difference between the position setpoint and the actual position value. The transmission times of the setpoint to the drive, and of the actual position value to the controller, are taken into account in the calculation of the following error.

GSD file

As a Generic Station Description, this file contains all properties of a PROFINET or PROFIBUS device that are necessary for its configuration.

Hardware limit switch

Mechanical limit position switch that limits the maximum permissible traversing range of the axis.

Homing

With homing, you create the relationship between the position in the technology object and the mechanical position of the axis. The position value in the technology object is assigned to a homing mark at the same time. This homing mark represents a known mechanical position.

Incremental encoder

Position encoder which outputs the position change incrementally in the form of a digital numerical value.

Kv factor

Velocity gain

Gain factor in position control loop

Master value

Input variable for synchronous operation

Motion Control instruction

Use the Motion Control instructions to start Motion Control jobs at technology objects in your user program and thus execute the desired functionality at the technology objects. You track the status of running jobs with the output parameters of the Motion Control instructions.

Override

Percentage correction of the velocity/speed

PROFIdrive

PROFIdrive is a profile specified by the PNO (PROFIBUS user organization) for PROFIBUS DP and PROFINET IO for speed- and position-controlled drives.

PROFIdrive frame

Frame for communication according to PROFIdrive.

Proximity switch

Position switch which is activated with the moving part without mechanical contact.

Restart

The technology object is reinitialized with the current configuration parameters.

Software limit switch

A programmable position which limits the traversing range of an axis.

Synchronous operation

Defined movement of a following axis to a leading axis.

Technology data block

The technology data block represents the technology object and contains all configuration data, setpoint and actual values, and status information of the technology object.

Technology interrupt

If an error occurs at a technology object (e.g. approaching a hardware limit switch), then a technology interrupt is triggered and indicated.

The impact of a technology interrupt on the technology object is specified by the interrupt reaction (e.g. remove enable). The interrupt reaction is specified by the system.

Technology module (TM)

Module for technological tasks, e.g. counting, measuring and positioning.

Zero mark

Position reference for the movement of rotary and linear incremental encoders. The zero mark of an incremental encoder is used as a homing mark, for example.

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