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Function manual

SIMATIC

S7-1500

S7-1500/S7-1500T Axis functions V5.0
in TIA Portal V16

Edition 12/2019

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Function Manual

TIA Portal V16

12/2019

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Preface (S7-1500, S7-1500T)

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.industry.siemens.com).

Security information (S7-1500, S7-1500T)

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens’ products and solutions constitute one element of such a concept.

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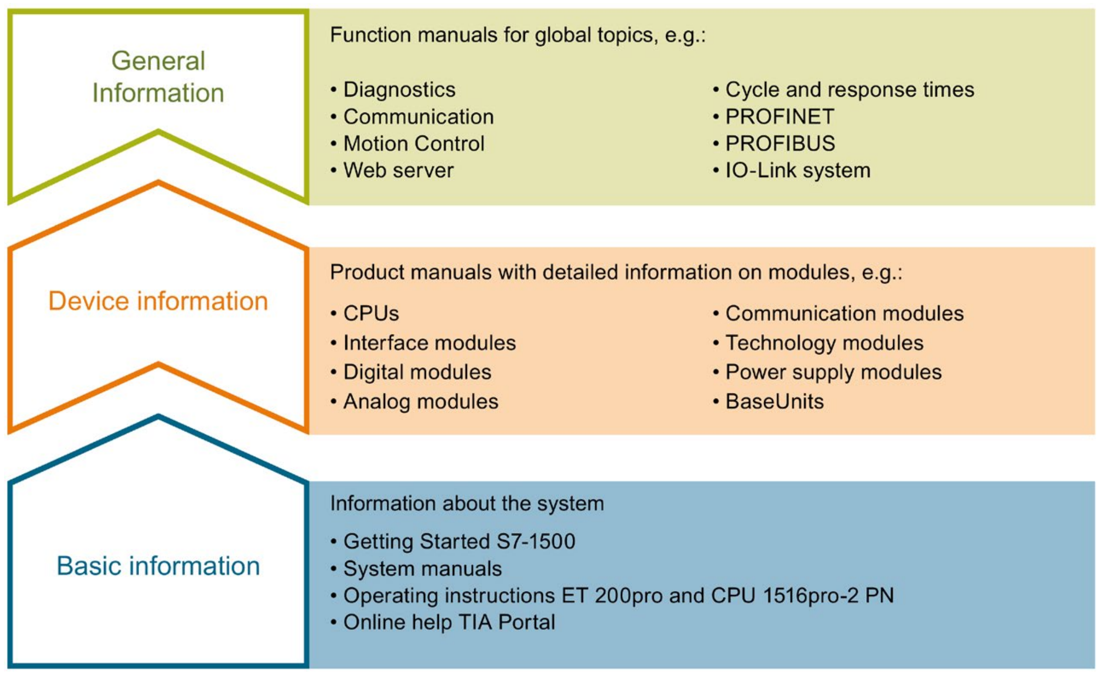
Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customers' exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (https://www.siemens.com/industrialsecurity).

Table of contents

1 Function manuals Documentation Guide (S7-1500, S7-1500T)

The documentation for the SIMATIC S7-1500 automation system, for CPU 1516pro-2 PN based on SIMATIC S7-1500, and for the distributed I/O systems SIMATIC ET 200MP, ET 200SP and ET 200AL is divided into three areas.
This division allows you easier access to the specific information you require.



Basic information

System manuals and Getting Started manuals describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500, ET 200MP, ET 200SP and ET 200AL systems; use the corresponding operating instructions for CPU 1516pro-2 PN. The STEP 7 online help supports you in configuration and programming.

Device information

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

General information

The function manuals contain detailed descriptions on general topics such as diagnostics, communication, Motion Control, Web server, OPC UA.

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742705).

Changes and additions to the manuals are documented in product information sheets.

You will find the product information on the Internet:

- S7-1500/ET 200MP (https://support.industry.siemens.com/cs/us/en/view/68052815)
- ET 200SP (https://support.industry.siemens.com/cs/us/en/view/73021864)
- ET 200AL (https://support.industry.siemens.com/cs/us/en/view/99494757)

Manual Collections

The Manual Collections contain the complete documentation of the systems put together in one file.

You will find the Manual Collections on the Internet:

- S7-1500/ET 200MP (https://support.industry.siemens.com/cs/ww/en/view/86140384)
- ET 200SP (https://support.industry.siemens.com/cs/ww/en/view/84133942)
- ET 200AL (https://support.industry.siemens.com/cs/ww/en/view/95242965)

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You must register once to use the full functionality of "mySupport".

You can find "mySupport" on the Internet (https://support.industry.siemens.com/My/ww/en).

Application examples

The application examples support 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 on individual products.

You will find the application examples on the Internet (https://support.industry.siemens.com/sc/ww/en/sc/2054).

Introduction (S7-1500, S7-1500T) 2

2.1 Interplay of the various documents (S7-1500, S7-1500T)

For a better overview, the documentation of the Motion Control functions is divided into the following documents:

Documentation	Description
S7-1500/S7-1500T Motion Control overview Function manual "S7-1500/ S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459)	This documentation describes the general Motion Control functions independent of technology objects.
Using S7-1500/S7-1500T axis functions Function manual "S7-1500/ S7-1500T Axis functions" (https://support.industry.siemens.com/cs/ww/en/view/109766462)	**This documentation describes the Motion Control functions for the following technology objects:** • **Speed axis** • **Positioning axis** • **External encoder**
Using S7-1500/S7-1500T measuring input and output cam functions Function manual "S7-1500/ S7-1500T Measuring input and output cam functions" (https://support.industry.siemens.com/cs/ww/en/view/109766466)	This documentation describes the Motion Control functions for the following technology objects: • Measuring input • Output cam • Cam track
Using S7-1500/S7-1500T synchronous operation functions Function manual "S7-1500/ S7-1500T Synchronous operation functions" (https://support.industry.siemens.com/cs/ww/en/view/109766464)	This documentation describes the Motion Control functions for the following technology objects: • Synchronous axis • Cam (S7-1500T) • Leading axis proxy (S7-1500T)
Using S7-1500T kinematics functions Function manual "S7-1500T Kinematics functions" (https://support.industry.siemens.com/cs/ww/en/view/109766463)	This documentation describes the Motion Control functions for the following technology objects: • Kinematics (S7-1500T)

Additional information

You can find an overview and important links to the topic "SIMATIC Motion Control" in the Siemens Industry Online Support under the entry ID 109751049 (https://support.industry.siemens.com/cs/ww/en/view/109751049).

2.2 Functions (S7-1500, S7-1500T)

You execute the functions of the speed axis, positioning axis and external encoder technology objects using Motion Control instructions in your user program or using the TIA Portal (under "Technology object > Commissioning").

The following table shows the Motion Control instructions that are supported by the technology objects:

Motion Control instruction	Validity		Technology object		
	S7-1500	S7-1500T	Speed axis (Page 18)	Positioning axis (Page 19)	External encoder (Page 20)
"MC_Power" Enable, disable technology object	X	X	X	X	X
"MC_Reset" Acknowledge alarms, restart technology object	X	X	X	X	X
"MC_Home" Home technology object, set home position	X	X	-	X	X
"MC_Halt" Pause axis	X	X	X	X	-
"MC_MoveAbsolute" Position axis absolutely	X	X	-	X	-
"MC_MoveRelative" Position axis relatively	X	X	-	X	-
"MC_MoveVelocity" Move axes with velocity/speed setpoint	X	X	X	X	-
"MC_MoveJog" Move axis in jog mode	X	X	X	X	-
"MC_MoveSuperimposed" Positioning axes overlapping	X	X	-	X	-
"MC_SetSensor" Switch alternative encoder to operative encoder	-	X	-	X	-
"MC_Stop" Pause axis and prevent new motion jobs	X	X	X	X	-
"MC_SetAxisSTW" Control bits of control word 1 and control word 2	X	X	X	X	-
"MC_WriteParameter" Write parameter	X	X	-	X	-
"MC_MotionInVeloctiy" Specify motion setpoints	-	X	X	X	-

Motion Control instruction	Validity		Technology object		
	S7-1500	S7-1500T	Speed axis (Page 18)	Positioning axis (Page 19)	External encoder (Page 20)
"MC_MotionInPosition" Specify motion setpoints	-	X	-	X	-
"MC_TorqueAdditive" Specify additive torque	X	X	X	X	-
"MC_TorqueRange" Specify high and low torque limits	X	X	X	X	-
"MC_TorqueLimiting" Activate/deactivate force/torque limit / fixed stop detection	X	X	X	X	-

The following table shows the functions supported by technology objects in the TIA Portal:

Functions in the TIA Portal	Technology object		
	Speed axis (Page 18)	Positioning axis (Page 19)	External encoder (Page 20)
"Axis control panel (Page 164)" Move and home axes using the TIA Portal	X	X	-
"Optimization (Page 169)" Optimization of closed loop position control	-	X	-

In addition to the functionality of the S7-1500 CPU, the S7-1500T CPU provides additional functions and technology objects:

Additional functions	Description
Multiple encoders for positioning axis/synchronous axis (Page 36)	Up to four encoders can be connected to a positioning axis/synchronous axis. The encoders can be switched over during operation. Only one encoder at a time is active for closed loop position control.
"MotionIn" function (Page 57)	With the "MC_MotionInVelocity" and "MC_MotionInPosition" Motion Control instructions, you specify cyclically applicable calculated motion setpoints as a basic motion for the axis. No velocity profile is calculated for this, the values are directly active at the technology object.
Kinematics technology object	The Kinematic technology object ("TO_Kinematics") is used to interconnect positioning axes to a kinematic. When you configure the kinematics technology object, you interconnect the axes in accordance with the configured kinematics type. The kinematics technology object is described in the "S7-1500T Kinematics functions (https://support.industry.siemens.com/cs/ww/en/view/109766463)" documentation.

Additional functions	Description
Gearing with "MC_GearInPos"	During gearing, the leading axis and following axis are coupled, similar to a mechanical gear unit, by a linear synchronous operation function. You use the gear ratio to specify the synchronous operation function. The synchronous positions of the leading and following axes starting at which the axes move synchronously can be specified in the Motion Control instruction "MC_GearInPos". The gearing with "MC_GearInPos" is described in the documentation "S7-1500/S7-1500T Synchronous operation functions (https://support.industry.siemens.com/cs/ww/en/view/109766464)".
Camming	During camming, the leading axis and following axis are coupled by a synchronism function, which you specify using a cam. The camming is described in the documentation "S7-1500/S7-1500T Synchronous operation functions (https://support.industry.siemens.com/cs/ww/en/view/109766464)".
Cross-PLC synchronous operation	Cross-PLC synchronous operation enables synchronous operation over multiple controllers. Leading and following axes can be configured on different controllers. The PLC-wide synchronous operation is described in the documentation "S7-1500/S7-1500T Synchronous operation functions (https://support.industry.siemens.com/cs/ww/en/view/109766464)".

3 Basics (S7-1500, S7-1500T)

3.1 Speed-controlled axis technology object (S7-1500, S7-1500T)

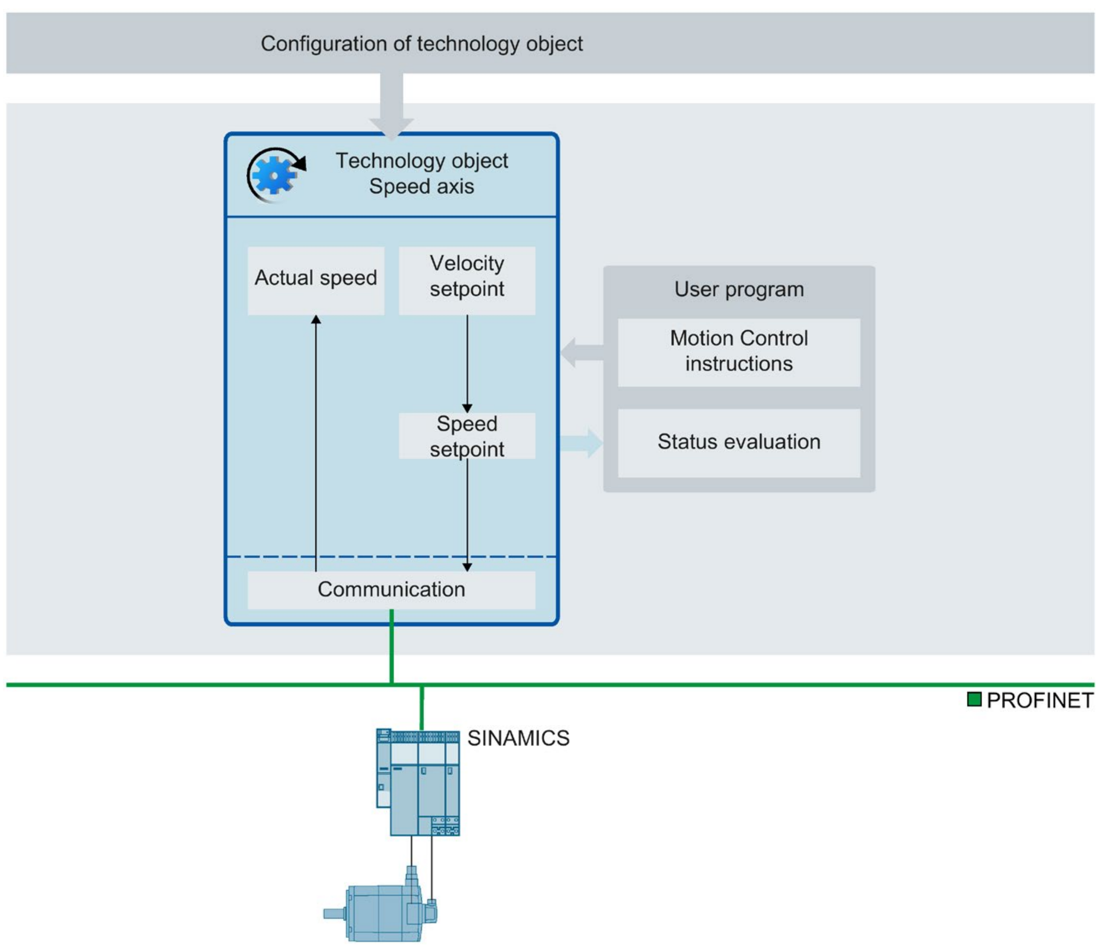
The speed axis technology object calculates speed setpoints, taking into account the dynamic settings, and outputs them to the drive. All motions of the speed axis take place as speed-controlled motions. An existing load gear is taken into account on the system side.

You can find an overview of the functions of the speed axis technology object in the "Functions (Page 15)" section.

A drive is assigned to each speed axis by means of a PROFIdrive telegram or 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:



3.2 Positioning axis technology object (S7-1500, S7-1500T)

The positioning axis technology object calculates position setpoints, taking into account the encoderc settings, and outputs corresponding speed setpoints to the drive. In position-controlled mode, all movements of the positioning axis take place as position-controlled movements. For absolute positioning, the physical position must be known to the positioning axis technology object.

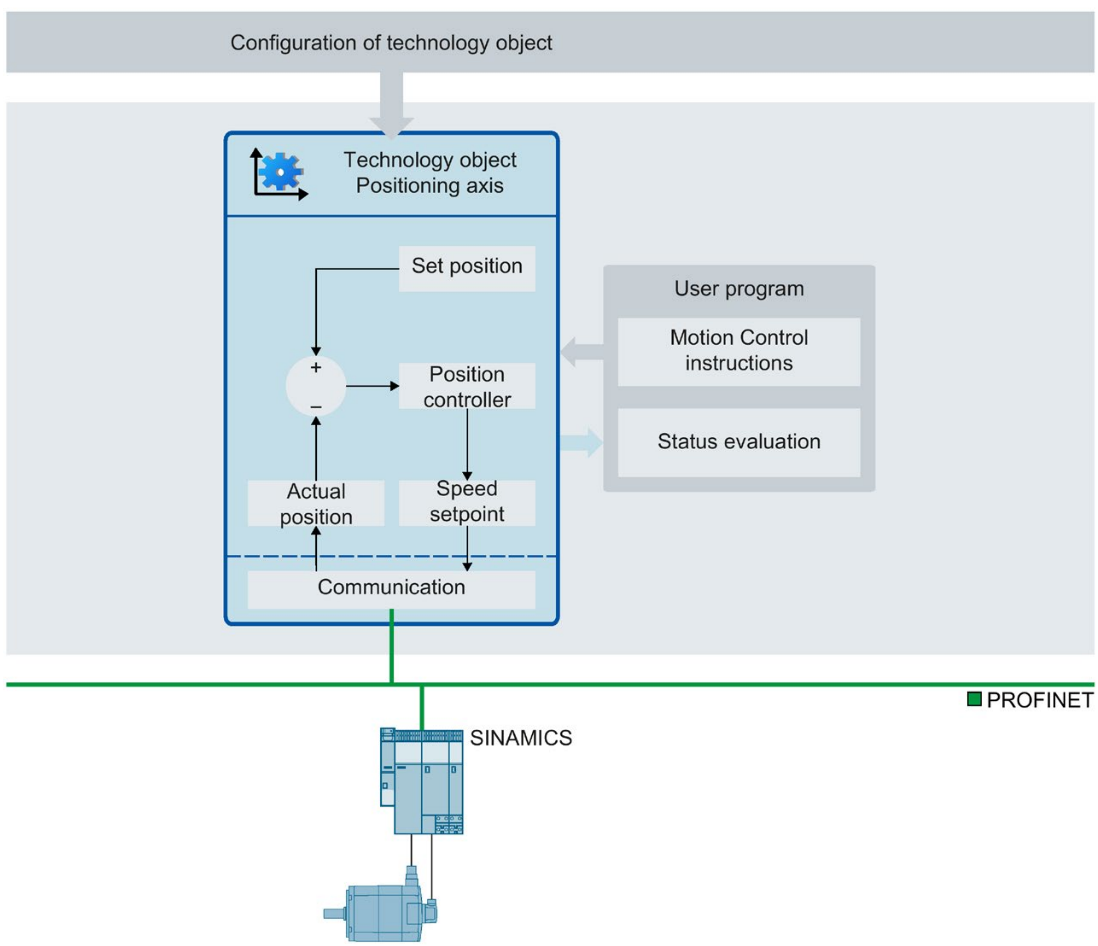
You can find an overview of the functions of the positioning axis technology object in the "Functions (Page 15)" section.

Each positioning axis is assigned a drive by means of a PROFIdrive telegram or an analog setpoint interface as well as an encoder by means of a PROFIdrive telegram.

The relationship between the encoder values and a defined position is established by the parameter assignment of the mechanical properties and encoder settings and by a homing operation. The technology object can also perform movements without a position relationship, and relative position movements, even without being in a homed status.

A positioning axis can be configured as a linear axis or rotary axis (Page 22), depending on the design of the mechanics.

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



3.3 External encoder technology object (S7-1500, S7-1500T)

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

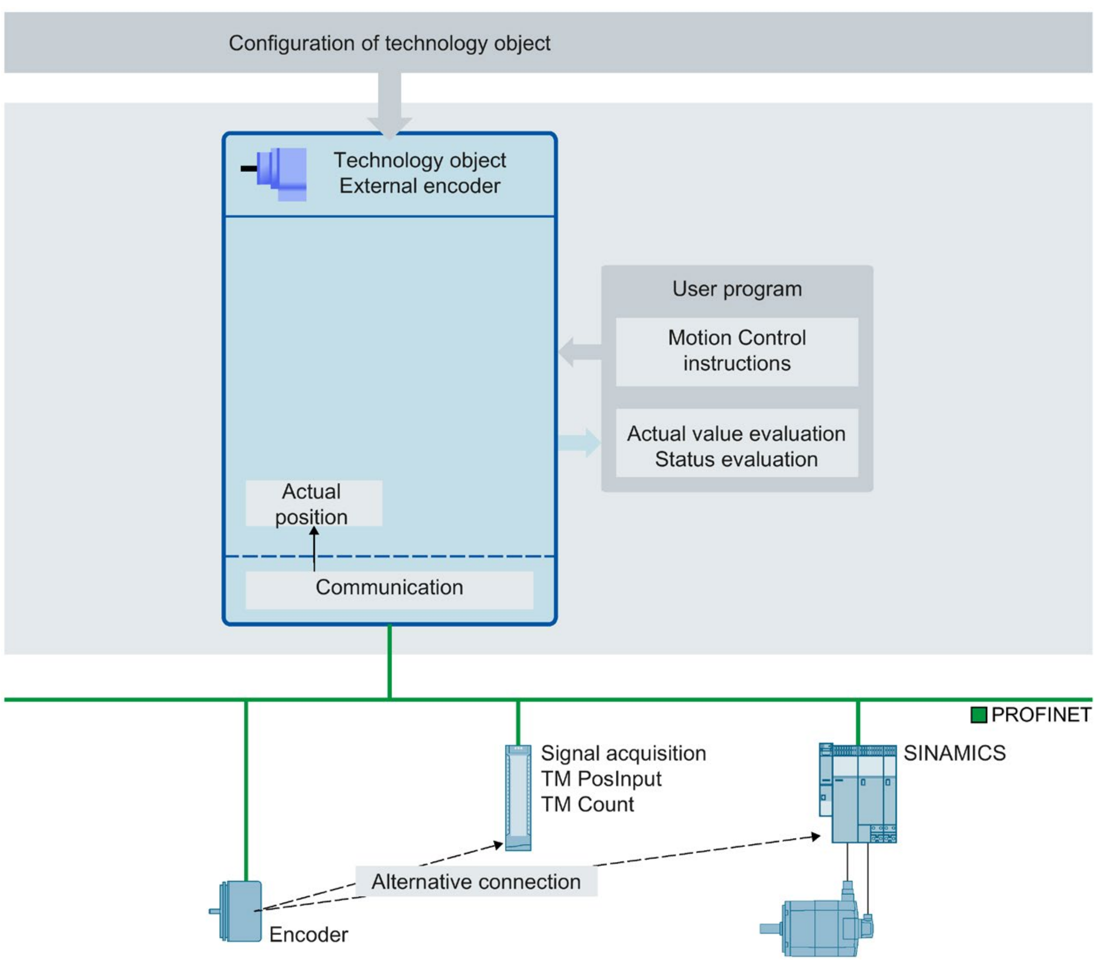
The actual position detected by the external encoder can be used for the following functions, for example:

- Measured value acquisition by a measuring input
- Position-dependent generation of switching signals and switching signal sequences by output cam and cam track with actual value reference.
- As a leading value of a synchronous axis (S7-1500T)

You can find an overview of the functions of the external encoder technology object in the "Functions (Page 15)" section.

The relationship between the encoder values and a defined position is established by the parameter assignment of the mechanical properties and encoder settings and by a homing operation.

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.

- **Rotary system of units**

  The position is specified as an angular measure, e.g. degrees.

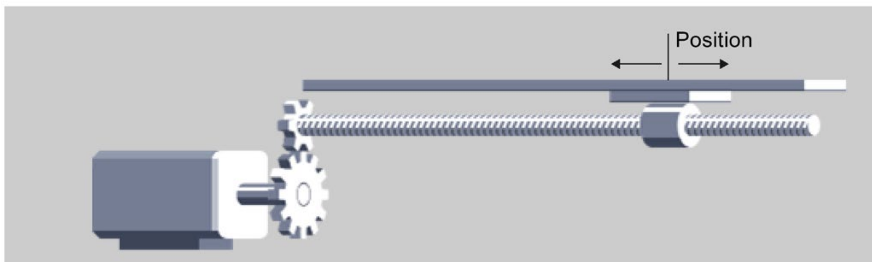
3.4 Axis types (S7-1500, S7-1500T)

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 (°).

3.5 Modulo setting (S7-1500, S7-1500T)

For the positioning axis, synchronous axis and external encoder technology objects, the "Modulo" setting can be activated.

When an axis moves in only one direction, the position value continually increases. To limit the position value to a recurring reference system, you can activate the "Modulo" setting. The long-term accuracy (Page 25) can also be adhered to with modular axes up to the maximum travel time.

When the "Modulo" setting is activated, the position value of the technology object is mapped onto 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°. As a result, the position value is mapped onto the modulo range 0° to 359.999°.

The modulo cycle counters for the position setpoint and the actual position on the positioning axis, synchronous axis and external encoder technology objects indicate the number of modulo revolutions.

Modulo cycle counter

If the "Modulo" setting is activated, the modulo cycle counter is activated for the Positioning axis, Synchronous axis, and External encoder technology objects. The modulo cycle counter is displayed at the technology object for the position setpoint and the actual position. The modulo cycle counter counts the modulo revolutions and thus the number of modulo runs at the technology object.

The counter values of the modulo cycles change during switch on, restart and homing.

The following applies to an incremental encoder:

Action	Description
Switching on the CPU	The modulo cycle counter is set to 0.
Reset with "Restart" = TRUE	The modulo cycle counter is set to 0.
Active and passive homing with "Mode" = 2, 3, 5, 8, 10	• If the home position is in the range "Modulo start value ≤ Home position ≤ (Modulo Start value + Modulo length / 2)", the modulo cycle counter is set to 0. • If the home position is in the range "(Modulo start value + Modulo length / 2) < Home position < (Modulo start value + Modulo length)" the modulo cycle is set to -1.
Direct homing absolute with "Mode"= 0, 11	The modulo value is the shortest distance between the current and new position. Depending of the distance, the modulo cycle counter can remain the same, increase by 1 or decrease by 1.
Direct homing absolute with "Mode"= 1, 12	The modulo cycle counter changes according to the specified position difference, even if no homing has taken place before.

The following applies to an absolute encoder:

Action	Description
Switching on the CPU	The modulo cycle counter changes according to the determined modulo length from the absolute value of the encoder and the absolute value offset of an absolute value encoder adjustment, if an absolute value encoder adjustment has taken place.
Reset with "Restart" = TRUE	The modulo cycle counter remains unchanged.
Absolute encoder adjustment with "Mode" = 6, 7	The modulo cycle counter is set to 0.
Direct homing absolute with "Mode"= 0, 11	The modulo value is the shortest distance between the current and new position. Depending of the distance, the modulo cycle counter can remain the same, increase by 1 or decrease by 1.
Direct homing absolute with "Mode"= 1, 12	The modulo cycle counter changes according to the specified position difference, even if no homing has taken place before.

3.6 Long-term accuracy (S7-1500, S7-1500T)

Long-term accuracy means that the technological set and actual position can always be determined uniquely.

The maximum technological position depends on the selected dimension and the maximum display of 9.0E12 mm. At higher resolution the maximum display is reduced to 9.0E9 mm.

The maximum travel time in which the technological position is accurate without rounding error depends on the maximum position and the velocity. The maximum travel time applies likewise to axes with and without modulo setting.

You can use the following equation to estimate when the limit of long-term accuracy is reached:

$$\text{Travel time} = \frac{\text{Maximum position}}{\text{Velocity}}$$

Example of the maximum traversing time

Maximum position = 9.0E12 mm

Velocity = 20.0 m/min = 2.0E4 mm/min

$$\text{Travel time} = \frac{\text{9.0E12 mm}}{\text{2.0E4 mm/min}} = \text{4.5E8 min} \quad \triangleq \text{856 years}$$

Dimension	Maximum travel time
nm, µm, mm, m, km, in, ft, mi, rad, °	4.5E8 min ≙ 856 years
mm[1)], °[1)]	4.5E5 min ≙ 0.856 years

1) Position values with higher resolution or six decimal places. The maximum position is reduced to 9.0E9 mm and thus also the travel time.

The traversing time restarts when one of the following conditions is fulfilled:

- You have homed the axis with "MC_Home".
- After POWER OFF → POWER ON of the CPU

A change in the velocity has the consequence that the traversing time changes accordingly.

Measures to maintain long-term accuracy

Carry out the following measures before the maximum travel time has elapsed:

- Incremental encoder: Home the incremental encoder again.
- Absolute encoder: Perform an absolute encoder calibration with the default of the currently known position.

3.7 Drive and encoder connection (S7-1500, S7-1500T)

A drive is assigned to the "Speed axis" technology object. A drive and one to four encoders (only with S7-1500T) are assigned to the "Positioning axis" and "Synchronous axis" technology objects. An encoder is assigned to the "External encoder" technology object.

The setpoint for the drive is specified either with PROFIdrive telegrams or using an analog output.

The following connection options are available for an encoder:

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

The actual encoder value is transmitted exclusively via PROFIdrive telegrams.

PROFIdrive

PROFIdrive is the standardized drive technology profile for connecting drives and encoders via PROFIBUS DP and PROFINET IO. Drives that support the PROFIdrive profile are connected according to the PROFIdrive standard.

The current PROFIdrive specification is available at:

https://www.profibus.com (https://www.profibus.com)

Communication between the controller and drive/encoder is performed using various PROFIdrive telegrams. Each of the telegrams has a standardized structure. You can select the appropriate telegram according to the application. Control words and status words as well as setpoints and actual values are transmitted in the PROFIdrive telegrams.

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

Analog drive connection

Drives with analog setpoint interfaces are connected using an analog output and an optional enable signal. The speed setpoint is specified via an analog output signal (e.g. from -10 V to +10 V) from the CPU.

Stepper motors

Drives with a stepper motor interface are connected using telegram 3 and with the help of PTO (Pulse Train Output) pulse generators.

For functional support of stepper motor operation, quantization of the control deviation can be set.

Through the specification of a quantization, a range around the target position is defined in which no correction of the actual position is to be made. This prevents a possible oscillation of the stepper motor around the target position. Two types of quantization can be set:

- Quantization of the control deviation corresponding to the encoder resolution

  ("<TO>.PositionControl.ControlDifferenceQuantization.Mode" = 1)

  This prevents oscillation of the stopped motor between two increment values, for example. This mode is especially helpful when using multiple encoders. With this setting, the quantization is adapted appropriately at an encoder switchover. This mode is helpful for stepper motors with encoders in which the resolution of the encoder is lower than the step size of the stepper motor.

- Direct specification of a value for quantization of the control deviation.

  ("<TO>.PositionControl.ControlDifferenceQuantization.Mode" = 2, value setting in "<TO>.PositionControl.ControlDifferenceQuantization.Value")

  This mode is helpful for stepper motors with encoders in which the resolution of the encoder is greater than the step size of the stepper motor.

3.7.1 PROFIdrive telegrams (S7-1500, S7-1500T)

PROFIdrive telegrams are used to transfer setpoints and actual values, control and status words and other parameters between the controller and drive/encoder.

When a PROFIdrive telegram is used for connection, the drives and encoders are handled and switched on in accordance with the PROFIdrive profile.

The following table shows the possible PROFIdrive telegrams for various technology objects.

Technology object	Possible PROFIdrive telegrams
Speed axis	• 1, 2 • 3, 4, 5, 6, 102, 103, 105, 106 (actual encoder value is not evaluated)
Positioning axis/synchronous axis	
Setpoint and actual encoder value in one drive telegram	3, 4, 5, 6, 102, 103, 105, 106
Setpoint and actual encoder value separately	
Setpoint in drive telegram	1, 2, 3, 4, 5, 6, 102, 103, 105, 106
Actual value from telegram	81, 83
External encoder	81, 83
Measuring input (Measuring via SINAMICS (central probe))	391, 392, 393
Measuring input at axis module	Corresponds to measuring via PROFIdrive

Telegram types

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

Telegram	Brief description
Standard telegrams	
1[1)]	• Control word STW1[5)], status word ZSW1 • Speed setpoint 16 bit (NSET), actual speed value 16 bit (NACT)
2	• Controls word STW1[5)] and STW2[5)], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT)
3	• Controls word STW1[5)] and STW2[5)], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2)
4	• Controls word STW1[5)] and STW2[5)], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) • Actual encoder value 2 (G2_XIST1, G2_XIST2)
5	• Controls word STW1[5)] and STW2[5)], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) (motor encoder) • Dynamic Servo Control (DSC)[2)] – Speed precontrol value – Position difference (XERR) – Kpc - Velocity precontrol of the closed loop position control
6	• Controls word STW1[5)] and STW2[5)], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) (motor encoder) • Actual encoder value 2 (G2_XIST1, G2_XIST2) • Dynamic Servo Control (DSC)[2)] – Speed precontrol value – Position difference (XERR) – Kpc - Velocity precontrol of the closed loop position control

Telegram	Brief description
Siemens telegrams (with torque limiting)	
102	• Controls word STW1[5] and STW2[5], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) • Torque limiting
103	• Controls word STW1[5] and STW2[5], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) • Actual encoder value 2 (G2_XIST1, G2_XIST2) • Torque limiting
105	• Controls word STW1[5] and STW2[5], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) (motor encoder) • Dynamic Servo Control (DSC)[2] – Speed precontrol value – Position difference (XERR) – Kpc - Velocity precontrol of the closed loop position control • Torque limiting
106	• Controls word STW1[5] and STW2[5], status words ZSW1 and ZSW2 • Speed setpoint 32 bit (NSET), actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2) (motor encoder) • Actual encoder value 2 (G2_XIST1, G2_XIST2) • Dynamic Servo Control (DSC)[2] – Speed precontrol value – Position difference (XERR) – Kpc - Velocity precontrol of the closed loop position control • Torque limiting
SIEMENS additional telegrams (torque data)	
750[3]	• Additive setpoint torque • High and low torque limits • Torque actual values

Telegram	Brief description
SIEMENS telegrams (measuring input) 4)	
391	• Control word CU_STW1, status word CU_ZSW1 • Measuring input control word (MT_STW), measuring input status word (MT_ZSW) • Measuring input time stamp of negative (MT1…2_ZS_F) or positive edges (MT1…2_ZS_S) • Digital output 16 bit, digital input 16 bit
392	• Control word CU_STW1, status word CU_ZSW1 • Measuring input control word (MT_STW), measuring input status word (MT_ZSW) • Measuring input time stamp of negative (MT1…6_ZS_F) or positive edges (MT1…6_ZS_S) • Digital output 16 bit, digital input 16 bit
393	• Control word CU_STW1, status word CU_ZSW1 • Measuring input control word (MT_STW), measuring input status word (MT_ZSW) • Measuring input time stamp of negative (MT1…8_ZS_F) or positive edges (MT1…8_ZS_S) • Digital output 16 bit, digital input 16 bit • Analog input 16 bit
Standard telegrams - encoder	
81	• Control word STW2_ENC, status word ZSW2_ENC • Actual encoder value 1 (G1_XIST1, G1_XIST2)
83	• Control word STW2_ENC, status word ZSW2_ENC • Actual speed value 32 bit (NACT) • Actual encoder value 1 (G1_XIST1, G1_XIST2)

1) Isochronous mode is not possible.

2) For use of Dynamic Servo Control (DSC), the motor encoder (first encoder in the telegram) of the drive must be used as the first encoder for the technology object.

3) Can also be used for the telegrams 1, 2, 3, 4, 5, 6, 102, 103, 105, 106

4) When using SINAMICS drives (measuring using SINAMICS measuring input)

5) STW1 and STW2: Bits not used by the technology object can be controlled via the user program with the Motion Control instruction "MC_SetAxisSTW".

See also

Data connection drive/encoder via data block (Page 44)

3.7.2 Actual values (S7-1500, S7-1500T)

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

The actual position value is provided by a PROFIdrive telegram.

The actual values are represented as incremental or absolute values in the PROFIdrive telegram. The actual values are normalized in the controller to the technological unit taking into account the configuration of the mechanics. The reference to a physical position of the axis or external encoder is established by homing.

The controller supports the following types of actual values (encoder types):

- 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)

Actual value calculation for virtual axis or axis in simulation

The actual value of a virtual axis or an axis in simulation is formed from the setpoint taking time delays into account.

You calculate the time delay from actual value to the setpoint (T_t) as follows:

Calculation	
With precontrol	$T_t = T_{ipo} + T_{servo} + T_{vtc} + T_{addPtc}$
Without precontrol, without DSC	$T_t = T_{ipo} + 1/Kv + T_{addPtc}$
Without precontrol, with DSC for one axis in simulation	$T_t = T_{ipo} + T_{servo} + 1/Kv + T_{addPtc}$

T_t	Time delay from the actual value to the setpoint
T_{ipo}	Cycle time of the MC-Interpolator [OB92]
T_{servo}	Cycle time of the MC-Servo [OB91]
T_{vtc}	Speed control loop substitute time (T_{vtc} off "<TO>.DynamicAxisModel.VelocityTimeConstant")
T_{addPtc}	Additive position control loop equivalent time (T_{addPtc} from "<TO>.DynamicAxisModel.AdditionalPositionTimeConstant")
kV	Gain factor (Kv from "<TO>.PositionControl.Kv")

See also

Virtual axis (Page 44)

Axis in simulation (Page 43)

3.7.2.1 Incremental actual value (S7-1500, S7-1500T)

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

After POWER ON, position zero is displayed. A transition of the CPU to RUN mode starts the actual value update. The actual value is then also updated in CPU STOP mode. The relationship between the technology object and the mechanical position must be re-established by means of homing.

3.7.2.2 Absolute actual value (S7-1500, S7-1500T)

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

After POWER ON, position zero is displayed. The first transition of the CPU to RUN mode starts the actual value update. The actual value is then also updated in CPU STOP mode. The supplied absolute value is assigned to the associated mechanical axis position by means of the absolute encoder adjustment. The absolute encoder 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 setting absolute
- The measuring range of the encoder is smaller than the traversing range of the axis:

  Absolute value with setting cyclic absolute

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

The axis position results directly from the current actual encoder value. The traversing range must be within an encoder measuring range. This means that the zero passage 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 actual encoder value.

Absolute actual value with setting cyclic 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 saved traversed measuring ranges 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, the actual value in the controller is no longer in accord with the mechanical axis position.

See also

Absolute value adjustment (Page 85)

3.7.2.3 Tags: Actual values (S7-1500, S7-1500T)

The tags named in the "Homing (Page 87)" section are relevant for adapting actual values.

3.7.3 Automatic transfer of drive and encoder parameters in the device (S7-1500, S7-1500T)

Identical reference values for the drive and encoder connections must be set in the controller and in the drive and encoder for the operation.

The speed setpoint NSET and the actual speed value NACT are transferred in the PROFIdrive telegram as a percentage of 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 telegram must likewise be set identically in the controller and in the drive and encoder modules

Automatic transfer of parameters

The drive and encoder parameters can be automatically applied in the CPU for the following drives and encoders.

- SINAMICS drives (see "compatibility list")
- PROFIdrive encoder as of product version A16

The corresponding parameters are transferred after the (re-)initialization of the technology object or (re)start of the drive and the CPU. Changes in the drive configuration are transferred after restart of the drive or technology object.

Successful transfer of the parameters can be checked in the controller with the value of the tags "<TO>.StatusDrive.AdaptionState" = 2 and "<TO>.StatusSensor[1..4].AdaptionState" = 2 of the technology object.

Parameters

The controller settings are made in the TIA Portal under "Technology object > Configuration > Hardware interface > Data exchange with the drive/encoder".

The drive and encoder settings are made in the configuration or the respective hardware.

The following table compares the settings in the TIA Portal, in the controller and the corresponding drive/encoder parameters:

Setting in the TIA Portal	Controller tag in the technology data block	Drive parameter	Automatic transfer
Drive			
Telegram number	Telegram input address <TO>.Actor.Interface.AddressIn Telegram output address <TO>.Actor.Interface.AddressOut	Telegram number P922	-
Reference speed in [1/min]	<TO>.Actor.DriveParameter. ReferenceSpeed	(SINAMICS drives: P2000)	X
Maximum speed of motor in [1/min]	<TO>.Actor.DriveParameter. MaxSpeed	(SINAMICS drives: P1082)	X
Reference torque in [NM]	<TO>.Actor.DriveParameter. ReferenceTorque	(SINAMICS drives: P2003)	X
Encoder			
Telegram	<TO>.Sensor[1..4].Interface.AddressIn <TO>.Sensor[1..4].Interface.AddressOut	P922	-
Encoder type	<TO>.Sensor[1..4].Type 0 Incremental 1 Absolute 2 Cyclic absolute	P979[5] Encoder 1 P979[15] Encoder 2	-
Measuring system	<TO>.Sensor[1..4].System 0 Linear 1 Rotary	P979[1] Bit0 Encoder 1 P979[11] Bit0 Encoder 2	X
Resolution (linear encoder) The grid spacing is specified on the nameplate of the encoder as a separation distance of the marks on the linear measuring system.	<TO>.Sensor[1..4].Parameter.Resolution	P979[2] Encoder 1 P979[12] Encoder 2	X
Increments per revolution (rotary encoder)	<TO>.Sensor[1..4].Parameter. StepsPerRevolution	P979[2] Encoder 1 P979[12] Encoder 2	X
Number of bits for fine resolution XIST1 (cyclic actual encoder value, linear or rotary encoder)	<TO>.Sensor[1..4].Parameter. FineResolutionXist1	P979[3] Encoder 1 P979[13] Encoder 2	X
Number of bits for fine resolution XIST2 (absolute encoder value, linear or rotary encoder)	<TO>.Sensor[1..4].Parameter. FineResolutionXist2	P979[4] Encoder 1 P979[14] Encoder 2	X
Differentiable encoder revolutions (rotary absolute encoder)	<TO>.Sensor[1..4].Parameter. DeterminableRevolutions	P979[5] Encoder 1 P979[15] Encoder 2	X

3.7.4 Using multiple encoders (S7-1500T)

The S7-1500T technology CPU offers the option of using up to 4 encoder or measuring systems per positioning axis and synchronous axis as the actual position for the closed loop position control

Only one encoder at a time is active for closed loop position control. You can switch between the 4 encoder or measuring systems.

However, the actual values of all configured encoders can be evaluated in the user program.

This opens up the following possible application areas, for example:

- Use of additional machine encoders (besides the motor encoder), e.g. as direct measuring systems for more accurate detection of actual positions of machining processes.
- Use of alternative encoder systems following a tool change in a flexible manufacturing process.

You configure the encoders in the axis configuration. You control the switchover of the encoders in the user program with the Motion Control instruction "MC_SetSensor".

Configuring an axis with multiple encoders

Note the following configuration windows when using multiple encoders:

- In the configuration window "Hardware interface > Encoder", configure which alternative encoders are to be used and their corresponding encoder type (incremental, absolute or cyclic absolute).
  All encoders marked as used supply continually updated actual values to the closed loop position control regardless of their use.
- In the configuration window "Hardware interface > Encoder", configure an encoder as "Encoder at power-up". This is necessary because an encoder must always be assigned to the positioning axis and synchronous axis.
- In the configuration window "Hardware interface > Data exchange with encoder", configure additional encoder details and the telegram that is to be used to connect the encoders. The configuration must be performed for each encoder used.
  Each encoder to be used or each measuring system may differ with regard to its encoder mounting type.
- In the configuration window "Extended parameters > Mechanics", configure the encoder mounting type and any gear parameters. The configuration must be performed for each encoder used.
- The axis can be homed with any configured encoder. In the configuration window "Extended parameters > Homing", configure the parameters for active and passive homing. The configuration can be performed for each encoder used.
  When the axis is homed with an encoder, the axis is homed and retains the "homed" status following encoder switchover.

Encoder switchover in the user program

For closed loop position control of the positioning and synchronous axes, an encoder must always be active. Individual encoders may fail as long as they are not involved in closed loop position control.

With the Motion Control instruction "MC_SetSensor", you switch over the encoder for closed loop position control of the axis.

The switchover can occur during an active motion job or at a standstill. The axis does not have to be enabled.

A switchover during an active homing or restart job is not possible.

Note

Homing

Homing with the Motion Control instruction "MC_Home" or the axis control panel is always performed with the encoder involved in closed loop position control.

The homing status of the axis is not changed following an encoder switchover.

Simulation

When the axis is simulated, all encoders configured as "used" are simulated.

Following the switchover to an alternative encoder or encoder system, you can select what happens if the actual positions of the encoders are different.

You define how to deal with the difference in the actual positions of the encoders using input parameter "Mode" of the Motion Control instruction "MC_SetSensor".

- **Switch over encoder and transfer actual position to the encoder to be switched ("Mode" = 0)**

  With this encoder switchover, step changes in the actual position are prevented. Bumpless switchover of the encoders is possible.

- **Switch over sensor without transferring the actual position ("Mode" = 1)**

  Following a switchover to an encoder without adjustment, a step change of the actual position may occur. This can be desirable if the new encoder is intended to compensate for possible mechanical influences (such as slip) in the positioning.

  The position difference is not implemented immediately but rather after a delay using time constant "<TO>.PositionControl.SmoothingTimeByChangeDifference" in order to prevent step changes in the actual position with active closed loop position control.

- **Transfer actual position ("Mode" = 2)**

  The actual position of the axis is transferred to the encoder specified in the "Sensor" parameter.

- **Transfer actual position of the reference encoder ("Mode" = 3)**

  The actual position of the "Reference encoder" ("ReferenceSensor" parameter) is transferred to the encoder specified in the "Sensor" parameter.

"Mode" = 2 and 3 can be used to prepare a switchover.

See also

MC_SetSensor: Switch alternative encoder to operative encoder V5 (Page 238)

3.7.5 Safety functions in the drive (S7-1500, S7-1500T)

Safety functions ("Safety Integrated Basic Functions") in the SINAMICS drive are safety-oriented, internal drive functions with the goal of shutting down the respective drive safely. In addition, additional safety functions ("Safety Integrated Extended Functions") are available to monitor definable limits. The goal of these safety functions is to monitor that the respective limit is maintained, to signal the violation or to subsequently shut down the drive safely. To prevent the monitoring function from being triggered, the axis must be switched to the monitored operating mode with the user program or maintained in this mode.

The interaction of the safety functions in the drive, the SIMATIC S7-1500 and S7-1500T are necessary to ensure fault-free plant operation.

The technology objects speed axis, positioning axis and synchronous axis support the "Safety Integrated Basic Functions" of the drive. The technology object detects that the Basic Safety function is triggered and displays a corresponding warning (technology alarm 550 - alarm response: Track setpoints) or alarm (technology alarm 421 - alarm response: Remove enable).

With alarm 421, it is not necessary to disable the technology object with "MC_Power". When alarm 550 occurs, you must not disable the technology object with the "MC_Power" as long as the security function is triggered.

When the alarms 421 and 550 occur, you may only acknowledge the alarm with "MC-Reset" if the safety function on the drive has been acknowledged and the drive is enabled.

The technology object is automatically released after acknowledgment with "MC-Reset".

The "Safety Integrated Extended Functions" are **not** supported by the technology object independently.

To prevent the extended safety functions from being triggered and thus prevent a disruption in plant operation, evaluate the status of the safety functions. This evaluation can take place in the user program by using or evaluating the status information of the "Safety Info Channels" (SIC). With the help of the corresponding Motion Control instruction, the axis can now stay within the monitored limit or reach it before a deviation is detected.

If a safety function is applied to a following axis in active synchronous operation, one of the following two responses is required:

- End synchronous operation
- Adjust velocity of the leading axis accordingly

Four status words are available in the SIC:

- S_ZSW1B
- S_ZSW2B
- S_ZSW3B
- S_V_LIMIT_B

Two predefined PROFIdrive telegrams are available for transmission:

- Tel. 700 (contains the status words S_ZSW1B & S_V_LIMIT_B)
- Tel. 701 (contains all four status words and two additional control words)

Additional information

Additional information on the safety functions in SINAMICS drives and on the SIC is available in the SINAMICS S120 Safety Integrated function manual.

https://support.industry.siemens.com/cs/ww/en/view/109754301 (https://support.industry.siemens.com/cs/ww/en/view/109754301)

The tables below provide an overview of the four SIC status words and the required response for each to prevent faults in plant operation.

S_ZSW1B

S_ZSW1B		Meaning		Recommended response of the respective axis in the user program
Bit	Assignment			
0	STO (active)	1	Safe Torque Off active	"MC_Power" can remain enabled (waiting).
		0	Not active	None
1	SS1 (active)	1	Safe Stop 1 active	Drive brakes autonomously and goes into STO. "MC_Power" remains enabled until STO.
		0	Not active	None
2	SS2 (active)	1	Safe Stop 2 active	Drive brakes autonomously and goes into SOS. "MC_Power" remains enabled.
		0	Not active	None
3	SOS (active)	1	Safe Operating Stop active	"MC_Power" remains enabled. The drive must not move (monitoring takes place in the drive)
		0	Not active	None
4	SLS (active)	1	Safety-Limited Speed active	"MC_Power" remains enabled. Velocity must be less than active velocity limit (see "Active SLS stage" or S_V_LIMIT_B).
		0	Not active	None
5	SOS (selected)	1	Safe Operating Stop selected	"MC_Power" remains enabled. Braking with "MC_Halt" and "MC_Stop" within the time permitted by SOS.
		0	Deselected	None
6	SLS (selected)	1	Safety-Limited Speed selected	Drop below velocity limit within the time specified by SLS. For example, by specifying an override or a new dynamic limit (restriction with synchronous motion).
		0	Deselected	None
7	Internal event	1	Group alarm that a safety function was selected or became active	Additional evaluation of the status words required to determine the triggering safety function. The bit indicates that a safety function is active. (See also "Safety alarm")
		0	No event	None

S_ZSW1B		Meaning		Recommended response of the respective axis in the user program
Bit	**Assignment**			
8	Reserved	-		-
9	Active SLS level	SLS velocity limit Display bit 0		Additional information on SLS (bit 6) – shows active velocity limit for SLS in levels (1… 4). This limit can be evaluated in the program to limit the current velocity of the axis as needed.
10		SLS velocity limit Display bit 1		
11	Reserved	-		-
12	SDI positive	1	Safe Direction positive selected	Reaching standstill or the positive velocity of the actual value of the axis (when SDI negative = 0) within the time specified by SDI.
		0	Deselected	None monitoring for positive direction.
13	SDI negative	1	Safe Direction negative selected	Reaching standstill or the negative velocity of the actual value of the axis (when SDI positive = 0) within the time specified by SDI.
		0	Deselected	None monitoring for negative direction.
14	ESR retraction	1	Extended stop and retraction required (not a Safety function)	To be considered individually. You can find additional information in the "SINAMICS S120 Safety Integrated" (https://support.industry.siemens.com/cs/ww/en/view/109754301) function manual.
		0	Not requested	None
15	Safety alarm	1	Effective	If necessary, evaluate bit as group alarm to see whether a Safety alarm is pending in the alarm buffer.
		0	Not effective	None

S_V_LIMIT_B

S_V_LIMIT_B		Meaning	Explanation
Bit	**Assignment**		
0 … 31	Velocity set-point limit	SLS Speed limit (32-bit resolution with sign)	Additional information on SLS (S_ZSW1B bit 6) Shows the selected/active velocity limit for SLS. If necessary, the velocity limit can be evaluated in the program to limit the current velocity of the axis as needed.

S_ZSW2B

S_ZSW2B		Meaning		Recommended response of the respective axis
Bit	Assignment			
0 … 3	Reserved	-		-
4	SLP selected position area	1	SLP area 2 selected	Safe position in the area 2. Do not change the position using the user program any longer.
		0	SLP area 1 selected	Safe position in the area 1. Do not change the position using the user program any longer.
5, 6	Reserved	-		-
7	SLP selected and user approval set	1	Safety-Limited Position selected and user approval is set	Status message (if required in the user program) Application-dependent evaluation (means that the SLP is selected and the safe position was confirmed by the user – see "Safe homing")
		0	SLP not selected or user approval missing	Application-dependent evaluation
8	SDI positive	1	Safe Direction positive selected	Reaching standstill or the positive velocity of the actual value of the axis within the time specified by SDI. (when SDI negative = 0)
		0	Deselected	None monitoring for positive direction
9	SDI negative	1	Safe Direction negative selected	Reaching standstill or the negative velocity of the actual value of the axis within the time specified by SDI. (when SDI positive = 0)
		0	Deselected	None monitoring for negative direction
10, 11	Reserved	-		-
12	Test stop active	1	Test stop active	Status message (if required in the user program) Application-dependent evaluation
		0	Not active	None
13	Test stop required	1	Test stop required	Perform test stop
		0	Not required	None
14, 15	Reserved	-		-

S_ZSW3B

S_ZSW3B Bit	Assignment	Meaning		Recommended response of the respective axis
0	Brake test	1	Brake test selected	"MC_Power" remains enabled. Do not start travel motion with user program.
		0	Deselected	None – brake test is inactive (normal plant operation)
1	Setpoint specification drive/external	1	Specification for drive	The speed setpoint is specified by the SBT function. Application-dependent evaluation
		0	External specification (control)	The "normal" speed setpoint is in effect. Application-dependent evaluation, setpoint value specification through user program required
2	Active brake	1	Test brake 2 active	Status message (if required in the user program) Application-dependent evaluation
		0	Test brake 1 active	Status message (if required in the user program) Application-dependent evaluation
3	Brake test active	1	Test active	Status message (if required in the user program) Application-dependent evaluation
		0	Inactive	None
4	Brake test result	1	Test required	Status message (if required in the user program) Application-dependent evaluation
		0	With error(s)	Status message (if required in the user program) Application-dependent evaluation, test must usually be successful to guarantee safety of the brake.
5	Brake test complete	1	Run test	Status message (if required in the user program) Application-dependent evaluation
		0	Incomplete	Status message (if required in the user program) Application-dependent evaluation, usually test is repeated
6	External brake request	1	Closing the brake	Closing external brake (when controlled by user program) Application-dependent evaluation
		0	Opening the brake	Opening external brake (when controlled by user program) Application-dependent evaluation
7	Current load sign	1	Negative sign	Status of the load sign if required in the user program Application-dependent evaluation
		0	Positive sign	
8 … 13	Reserved	-		-
14	Acceptance test SLP(SE) selected	1	Acceptance test SLP(SE) selected	Status message (if required in the user program) Application-dependent evaluation
		0	Deselected	None
15	Acceptance test mode selected	1	Acceptance test mode selected	Status message (if required in the user program) Application-dependent evaluation
		0	Deselected	None

3.7.6 Axis in simulation (S7-1500, S7-1500T)

S7-1500 Motion Control offers the option to move real axes in simulation mode. Speed, positioning and synchronous axes can thus be simulated without a connected drive and encoder in the CPU.

When the simulation mode is activated, the drive and encoder connection does not need to be configured in the axis configuration, for example, if the drive configuration is not yet available at this time. The "Simulation" configuration can be changed during runtime of the user program (<TO>.Simulation.Mode). A valid drive and encoder connection is required when exiting the simulation.

To use a technology object in simulation mode or with SIMATIC S7 PLCSIM, you need to use encoder 1 for closed loop position control of the axis.

Applications

- For example, an axis is simulated for programming the machine application and assigned to the configured hardware later for commissioning.
- During commissioning, for example, not all hardware components are available.
- No axis motions should take place during commissioning.

Characteristics in simulation mode

An axis in simulation does not output setpoints to the drive and does not read any actual values of the encoder. The actual values (Page 31) are formed with a time delay from the setpoints.

Hardware limit switches and home position switches have no effect.

The technology objects measuring input (with signal detection via TM Timer DIDQ or SINAMICS measuring input), output cam and cam track can also be used for axes in simulation.

The following table shows the Motion Control instructions with adapted behavior in simulation mode:

Motion Control instruction	Characteristics in simulation mode
MC_Power	The axis is enabled immediately without waiting for feedback from the drive.
MC_Home	Homing jobs are executed immediately without simulated axis motion.
MC_TorqueLimiting	The specified torque is not output to the drive.

3.7.7 Virtual axis (S7-1500, S7-1500T)

S7-1500 Motion Control offers the possibility to configure an axis as a virtual axis. A virtual axis behaves like a real axis, but has no drive or encoder connection. The setpoints are only processed within the controller and no real drive is controlled.

Application:

A virtual axis, for example, is often used as a virtual leading axis in order to generate the setpoints for several real following axes in synchronous operation.

The "Virtual axis" configuration can only be changed by a new download to the CPU (in STOP mode) (<TO>.VirtualAxis.Mode).

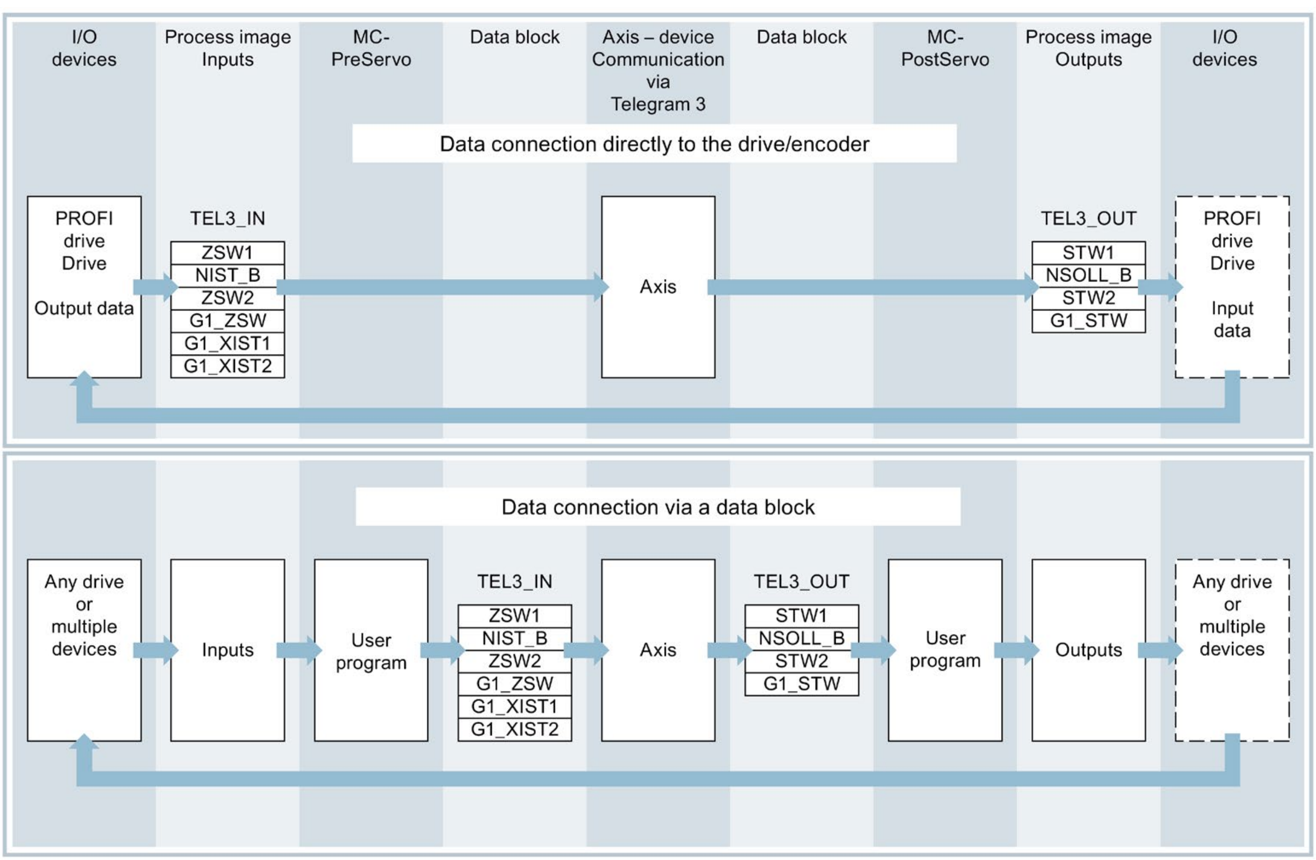
The behavior of a virtual axis is identical to the behavior of an axis in simulation (Page 43).

3.7.8 Data connection drive/encoder via data block (S7-1500, S7-1500T)

The data connection of PROFIdrive drives and encoders occurs either directly via the PROFIdrive telegram or via a data block.

Use the system-generated tags of the PROFIdrive telegrams if you want to evaluate the telegram contents.

Use the connection via data block if you want to influence or evaluate telegram contents in the user program for process-specific reasons.



Principle of data connection via data block

Generally, at the start of closed loop position control of the axis (by MC-Servo [OB91]), the input area of the drive or encoder telegram is read.

At the end of closed loop position control, the output area of the drive or encoder telegram is written.

To influence or evaluate telegram contents for process-specific reasons, a data interface via a data block must be connected in between before and after the closed loop position control.

- The input area of the telegram can be edited using the MC-PreServo [OB67] organization block. The MC-PreServo is called before the MC-Servo.
- The input area of the telegram can be edited using the MC-PostServo [OB95] organization block. The MC-PostServo is called after the MC-Servo.

The data block must be created by the user and contain a data structure of data type "PD_TELx" for the data connection. Here, "x" stands for the telegram number of the drive or encoder configured in the device configuration.

The organization blocks MC-PreServo and MC-PostServo can be programmed by the user and must be added with the command "Add new block". The connection to the I/O via telegram must be programmed in this organization block. When you use DSC you have to edit the signs of life in the telegrams in MC-PreServo and MC-PostServo yourself according to the PROFIdrive standard.

See also

PROFIdrive telegrams (Page 27)

3.7.9 Tags: Drive and encoder connection (S7-1500, S7-1500T)

The following technology object tags are relevant for the drives and encoder connections:

Drive telegram	
Tag	**Description**
<TO>.Actor.Interface.AddressIn	Input address for the PROFIdrive telegram
<TO>.Actor.Interface.AddressOut	Output address for the PROFIdrive telegram or the analog setpoint
<TO>.Actor.DriveParameter.ReferenceSpeed	Reference value (100%) for the speed setpoint (NSET) of the drive
<TO>.Actor.DriveParameter.MaxSpeed	Maximum value for the speed setpoint of the drive (NSET)
<TO>.Actor.DriveParameter.ReferenceTorque	Reference torque for the torque transferred as a percentage

Encoder telegram	
Tag	**Description**
<TO>.Sensor[1..4].Interface.AddressIn	Input address for the PROFIdrive telegram
<TO>.Sensor[1..4].Interface. AddressOut	Output address for the PROFIdrive telegram
<TO>.Sensor[1..4].System	Encoder system linear or rotary
<TO>.Sensor[1..4].Type	Encoder type, incremental, absolute or cyclic absolute
<TO>.Sensor[1..4].Parameter. Resolution	Resolution for linear encoder The grid spacing corresponds to the distance between two marks.
<TO>.Sensor[1..4].Parameter. StepsPerRevolution	Steps per revolution for rotary encoder
<TO>.Sensor[1..4].Parameter. DeterminableRevolutions	Number of differentiable encoder revolutions for a multi-turn absolute encoder

Fine resolution	
Tag	**Description**
<TO>.Sensor[1..4].Parameter. FineResolutionXist1	Number of bits for fine resolution XIST1 (cyclic actual encoder value)
<TO>.Sensor[1..4].Parameter. FineResolutionXist2	Number of bits for fine resolution XIST2 (absolute value of encoder)

Simulation mode		
Tag	**Description**	
<TO>.Simulation.Mode	Simulation mode	
	0	No simulation, normal operation
	1	Simulation mode

3.8 Mechanics (S7-1500, S7-1500T)

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 a unit of angle (rotary axis).

Examples of units of length: mm, m, km

Examples of units of angle: °, 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)
- Encoder mounting type:
  - Motor side (before the load gear)
  - Load side (after the load gear and as applicable the leadscrew)
  - External (e.g. odometer)
- Inversion of drive direction
- Inversion of encoder direction

External encoder

The following configuration options for mechanics are supported:

- Measuring gear (for rotary encoders)
- Leadscrew pitch (only with linear system of units and rotary encoders)
- Inversion of encoder direction

Speed axis

The following configuration options for mechanics are supported:

- Load gear
- Inversion of drive direction

3.8.1 Tags: Mechanics (S7-1500, S7-1500T)

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

Type of motion

Tag	Description	
<TO>.Properties.MotionType	Indication of linear or rotary motion	
	0	Linear motion
	1	Rotary motion

Load gear

Tag	Description
<TO>.LoadGear.Numerator	Load gear numerator
<TO>.LoadGear.Denominator	Load gear denominator

Leadscrew pitch

Tag	Description
<TO>.Mechanics.LeadScrew	Leadscrew pitch

Encoder mounting type

Tag	Description
<TO>.Sensor[1..4].MountingMode	Encoder mounting type
<TO>.Sensor[1..4].Parameter.DistancePerRevolution	Load distance per encoder revolution with an externally mounted encoder

Inversion

Tag	Description
<TO>.Actor.InverseDirection	Setpoint inversion
<TO>.Actor.Efficiency	Efficiency of leadscrew pitch
<TO>.Sensor[1..4].InverseDirection	Actual value inversion

Modulo

Tag	Description
<TO>.Modulo.Enable	Enable modulo
<TO>.Modulo.Length	Modulo length
<TO>.Modulo.StartValue	Modulo start value

3.9 Traversing range limitation (S7-1500, S7-1500T)

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 the operating range, maximum traversing range and limit switches:

① Mechanical endstop
② Hardware limit switches
③ Software limit switches
④ Maximum traversing range
⑤ Operating range

3.9.1 Hardware limit switches (S7-1500, S7-1500T)

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 as to whether the switches are reached or crossed.

If a hardware limit switch is reached, 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 output cams during homing, then the monitoring of the hardware limit switches has no effect.

When hardware limit switches are used as reversing output cams, the axis is braked with the deceleration configured in the dynamic defaults.

This must be taken into account when planning the distance of the hardware limit switch to the mechanical endstop.

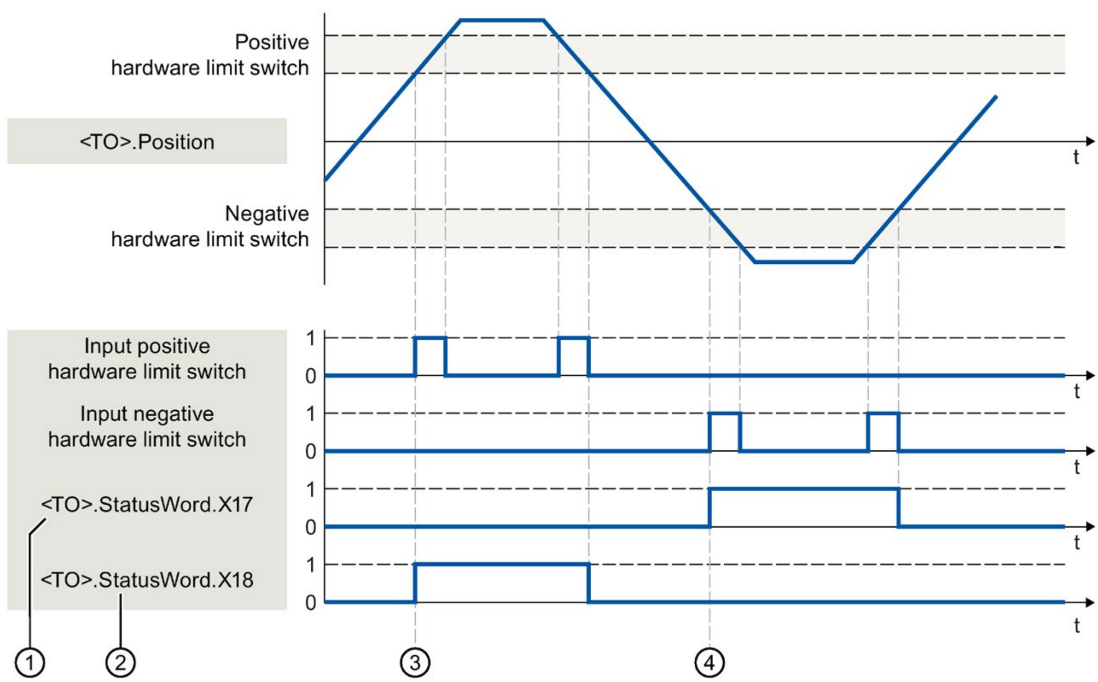
Retracting

The position of the axis when the hardware limit switch is detected is stored internally on the CPU. The status of the reached 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 retract the axis after it reaches the hardware limit switch and to reset the status of the hardware limit switch, follow the steps below:

1. To enable motion in the retraction direction, acknowledge the technology alarm.
2. Traverse the axis in the retraction direction until the hardware limit switch is left. The axis must then be within the maximum traversing range. If you move the axis opposite the retraction direction before the hardware limit switch is left, the monitoring will be triggered again.

The following chart shows the behavior of the status word when the hardware limit switch is reached and when the axis is retracted:



① <TO>.StatusWord.X17 (HWLimitMinActive)

0 Negative hardware limit switch not reached

1 Negative hardware limit switch reached or overtraveled

② <TO>.StatusWord.X18 (HWLimitMaxActive)

0 Positive hardware limit switch not reached

1 Positive hardware limit switch reached or overtraveled

③ The position of the axis when the **positive** hardware limit switch is detected is saved internally in the CPU. To reset the status of the hardware limit switch, the axis position must fall short of this position.

④ The position of the axis when the **negative** hardware limit switch is detected is saved internally in the CPU. To reset the status of the hardware limit switch, the axis position must go past this position.

Deactivating the hardware limit switch

For example, to enable homing at the fixed stop, you can temporarily disable the hardware limit switch using the Motion Control instruction "MC_WriteParameter (Page 249)" via the parameter "PositionLimits_HW.Active" = FALSE.

See also

MC_WriteParameter: Write parameter V5 (Page 249)

Direct homing (Page 83)

3.9.2 Software limit switch (S7-1500, S7-1500T)

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 in effect 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 function is enabled

When the modulo function is enabled, the modulo position is monitored.

The software limit switches are configured and activated in the axis configuration. The software limit switches can be activated or deactivated in the user program using the "<TO>.PositionLimits_SW.Active" tag. If the positions of both software limit switches are outside the modulo range, the monitoring has no effect. No check is made to determine whether the positions of the software limit switches are within the modulo range.

Approaching the software limit switches

The axis continually checks the position of the software limit switch during motion and brakes to exactly this position, if necessary.

If the software limit switches are reached, 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.

Overrun of the software limit switches

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

Retracting

To retract the axis after violation of the software limit switch, follow the steps below:

1. Acknowledge the technology alarm.
2. Move the axis in the retraction direction until the software limit switch is left.

   If you move the axis opposite the retraction direction before the software limit switch is left, the monitoring with be triggered again.

3.9.3 Tags: Traversing range limitation (S7-1500, S7-1500T)

Software limit switch

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

Status indicators	
Tag	**Description**
<TO>.StatusWord.X15 (SWLimitMinActive)	Negative software limit switch is active.
<TO>.StatusWord.X16 (SWLimitMaxActive)	Positive software limit switch is active.
<TO>.ErrorWord.X8 (SWLimit)	An alarm is pending, indicating that a software limit switch has been violated.

Control bits	
Tag	**Description**
<TO>.PositionLimits_SW.Active	Enables/disables the monitoring of the software limit switches.

Position values	
Tag	**Description**
<TO>.PositionLimits_SW.MinPosition	Position of the negative software limit switch
<TO>.PositionLimits_SW.MaxPosition	Position of the positive software limit switch

Hardware limit switches

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

Status indicators	
Tag	**Description**
<TO>.StatusWord.X17 (HWLimitMinActive)	Negative hardware limit switch is active.
<TO>.StatusWord.X18 (HWLimitMaxActive)	Positive hardware limit switch is active.
<TO>.ErrorWord.X9 (HWLimit)	An alarm is pending. A hardware limit switch was reached.

Control bits	
Tag	**Description**
<TO>.PositionLimits_HW.Active	Enables/disables the monitoring of the hardware limit switches.

Parameters		
Tag	**Description**	
<TO>.PositionLimits_HW. MinSwitchLevel	Level selection for activation of the low hardware limit switch	
	FALSE	At low level, the signal is active.
	TRUE	At high level, the signal is active.
<TO>.PositionLimits_HW. MinSwitchAddress	Byte number of the I/O address of the hardware limit switch for the low or minimum position	
<TO>.PositionLimits_HW. MaxSwitchLevel	Level selection for activation of the high hardware limit switch	
	FALSE	At low level, the signal is active.
	TRUE	At high level, the signal is active.
<TO>.PositionLimits_HW. MaxSwitchAddress	Byte number of the I/O address of the hardware limit switch for the high or maximum position	

3.10 Motion control and limits for dynamics (S7-1500, S7-1500T)

Motion control of the axis occurs by means of velocity profiles (Page 54). 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 dynamic limits have no effect on a following axis in synchronous operation.

The configurable emergency stop deceleration (Page 56) 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.

3.10.1 Velocity profile (S7-1500, S7-1500T)

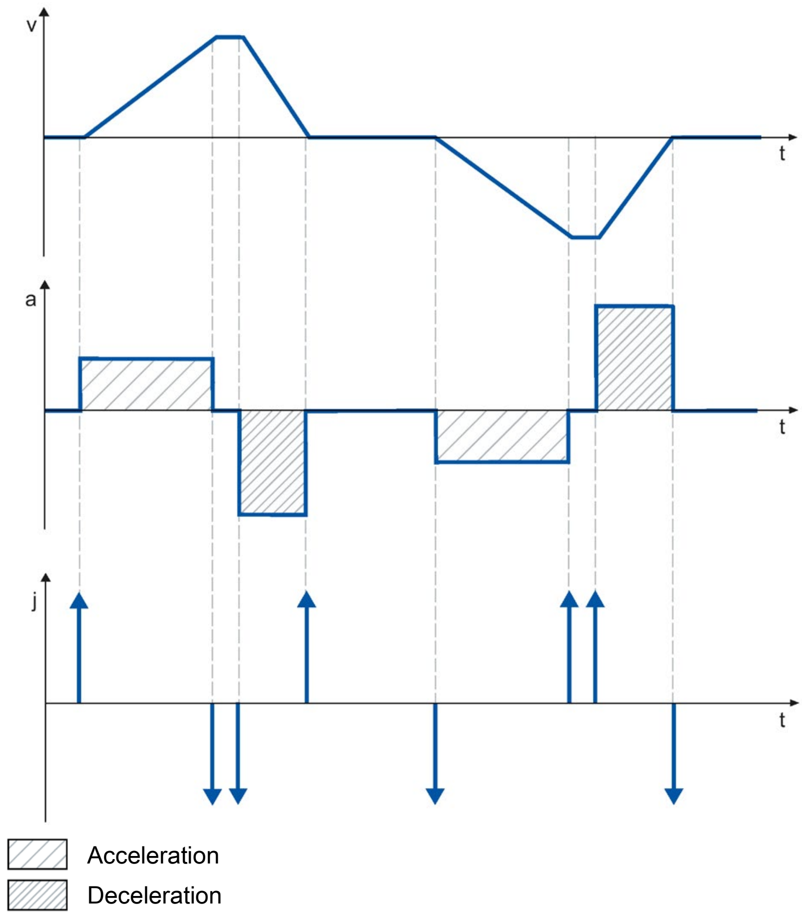
Velocity profiles with or without jerk limitation are supported for motion control of the axis.

The dynamic values for the motion are specified in the Motion Control job. Alternatively, the values of the dynamic defaults (Page 125) 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.

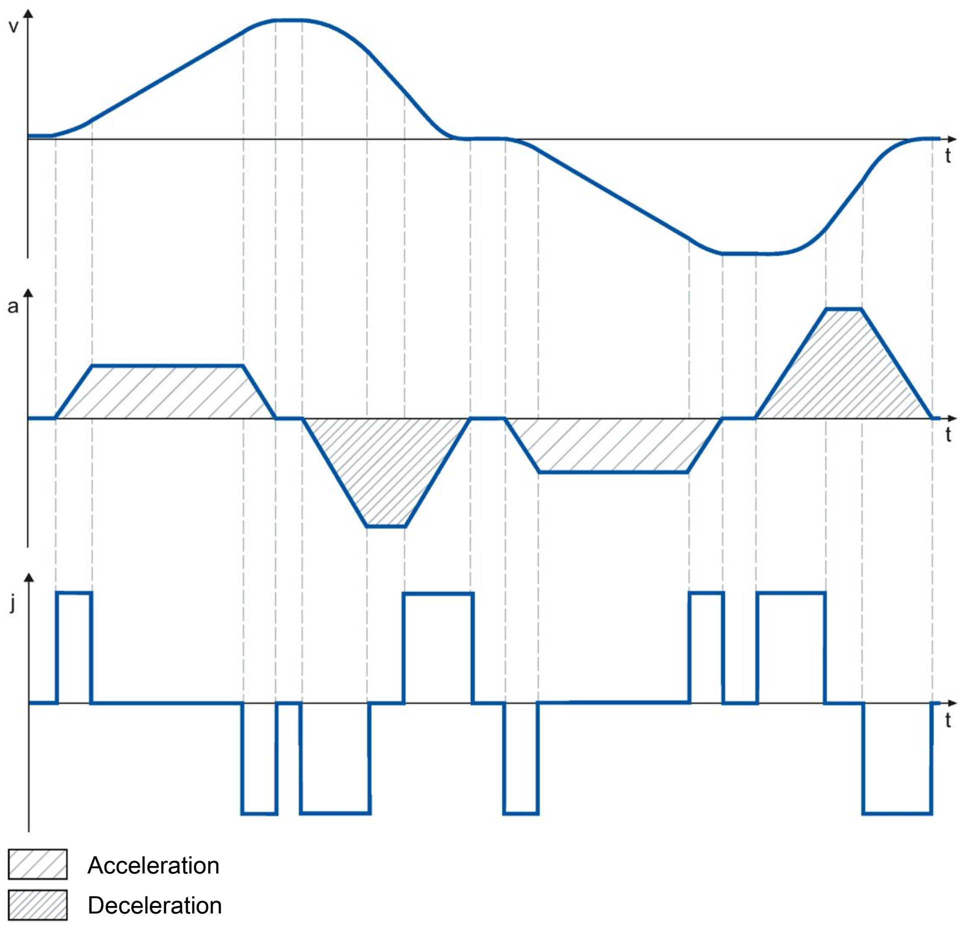
Velocity profile without jerk limitation

The following figure shows velocity, acceleration and jerk:



Velocity profile with jerk limitation

The following figure shows velocity, acceleration and jerk:



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

3.10.2 Emergency stop deceleration (S7-1500, S7-1500T)

When stopping with the emergency stop ramp, the axis is braked from the current actual position and actual velocity to a standstill without a jerk limitation, using the configured emergency deceleration.

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

- In case of an emergency stop ramp that has been enabled via the Motion Control instruction "MC_Power" or "MC_Stop".
- 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".

3.10.3 Motion specification via "MotionIn" (S7-1500T)

In contrast to the Motion Control instructions such as "MC_MoveAbsolute" and "MC_MoveRelative", no motion profile is calculated by the system when "MC_MotionInVelocity" and "MC_MotionInPosition" are used. Each individual setpoint of the motion profile (motion vector) must be specified with the "MotionIn" instruction in the application cycle. This allows you to calculate your own motion profile.

The setpoints are typically adapted in the processing cycle of the technology object. For this purpose, the "MotionIn" instruction is called in the organization block MC-PreServo [OB67]. The setpoints are then effective directly at the axis in MC-Servo [OB91].

WARNING

Uncontrolled axis motions

When using the motion specification via the Motion Control instructions "MC_MotionInVelocity" and "MC_MotionInPosition", the axis can perform uncontrolled motions.

Consider the current dynamics of the axis when specifying the new motion vectors. The motion vectors must be consistent with each other.

Set up the following protective measures before operating with the Motion Control instructions "MC_MotionInVelocity" and "MC_MotionInPosition":

- 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.

Note that a following axis that is coupled to the axis is also moved.

Overriding with "MotionIn" instructions

If a Motion Control instruction is overridden by a "MotionIn" instruction, the specified setpoints take immediate effect with the current application cycle. The dynamic results exclusively through the setpoint specifications of the user program. It is not limited and no smooth transition takes place from the current motion state. Consider the current dynamics of the axis when specifying the new motion vectors. Note that dynamic limits set on the technology object have no effect. Only limits set on the drive side are in effect.

Stopping the "MotionIn" instructions

The "MotionIn" instructions can be canceled by the following means:

- Overriding them with another Motion Control instruction

  The "MotionIn" instructions are triggered according to the behavior described in the section "Tripping characteristics V5: Homing and motion jobs (Page 271)". As a rule, the current dynamics are overridden by the new motion.

  Note

  Dynamic deviation possible

  Pay attention to consistent specifications relating to velocity and acceleration when the "MotionIn" instruction is overridden by another Motion Control instruction.

  When the "MotionIn" instruction is overridden, make sure that the new acceleration specifications are coordinated with the currently effective acceleration because the last effective acceleration value will be applied.

- Setting the parameter "Enable" to "FALSE"

  If you set "Enable" parameter to "FALSE", the setpoint is immediately set to zero. Note that the dynamic limits set on the technology object have no effect. Only limits set on the drive side are in effect.

"MC_MotionInVelocity"

Use the "MC_MotionInVelocity" instruction to specify the velocity and acceleration of the motion. The instruction is applicable for speed, positioning and constant axes.

To execute the instruction, you must at least specify the velocity. Acceleration is usually only required for the substituting running motions. By default, the value of the acceleration is zero.

"MC_MotionInPosition"

Use the "MC_MotionInPosition" instruction to specify the position, velocity and acceleration of the motion. The instruction is used for velocity, positioning and synchronous axes.

To execute the instruction, you must at least specify the position and velocity. Acceleration is usually only required for the substituting running motions. By default, the value of the acceleration is zero. The specified setpoints must be consistent with each other.

The position specification is position-controlled. If you use a velocity precontrol, the velocity specification is processed via the velocity precontrol.

See also

MC_MotionInVelocity: Specify motion setpoints V5 (Page 251)

MC_MotionInPosition: Specify motion setpoints V5 (Page 255)

3.10.4 Torque limits (S7-1500, S7-1500T)

3.10.4.1 Force/torque limiting (S7-1500, S7-1500T)

Adjustable force/torque limiting is available for the speed axis, positioning axis and synchronous axis technology objects. The force/torque limiting can be activated and deactivated before and during a motion job. To use force/torque limiting, the drive and the PROFIdrive telegram must support torque reduction. You can use, for example, a telegram 10x.

The limit value can be configured as a default value during configuration of the axis or it can be defined in the user program using Motion Control instruction "MC_TorqueLimiting".

You specify the limiting values in the configured unit of measure for force or torque. The units of measure are defined in the "Basic parameters" configuration window.

The following configuration options are available for force/torque limiting.

- **"Linear" axis type**
  - Torque limiting is active on motor side
  - Force limiting is active on the load side
- **"Rotary" axis type**
  - Torque limiting is active on load side or motor side

The force/torque limit defined by the user in accordance with the specification in the PROFIdrive telegrams 10x are transferred internally to the drive as a percentage torque reduction. The reference torque set in the "Data exchange with the drive" configuration dialog must match the reference torque set for the drive.

Linear axis type

Load-side force limitation you have defined is converted by the technology into torque reduction. If the limiting relates to the load side, the gear and leadscrew parameters defined in the "Mechanics" configuration dialog are taken into consideration. If the efficiency of the gear and leadscrew is crucial, you can set them in the "<TO>.Actor.Efficiency" tag.

Rotary axis type

The torque is reduced on the load side with the rotary axis type. The gear parameters defined in the "Mechanics" configuration window are taken into consideration. If the efficiency of the gear is crucial, you can set it in the "<TO>.Actor.Efficiency" tag.

The defined limiting values act as an absolute value and thus in the same way for positive and negative forces/torques.

Positioning and following error monitoring with active force/torque limiting

As a result of force/torque limiting, a larger setpoint-actual value difference can build up for position-controlled axes, which may cause unwanted activation of the positioning and following error monitoring.

Therefore, in the "Torque limiting" configuration window, the positioning and following error monitoring of the axis can be set as deactivated by default when force/torque limiting is active. If necessary, the positioning and following error monitoring can also be kept active even when force/torque limiting is active.

Typical behavior of a positioning or synchronous axis with active force/torque limiting

With active force/torque limiting, a larger setpoint-actual value difference can build up than during motion without force/torque limiting.

Given a constant setpoint, the axis makes repeated attempts to reduce the following error.

When the limiting values are increased or limiting is deactivated during active closed loop position control, the axis can accelerate briefly to reduce the following error. If the axis is switched to non-position-controlled operation, e.g. using "MC_MoveVelocity" with "PositionControlled" = FALSE, the following error is no longer in effect.

Stopping an axis with active force/torque limiting

When stopping an axis in position-controlled mode with "MC_Halt" or "MC_Stop", the position setpoint and the velocity setpoint are used as basis. Torque limiting still remains active and any accumulated following error is reduced. The axis is in standstill when the actual velocity "0.0" is reached and the minimum dwell time in the standstill window has expired. The axis remains enabled.

When stopping an axis with "MC_Power" and an emergency stop ramp, the actual position value and the actual velocity are used as a basis. The axis is braked with the configured emergency stop deceleration without any jerk limit and brought to a standstill. The axis is then disabled when at a standstill.

See also

Fixed stop detection (Page 61)

Configuration - Torque limits (Page 107)

Configuration - Torque limits (Page 131)

3.10.4.2 Fixed stop detection (S7-1500, S7-1500T)

With the Motion Control instruction "MC_TorqueLimiting", you activate and monitor a fixed stop detection. Together with a position-controlled motion job, a "Travel to fixed stop" can be realized. The operation is also referred to as clamping. "Travel to fixed stop" can be used, for example, to move quills against the workpiece with a specified torque.

The fixed stop detection is configured in the configuration window "Extended parameters > Limits > Fixed stop detection".

The fixed stop detection is only possible in position-controlled operation of the axis. If the drive and telegram support force/torque limiting, this is active during travel to fixed stop and for clamping.

Detection of the fixed stop using following error

If the drive is stopped by a mechanical fixed stop during a motion job, the following error is increased. When the following error configured in the configuration window "Extended parameters > Limits > Fixed stop detection" is exceeded, this is regarded as the fixed stop having been reached.

When following error monitoring is activated, the configured following error must be greater than the following error for fixed stop detection.

Clamping at the mechanical endstop

When the fixed stop is reached, the active position-controlled motion job is canceled with "CommandAborted". The setpoint is no longer changed and the following error remains constant. The closed loop position control remains active and the monitoring of the configured "Positioning tolerance" is activated The drive is in "Clamping" state.

If the drive and telegram support force/torque limiting, this continues to be active with active fixed stop detection. During clamping, the clamping force or clamping torque can be changed. The value in input parameter "Limit" of the Motion Control instruction "MC_TorqueLimiting" can be changed for this.

Monitoring of the clamping

If the actual position changes by a value greater than the configured "Positioning tolerance" during active clamping, this is regarded as the break or push-back of the fixed stop. An alarm is triggered. The axis is disabled and the drive is stopped according to its configuration.

If the position setpoint is within the configured "Positioning tolerance", the breaking away or turning back of the fixed stop cannot be detected.

The configured position tolerance must be less than the configured following error for detection of clamping.

Retracting

Retracting from the fixed stop is only possible with a position-controlled motion job in the opposite direction to the fixed stop.

The "Travel to fixed stop" or "Clamping" function is ended when the "Positioning tolerance" is left in the retraction direction.

See also

Force/torque limiting (Page 59)

Configuration - Fixed stop detection (Page 133)

MC_TorqueLimiting: Activate/deactivate force/torque limit / fixed stop detection V5 (Page 265)

3.10.4.3 Additive setpoint torque (S7-1500, S7-1500T)

The Motion Control instruction "MC_TorqueAdditive" allows you to apply additional torque in the drive.

The additive setpoint torque is used for example in torque feedforward control or the specification of the tensile torque for winding applications.

The following requirements must be fulfilled to set the additive torque setpoint:

- SINAMICS drive (see "compatibility list")
- SIEMENS supplementary telegram 750 for transmitting the torque data to the drive

The additional torque can be either positive or negative. The value specified in the instruction is a technological value, not a percentage. Set the unit of measurement for the torque at the axis (default value: Nm).

See also

MC_TorqueAdditive: Specify additive torque V5 (Page 259)

3.10.4.4 Permissible torque range (S7-1500, S7-1500T)

The Motion Control instruction "MC_TorqueRange" allows you to set torque limits for the drive.

The motion control instruction is used, for example, for winding applications in order to prevent the tearing of the material.

The following requirements must be fulfilled to set the torque data:

- SINAMICS drive (see "compatibility list")
- SIEMENS supplementary telegram 750 for transmitting the torque data to the drive

The value specified in the instruction is a technological value, not a percentage. Set the unit of measurement for the torque at the axis (default value: Nm). If you invert the setpoints at the technology object of the axis, the values for the high and low torque limit are output inverted and reversed.

If the torque limitation is activated by specifying the high and low torque limit, the following monitorings and limits are deactivated:

- Following error monitoring
- Time limits for positioning monitoring
- Time limits for standstill monitoring

Monitoring remains in effect if you have selected the option "Leave position-related monitoring enabled" under "Technology object > Configuration > Extended parameters > Limits > Torque limiting".

See also

MC_TorqueRange: Set high and low torque limits V5 (Page 262)

3.10.5 Tags: Motion control and limits for dynamics (S7-1500, S7-1500T)

The following technology object tags are relevant for motion control:

Status		
Tag	**Description**	
<TO>.StatusWord	Status indicator for an active motion	
<TO>.Position	Position setpoint	
<TO>.Velocity	Velocity setpoint/speed setpoint	
<TO>.VelocitySetpoint	Output velocity setpoint/speed setpoint	
<TO>.ActualPosition	Actual position	
<TO>.ActualVelocity	Actual velocity	
<TO>.ActualSpeed	Actual speed of the motor (only with PROFIdrive drive type)	
<TO>.Acceleration	Setpoint acceleration	
<TO>.ActualAcceleration	Actual acceleration	
<TO>.StatusSynchronizedMotion. StatusWord.X0 (MaxVelocityExceeded)	The tag is set to the value "TRUE" when the maximum velocity configured for the following axis is exceeded during synchronous operation.	
<TO>.StatusSynchronizedMotion. StatusWord.X1 (MaxAccelerationExceeded)	The tag is set to the value "TRUE" when the maximum acceleration configured for the following axis is exceeded during synchronous operation.	
<TO>.StatusSynchronizedMotion. StatusWord.X2 (MaxDecelerationExceeded)	The tag is set to the value "TRUE" when the maximum deceleration configured for the following axis is exceeded during synchronous operation.	
<TO>.StatusMotionIn.FunctionState	Status of the "MotionIn" function	
	0	No "MotionIn" function active
	1	"MC_MotionInVelocity" active
	2	"MC_MotionInPosition" active

Override	
Tag	**Description**
<TO>.Override.Velocity	Velocity or speed override

Dynamic limit values	
Tag	**Description**
<TO>.DynamicLimits.MaxVelocity	Dynamic limitation for maximum speed (mechanical)
<TO>.DynamicLimits.Velocity	Dynamic limitation for maximum speed (programmable)
<TO>.DynamicLimits.MaxAcceleration	Dynamic limitation for maximum acceleration
<TO>.DynamicLimits.MaxDeceleration	Dynamic limitation for maximum deceleration
<TO>.DynamicLimits.MaxJerk	Dynamic limitation for maximum jerk

Defaults for the dynamics	
Tag	**Description**
<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

Torque limiting		
Tag	**Description**	
<TO>.TorqueLimiting.LimitDefaults. Torque	Limiting torque	
<TO>.TorqueLimiting.LimitDefaults. Force	Limiting force	
<TO>.TorqueLimiting.LimitBase	Torque limiting motor or drive side	
	0	Motor side
	1	Load side
<TO>.TorqueLimiting. PositionBasedMonitorings	Positioning and following error monitoring	
	0	Disabled
	1	Enabled
<TO>.StatusTorqueData. CommandAdditiveTorqueActive	Additive torque setpoint function	
	0	Disabled
	1	Enabled
<TO>.StatusTorqueData. CommandTorqueRangeActive	Torque limits function	
	0	Disabled
	1	Enabled
<TO>.StatusTorqueData.ActualTorque	Actual torque of the axis	

Fixed stop detection	
Tag	**Description**
<TO>.Clamping. FollowingErrorDeviation	Value of the following error starting from which the fixed stop is detected
<TO>.Clamping.PositionTolerance	Position tolerance for the clamping monitoring

3.11 Homing (S7-1500, S7-1500T)

With homing, you create the relationship between the position in the technology object and the mechanical position. The actual 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 encoder adjustment.

Homing is a requirement for display of the correct position for the technology object and for absolute positioning.

Homing is activated with the Motion Control instruction "MC_Home".

Homing status

The "<TO>.StatusWord.X5 (HomingDone)" tag of the technology object indicates whether the axis or external encoder technology object is homed.

Type of homing

Homing can occur by means of an independent homing motion (active homing), the detection of a homing mark during a motion initiated on the user side (passive homing) or a 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 homing mark approach. When the homing mark is detected, the actual position is set to the value specified in MC_Home. It is possible to specify a home position offset. Retraction to the home position offset occurs automatically during the home position approach.

  When active homing starts, current traversing movements are aborted.

- **Passive homing**

  The homing job does not perform its own homing motion. When the homing mark is detected during a motion initiated on the user side, the actual position is set to the value specified in "MC_Home".

  Passive homing is also called homing on the fly.

- **Direct homing**

  With the homing job, the actual position is set directly to the value specified in "MC_Home" or is offset by this value.

- **Absolute encoder adjustment**

  In absolute encoder adjustment, the actual position of the axis or encoder is set with the absolute or relative value specified at "MC_Home". The absolute value offset is stored retentively in the CPU.

Homing mode

Depending on the type of homing mark and homing mark search, a distinction is made among the following homing modes (Page 69):

- Homing with homing output cam and zero mark via PROFIdrive telegram
- Homing with zero mark via PROFIdrive telegram
- Homing with digital input

3.11.1 Terms (S7-1500, S7-1500T)

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 telegram. Perform the setting and evaluation as an encoder zero mark or external zero mark at the drive module and encoder module.
- **An edge at the digital input**

  The negative or positive edge at a digital input is used as a homing mark.

Reference cam

If there are several zero marks in the traversing range, the reference cam is used to select a specific zero mark before or after the reference cam.

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 home position and the homing mark position is the home position offset.

A home position offset only has an effect with active homing. The offset is traversed after the synchronization of the axis using the Motion Control instruction "MC_Home". For axes with modulo setting, the home position offset is always traversed with 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 was not detected or was approached from the wrong side, the motion continues in the opposite direction after the reversing cam.

3.11.2 Homing mode (S7-1500, S7-1500T)

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 homing cam and zero mark via PROFIdrive telegram

The system checks for when the reference cam is reached. After the reference cam has been reached and left again in the assigned homing direction, zero mark detection is enabled via the PROFIdrive telegram.

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 telegram

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.

3.11.3 Active homing with homing output cam and zero mark (S7-1500, S7-1500T)

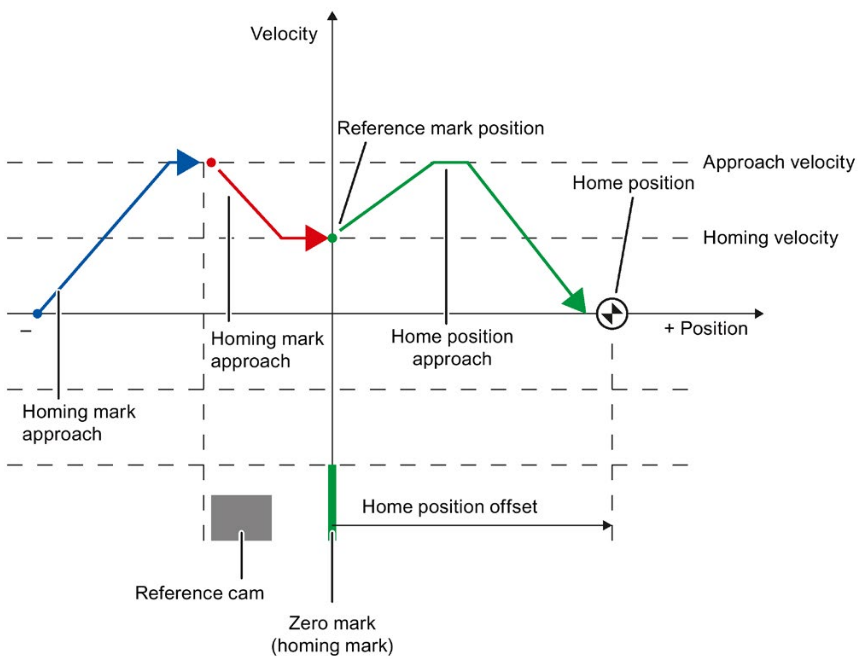
The following examples show homing motions in the positive and negative directions.

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 homing output cam and zero mark
- Approach in the positive direction
- Homing in the positive direction
- Positive home position offset

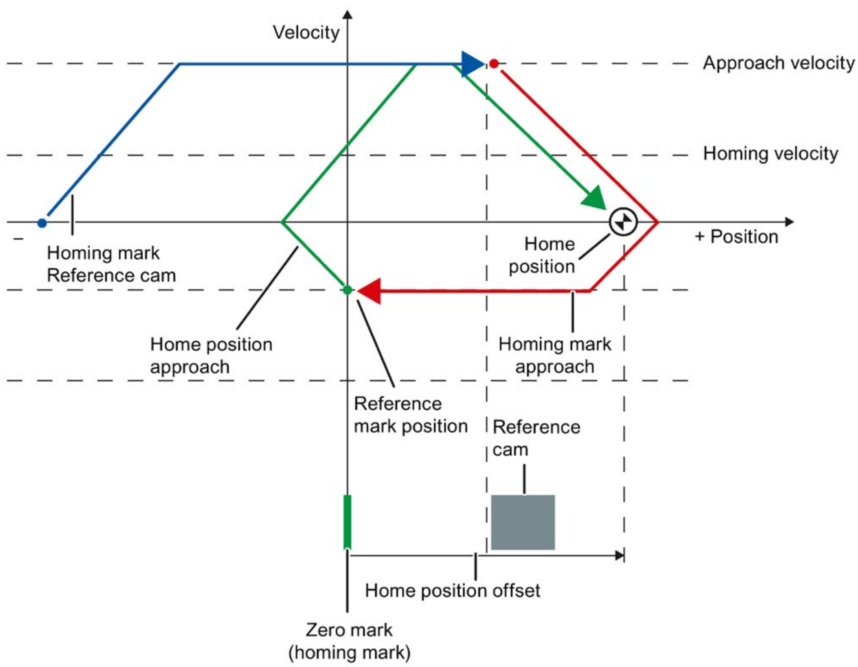


Example of homing in the negative direction

The approach to the homing mark occurs in the negative direction by means of a direction reversal during the homing process. The approach to 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 homing output cam and zero mark
- 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 "MC_Home" Motion Control instruction
2. Approach to reference output cam
3. Detection of the homing output cam in the homing direction and travel with homing velocity
4. Departure from the reference output cam and travel to the homing mark

   With the departure from the homing output cam, 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:

   – "Mode" parameter at "MC_Home" = 3

     Position = value in parameter "Position" minus "<TO>.Sensor[1..4].ActiveHoming.HomePositionOffset"

   – "Mode" parameter at "MC_Home" = 5

     Position = value in tag "<TO>.Homing.HomePosition" minus "<TO>.Sensor[1..4].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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

   ---

6. Approach to the home position

   – "Mode" parameter at "MC_Home" = 3

     The axis moves to the position that is specified in the "Position" parameter.

   – "Mode" parameter at "MC_Home" = 5

     The axis moves to the position that is specified in the "<TO>.Homing.HomePosition" tag.

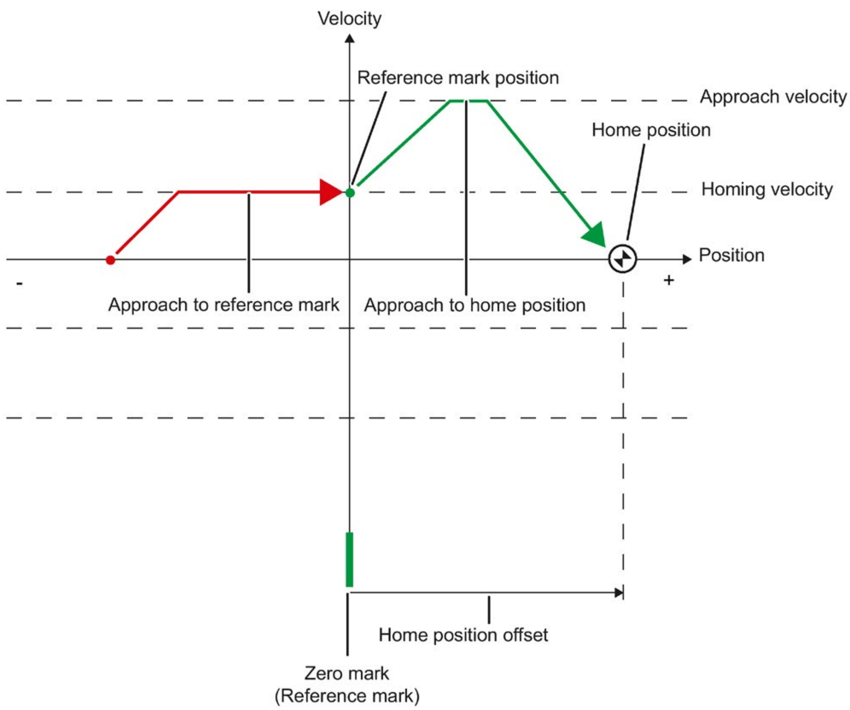
   Note

   If the velocity cannot be reduced to the reference velocity between detection of the reference output cam and the zero mark, homing is performed at the velocity present when the zero mark is crossed.

3.11.4 Active homing with zero mark (S7-1500, S7-1500T)

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:

   – "Mode" parameter at "MC_Home" = 3

     Position = value in parameter "Position" minus "<TO>.Sensor[1..4].ActiveHoming.HomePositionOffset"

   – "Mode" parameter at "MC_Home" = 5

     Position = value in tag "<TO>.Homing.HomePosition" minus "<TO>.Sensor[1..4].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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

   ---

4. Approach to the home position

   – "Mode" parameter at "MC_Home" = 3

     The axis moves to the position that is specified in the "Position" parameter.

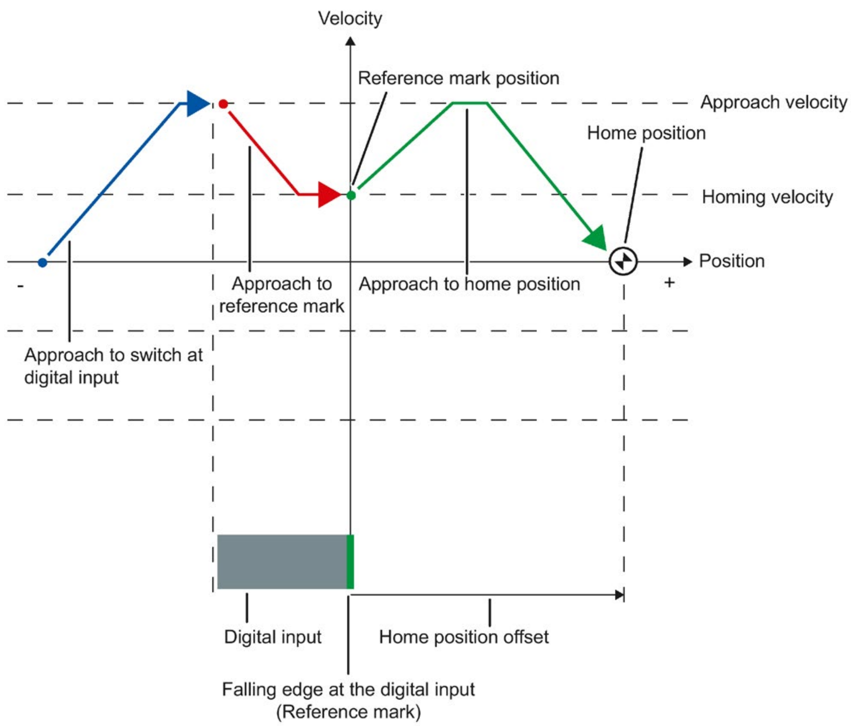
   – "Mode" parameter at "MC_Home" = 5

     The axis moves to the position that is specified in the "<TO>.Homing.HomePosition" tag.

3.11.5 Active homing with digital input (S7-1500, S7-1500T)

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 "MC_Home" Motion Control instruction
2. Detection of the positive edge at the digital input, while moving with homing velocity
3. Approach to the homing mark

4. Detection of the homing mark

   In the example, the negative 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:

   – "Mode" parameter at "MC_Home" = 3

     Position = value in parameter "Position" minus "<TO>.Sensor[1..4].ActiveHoming.HomePositionOffset"

   – "Mode" parameter at "MC_Home" = 5

     Position = value in tag "<TO>.Homing.HomePosition" minus "<TO>.Sensor[1..4].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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

5. Approach to the home position

   – "Mode" parameter at "MC_Home" = 3

     The axis moves to the position that is specified in the "Position" parameter.

   – "Mode" parameter at "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 positive edge to the negative edge cannot be reduced to the homing velocity, then homing occurs at the velocity that exists when the homing mark is traversed.

3.11.6 Direction reversal at the hardware limit switch (reversing cam) (S7-1500, S7-1500T)

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, the motion continues in the opposite direction with the approach velocity after the reversing cam.

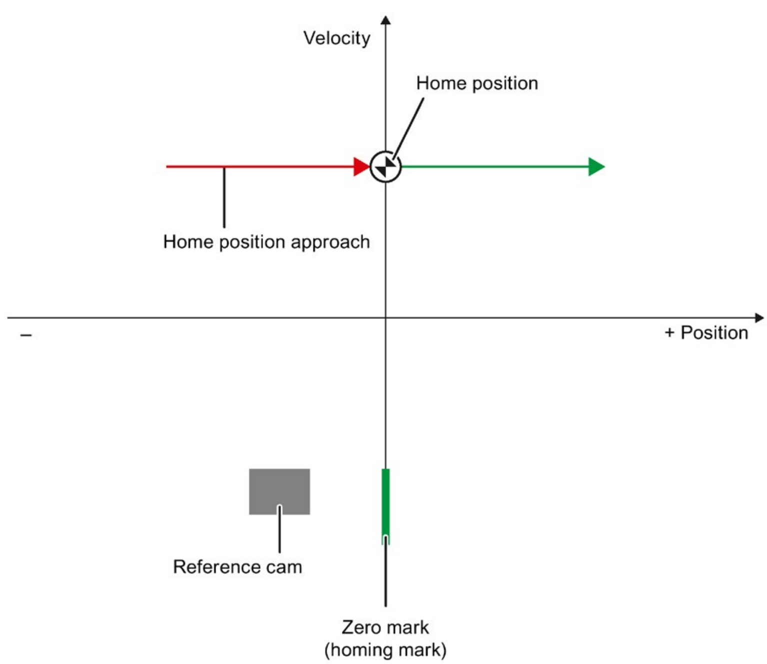
When the hardware limit switch is reached, the default settings for dynamics take effect. Deceleration with the emergency deceleration does not hereby occur.

NOTICE
Avoid moving to a mechanical endstop Ensure by one of the following measures, that in a direction reversal the machine does not move to a mechanical endstop. • Keep the approach velocity low. • Increase the configured acceleration/deceleration. • Increase the distance between the hardware limit switch and the mechanical endstop.

3.11.7 Passive homing with homing output cam and zero mark (S7-1500, S7-1500T)

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

- Passive homing with homing output cam and zero mark
- Homing in the positive direction



Motion sequence

The motion occurs in the following sequence:

1. Activation of passive homing using the Motion Control instruction "MC_Home"
2. Motion due to a Motion Control job from the user

   The detection of the reference output cam and homing mark is enabled when the actual position value of the axis or encoder moves in the assigned homing direction.
3. Detection of the reference output cam
4. Departure from the reference output cam

   The departure from the reference output cam 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:

   – "Mode" parameter at "MC_Home" = 2, 8

     Position = value in parameter "Position"

   – "Mode" parameter at "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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

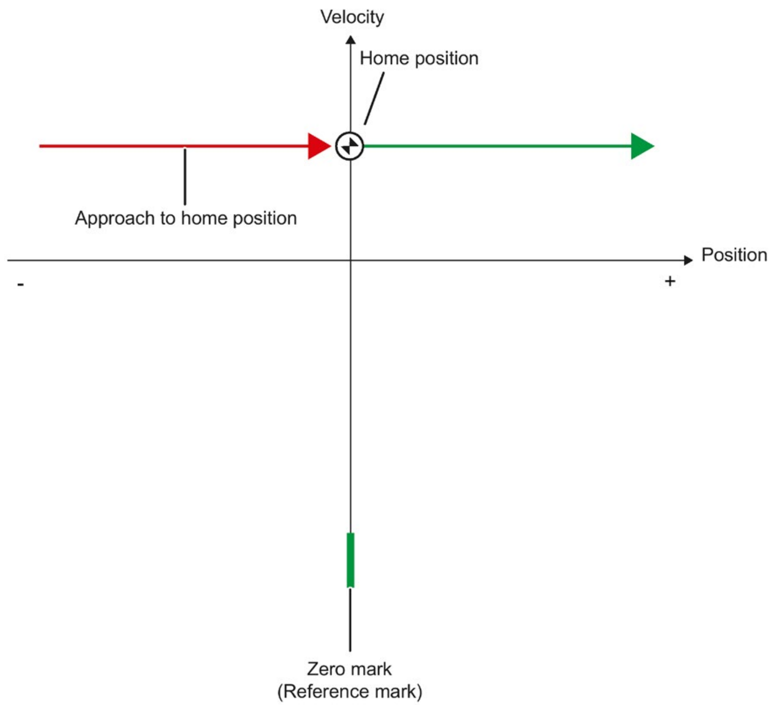
Note

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

3.11.8 Passive homing with zero mark (S7-1500, S7-1500T)

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. Activation of passive homing using the Motion Control instruction "MC_Home"
2. Motion due to a Motion Control job from the user

   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

   During the detection of the homing mark, the position of the axis or encoder is set depending on the set mode:

   – "Mode" parameter at "MC_Home" = 2, 8

     Position = value in parameter "Position"

   – "Mode" parameter at "MC_Home" = 10

     Position = value in tag "<TO>.Homing.HomePosition"

Note

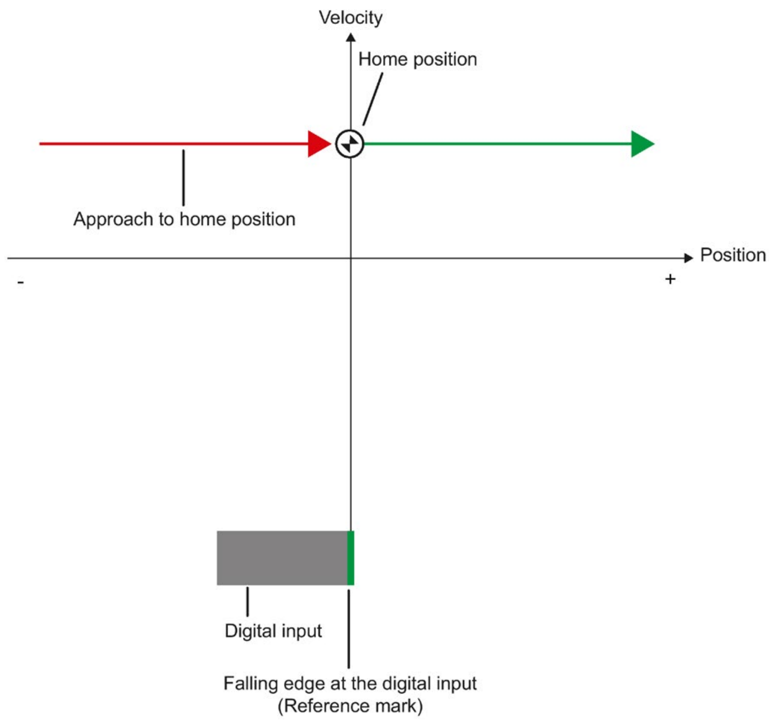
Parameter "MC_Home.Mode"

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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

3.11.9 Passive homing with digital input (S7-1500, S7-1500T)

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. Activation of passive homing using the Motion Control instruction "MC_Home"
2. Motion due to a Motion Control job from the user

   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:

   – "Mode" parameter at "MC_Home" = 2, 8

     Position = value in parameter "Position"

   – "Mode" parameter at "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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

3.11.10 Direct homing (S7-1500, S7-1500T)

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 actual position absolutely

To set the actual position absolutely, proceed as follows:

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

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

Set actual position relatively

To set the actual position relatively, proceed as follows:

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

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

Set position setpoint absolutely

To set the position setpoint absolutely, proceed as follows:

1. In the "MC_Home" Motion Control instruction, enter the absolute position setpoint in the "Position" parameter.
2. Call the "MC_Home" Motion Control instruction with parameter "Mode" = 11.

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

Set position setpoint relatively

To set the position setpoint relatively, proceed as follows:

1. In the "MC_Home" Motion Control instruction, enter the relative position setpoint in the "Position" parameter.
2. Call the "MC_Home" Motion Control instruction with parameter "Mode" = 12.

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

Direct homing at fixed stop

For direct homing at fixed stop, all motions must be programmed in the user program. Change the configuration data directly in the user program. The fixed stop is used as homing mark.

NOTICE
Too fast manual traversing to the fixed stop
Too fast a manual traversing of the axis can lead to machine damage.
Move the axis manually with low speed/velocity. Configure a suitable torque limit.

To set the position at the fixed stop absolutely or relatively, proceed as follows:

1. Activate a suitable fixed stop detection with the Motion Control instruction "MC_TorqueLimiting".
2. Deactivate the existing hardware limit switch with the Motion Control instruction "MC_WriteParameter".
3. Move the axis to the fixed stop using a suitable motion job. For example, use the Motion Control instructions "MC_MoveRelative" or "MC_MoveJog".
4. After the axis has reached the fixed stop, execute a direct homing using the Motion Control instruction "MC_Home".
5. Move the axis back to the working area between the hardware limit switches.
6. Activate the hardware limit switch with the Motion Control instruction "MC_WriteParameter".
7. Deactivate the fixed stop detection using the Motion Control instruction "MC_TorqueLimiting".

See also

MC_TorqueLimiting V5 (Page 265)

MC_WriteParameter V5 (Page 249)

MC_MoveJog V5 (Page 227)

MC_MoveRelative V5 (Page 216)

MC_Home V5 (Page 200)

3.11.11 Absolute value adjustment (S7-1500, S7-1500T)

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"

3.11.12 Resetting the "Homed" status (S7-1500, S7-1500T)

Incremental encoder

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

- Error in sensor system/encoder failure
- Triggering of the active homing with the Motion Control instruction "MC_Home" with "Mode" = 3, 5

  (After successful completion of the homing operation, the "Homed" status is reset.)

  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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

- Triggering of passive homing using the Motion Control instruction "MC_Home" with "Mode" = 2, 8, 10

  (After successful completion of the homing operation, the "Homed" status is reset.)
- 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 encoder

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

- Replacement of the CPU
- Modification of the encoder configuration
- Restoration of the CPU factory settings
- Transfer of a different project into the controller

When you use a new absolute value encoder you need to home the absolute encoder once again.

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

3.11.13 Tags: Homing (S7-1500, S7-1500T)

The following technology object tags are relevant for homing:

Status indicators	
Tag	**Description**
<TO>.StatusWord.X11 (HomingCommand)	Homing job running
<TO>.StatusWord.X5 (HomingDone)	Technology object homed
<TO>.ErrorWord.X10 (HomingFault)	Error occurred during homing

Note

Evaluation of the bits in StatusWord, ErrorWord and WarningWord

Note the information in section "Evaluating StatusWord, ErrorWord und WarningWord" of the documentation "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459).

Approach to reference output cam	
Tag	**Description**
<TO>.Homing.ApproachDirection	Start direction or approach direction for the approach to the reference output cam
<TO>.Homing.ApproachVelocity	Velocity for the approach to the reference output cam

Approach to the homing mark	
Tag	**Description**
<TO>.Sensor[1..4].ActiveHoming.Direction	Homing direction
<TO>.Homing.ReferencingVelocity	Velocity for the approach to the homing mark

Approach to home position	
Tag	**Description**
<TO>.Homing.ApproachVelocity	Velocity for the move to homing point

Positions	
Tag	**Description**
<TO>.Homing.AutoReversal	Reversal at the hardware limit switches
<TO>.Homing.HomePosition	Home position
<TO>.StatusSensor[1..4].AbsEncoderOffset	Calculated offset after the absolute encoder adjustment

Parameters for active homing	
Tag	**Description**
<TO>.Sensor[1..4].ActiveHoming.Mode	Homing mode
<TO>.Sensor[1..4].ActiveHoming.SideInput	Side of the digital input
<TO>.Sensor[1..4].ActiveHoming.Direction	Homing direction or approach direction
<TO>.Sensor[1..4].ActiveHoming.DigitalInputAddress	Address of digital input
<TO>.Sensor[1..4].ActiveHoming.HomePositionOffset	Offset of the homing mark from the home position

Parameters for passive homing	
Tag	**Description**
<TO>.Sensor[1..4].PassiveHoming.Mode	Homing mode
<TO>.Sensor[1..4].PassiveHoming.SideInput	Side of the digital input
<TO>.Sensor[1..4].PassiveHoming.Direction	Homing direction or approach direction
<TO>.Sensor[1..4].PassiveHoming.DigitalInputAddress	Address of digital input

3.12 Position monitoring functions (S7-1500, S7-1500T)

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

- Positioning monitoring (Page 89)

  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 90)

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

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

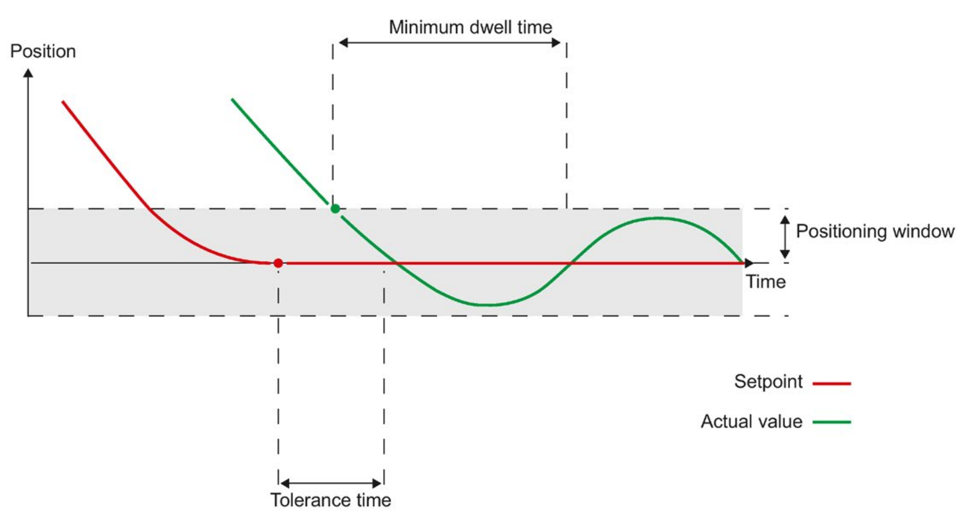
3.12.1 Positioning monitoring (S7-1500, S7-1500T)

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

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

If the actual position is reached at the end of a positioning motion 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. After expiration of the minimum dwell time, the "Done" parameter of the corresponding Motion Control instruction is also set. This completes a motion 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 motion by the Motion Control instruction "MC_Halt" or "MC_Stop"

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.

3.12.2 Following error monitoring (S7-1500, S7-1500T)

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 velocity setpoint.

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

Above this low velocity limit, the permissible following error increases in proportion to the velocity setpoint. The configurable maximum permissible following error is the maximum velocity limit.

Calculation of the following error

The real following error is the difference between the set and actual position in relation to the values of the drive. The real following error is therefore greater than the following error calculated in the CPU and greater than the following error calculated in the trace. When calculating the following error, the transmission times of the setpoint to the drive and of the actual position value to the controller are deducted. The following error is calculated from the delayed position setpoint minus the actual position in the controller.

The calculation of the following error is valid for the following conditions:

- Position control with and without DSC
- Configuration with and without precontrol of the position control loop
- Configuration of the drive coupling via a PROFIdrive telegram or via an analog output

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.

Violation 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).

When force/torque limiting is activated, the monitoring of the permissible following error can be deactivated.

3.12.3 Standstill signal (S7-1500, S7-1500T)

When the actual velocity reaches the standstill window and remains there for the minimum dwell time, the standstill of the axis is indicated.

3.12.4 Tags: Position monitoring functions (S7-1500, S7-1500T)

Standstill signal

The following technology object tags are relevant for position monitoring and for the standstill signal:

Status indicators	
Tag	**Description**
<TO>.StatusWord.X7 (Standstill)	Set to the value "TRUE" when the actual velocity reaches the standstill window and does not exit it within the minimum dwell time. The standstill signal is only present for the positioning axis/synchronous axis.
<TO>.StatusWord.X6 (Done)	**Positioning axis/synchronous axis** Set to the value "TRUE" when the actual velocity value reaches the positioning window within the tolerance time and remains in the window for the minimum dwell time.
	Speed axis Set to "TRUE" when the motion is complete and the speed setpoint is therefore equal to zero.
<TO>.ErrorWord.X12 (PositioningFault)	A positioning error has occurred.

Positions and times	
Tag	**Description**
<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 position window
<TO>.PositioningMonitoring.Window	Positioning window

Standstill signal	
Tag	**Description**
<TO>.StandstillSignal. VelocityThreshold	Velocity threshold for the standstill signal
<TO>.StandstillSignal.MinDwellTime	Minimum dwell time below the velocity threshold

Following error monitoring

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

Status indicators	
Tag	**Description**
<TO>.StatusPositioning.FollowingError	Current following error
<TO>.ErrorWord.X11 (FollowingErrorFault)	Status indication, that the following error is too large
<TO>.WarningWord.X11 (FollowingErrorWarning)	Status indication, that the following error warning limit has been reached

Control bits	
Tag	**Description**
<TO>.FollowingError.EnableMonitoring	Enable/disable following error monitoring

Limits	
Tag	**Description**
<TO>.FollowingError.MinVelocity	Lower velocity setpoint 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)

3.13 Closed-loop control (S7-1500, S7-1500T)

The position controller of the positioning axis/synchronous axis is a closed-loop P controller with or without velocity precontrol. Use the servo gain factor to set the gain of the proportional-action controller. The achievable servo gain factor depends on the structural requirements of the axis.

Closed-loop controllers and monitoring are active when closed loop position control is active.

If closed loop position control is inactive, encoder systems, actual value calculation and monitoring are active on the actual value side.

Velocity precontrol

The velocity precontrol can be used to minimize the velocity-based following error during position control. As a result, faster positioning is achieved, if needed, because the position controller only has to compensate disturbances.

When using the velocity precontrol, the velocity setpoint is additionally added to the output of the position controller. You can weight this additional setpoint by a factor.

The symmetry filter is a simplified model of the speed control loop. The symmetry filter is used to prevent the position controller from overriding the speed manipulated variable during the acceleration and deceleration phases. To accomplish this, the position setpoint of the position controller is delayed by the speed control loop substitute time in relation to the speed pre-control.

Dynamic Servo Control (DSC)

In drives that support Dynamic Servo Control (DSC), you can optionally use the closed-loop position controller in the drive. If you use telegrams that support DSC, DSC is automatically activated. 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 following requirements must be met to use DSC:

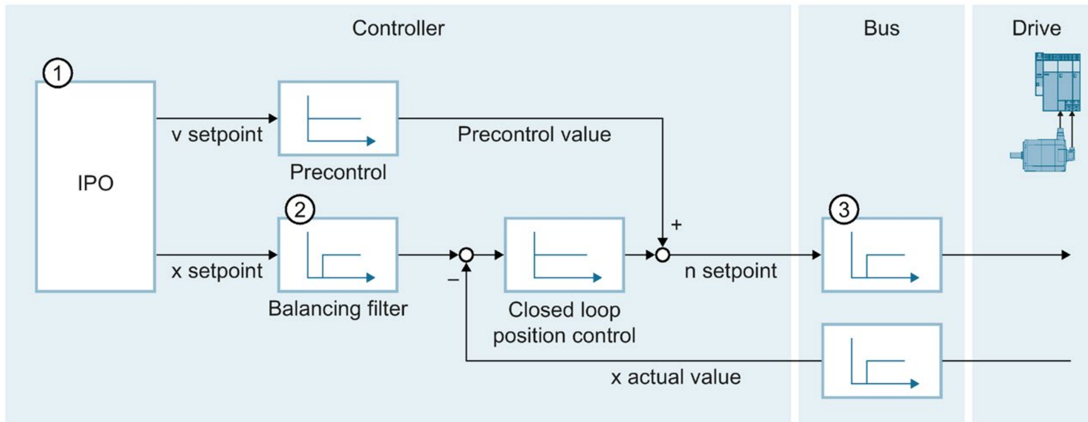
- The motor encoder (first encoder in the telegram) of the drive is used as the first encoder for the technology object.
- One of the following PROFIdrive telegrams is used for the drive:
  - Standard telegram 5 or 6
  - SIEMENS telegram 105 or 106

See also

PROFIdrive telegrams (Page 27)

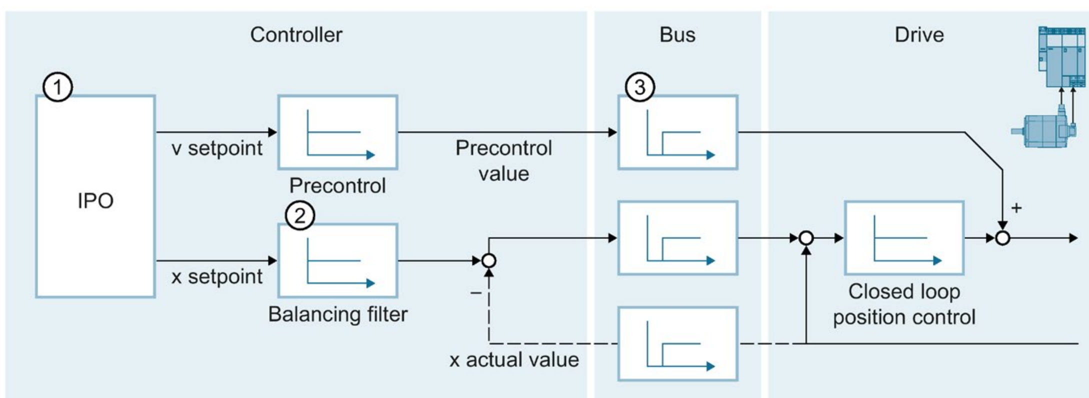
3.13.1 Control structure (S7-1500, S7-1500T)

The following figure shows the effective closed loop control structure **without** DSC:



① Interpolator with motion control
② Internal consideration of the signal propagation times and the speed-control loop substitute time
③ Communication between controller and drive

The following figure shows the effective closed loop control structure **with** DSC:



① Interpolator with motion control
② Internal consideration of speed control loop substitute time
③ Communication between controller and drive

Additional information

For more information about the control structure, refer to Siemens Industry Online Support in the FAQ entry 109770664 (https://support.industry.siemens.com/cs/ww/en/view/109770664).

See also

Configuration - Control loop (Page 145)

3.13.2 Non position-controlled operation (S7-1500, S7-1500T)

The closed loop position control of an axis can be switched off/switched with the following Motion Control instructions:

- MC_Power
- MC_MoveVelocity
- MC_MoveJog
- MC_MotionInVelocity

The non-position-controlled operation is displayed with "<TO>.StatusWord.X28 (NonPositionControlled)" = TRUE.

MC_Power

The axis is enabled without closed loop position control with "MC_Power" and the parameter "StartMode" = 0. The closed loop position control remain switched off until a different Motion Control instruction changes the status of the closed loop position control.

MC_MoveVelocity and MC_MoveJog

A "MC_MoveVelocity" or "MC_MoveJog" job with "PositionControlled" = FALSE forces non-position-controlled operation.

A "MC_MoveVelocity" or "MC_MoveJog" job with "PositionControlled" = TRUE forces position-controlled operation.

The selected mode remains in effect after the job is completed.

MC_MotionInVelocity and MC_MotionInPosition

A "MC_MotionInVelocity" job with "PositionControlled" = FALSE forces non-position-controlled operation.

A "MC_MotionInVelocity" job with "PositionControlled" = TRUE forces position-controlled operation.

The selected mode remains in effect after the job is completed.

A "MC_MotionInPosition" job forces position-controlled operation.

Influence of additional Motion Control instructions

Starting the following Motion Control instructions forces position-controlled operation of the axis:

- MC_Home with "Mode" = 3, 5
- MC_MoveAbsolute
- MC_MoveRelative
- MC_MoveSuperimposed
- MC_MotionInPosition

- MC_GearIn
- MC_GearInPos (S7-1500T)
- MC_CamIn (S7-1500T)

The closed loop position control remains active after completing the corresponding jobs.

The Motion Control instructions "MC_Halt" and "MC_Stop" are executed in position-controlled and also in non-position-controlled operation. The status of the closed loop position control is not changed by "MC_Halt"/"MC_Stop".

A torque limiting activated with "MC_TorqueLimiting" is in effect even with non-position-controlled operation.

3.13.3 Tags: Closed-loop control (S7-1500, S7-1500T)

The following technology object tags are relevant for the closed-loop control:

<table>
<tr><th colspan="3">Parameters</th></tr>
<tr><th>Tag</th><th colspan="2">Description</th></tr>
<tr><td><TO>.PositionControl.Kv</td><td colspan="2">Proportional gain of the closed loop position control</td></tr>
<tr><td><TO>.PositionControl.Kpc</td><td colspan="2">Velocity precontrol of the positioning system (in %)</td></tr>
<tr><td><TO>.PositionControl.EnableDSC</td><td colspan="2">Enable DSC</td></tr>
<tr><td><TO>.DynamicAxisModel.VelocityTime Constant</td><td colspan="2">Speed control loop substitute time [s]</td></tr>
<tr><td rowspan="5"><TO>.PositionControl.
ControlDifferenceQuantization.Mode</td><td colspan="2">Type of quantification
Configuration of a quantization when a drive with stepper motor interface is connected</td></tr>
<tr><td>0</td><td>No quantification</td></tr>
<tr><td>1</td><td>Quantization corresponding to encoder resolution</td></tr>
<tr><td>2</td><td>Quantization to a direct value (value input in "<TO>.PositionControl.
ControlDifferenceQuantization.Value")</td></tr>
<tr><td colspan="2">Configuration is performed using the parameter view (data structure).</td></tr>
<tr><td><TO>.PositionControl.
ControlDifferenceQuantization.Value</td><td colspan="2">Value of quantification
Configuration of a value for quantization to a direct value ("<TO>.PositionControl.
ControlDifferenceQuantization.Mode" = 2)
The quantization value is specified in the position unit of the axis.
Configuration is performed using the parameter view (data structure).</td></tr>
</table>

Configuring (S7-1500, S7-1500T) 4

4.1 Configuring the Speed-Control Axis technology object (S7-1500, S7-1500T)

4.1.1 Configuration - Basic Parameters (S7-1500, S7-1500T)

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

Name

Define the name of the speed axis in this field. The technology object is listed under this name in the project tree. You can use the variables of the speed axis in the user program under this name.

Axis type

If you want to use the axis in the CPU exclusively as a virtual leading axis for synchronization, for example, select the "Virtual axis" check box. The configuration of a drive and encoder connection is not relevant.

Units of measure

In the drop-down lists, select the desired units of measurement for the speed and the torque.

Simulation

If you want to move a real axis in the simulation mode, select the "Activate simulation" check box.

In simulation mode, speed, positioning and synchronous axes can be simulated in the CPU without connected drives and encoders. Simulation mode is possible as of Technology Version V3.0 even without a configured drive and encoder connection.

For simulation mode without hardware connected to the CPU, you can influence the startup time of the CPU via the "Configuration time for central and distributed I/Os" parameter. You can find the parameter in the CPU properties in the "Startup" area navigation.

See also

Axis in simulation (Page 43)

4.1.2 Hardware interface (S7-1500, S7-1500T)

4.1.2.1 Configuration - Drive (S7-1500, S7-1500T)

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 is performed via PROFIdrive telegrams.

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

Drive type: PROFIdrive

Data connection

In the drop-down list, select whether the data connection is to be made directly with the drive device or via an editable data block in the user program.

Drive/data block

In the "Drive" field, select an already configured PROFIdrive drive/slot. If you have selected a PROFIdrive drive, you can configure the PROFIdrive drive using the "Device configuration" button.

If no PROFIdrive drive is available for selection, switch to the device configuration, and add a PROFIdrive drive in the network view.

Note

Option "Show all modules"

If a PROFIdrive that has already been configured is not available for selection, use the option "Show all modules" to display all reachable modules.

When you select the option "Show all modules", only the address range for each of the displayed modules is checked. If the address range of the module is large enough for the selected PROFIdrive frame, you can select the module. For this reason, make sure that you select a PROFIdrive drive.

If you have selected "Data block" under the data connection, select a previously created data block which contains a tag structure of the data type "PD_TELx" ("x" stands for the telegram number to be used).

Drive type: Analog drive connection

Analog output

In the "Analog output" field, select the PLC tag of the analog output via which the drive is to be controlled.

In order to be able to select an output, you first need to add an analog output module in the device configuration and define the PLC tag name for the analog output.

Activating enable output

Select the "Activate enable output" check box if the drive supports an enable.

Select the PLC tag of the digital output for the drive enable in the corresponding field. 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 be added in the device configuration and the PLC tag name must be defined for the digital output.

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

Select the "Enable ready input" check box if the drive can signal its readiness.

Select the PLC tag of the digital input via which the drive is to signal its operational readiness to the technology object in the corresponding field. The power module is switched on and the analog speed setpoint input is enabled.

In order to be able to select a ready input, you first need to add a digital input module in the device configuration and define the PLC tag name for the digital input.

Note

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

The following boundary conditions apply to the activated ready input:

- The axis is only enabled ("MC_Power Status" = TRUE) when a signal is present at the ready input.
- If a signal is not present at the ready input on an enabled axis, the axis of the alarm response "Remove enable" is disabled.
- If the axis is disabled with the instruction "MC_Power" ("Enable" = FALSE), the axis is disabled even when a signal is present at the ready input.

See also

Configuration - Data exchange with the drive (Page 100)

Drive and encoder connection (Page 26)

4.1.2.2 Configuration - Data exchange with the drive (S7-1500, S7-1500T)

Configure the data exchange with the drive in the "Data exchange with the drive" configuration window.

The configuration differs according to the selected drive type:

Drive type: PROFIdrive

Drive telegram

The telegram to the drive that is set in the device configuration is preselected in the drop-down list.

Automatically apply drive values during configuration (offline)

Select the check box if you want to transfer the offline values of the drive "Reference speed", "Maximum speed" and "Reference torque" to the configuration of the technology object in the project.

Automatically apply drive values at runtime (online)

Select the check box if you want to transfer the effective values "Reference speed", "Maximum speed" and "Reference torque" online in the drive to the CPU during runtime. The drive parameters are transferred from the bus after the (re-)initialization of the technology object or the (re)start of the drive or the CPU.

Alternatively, you must synchronize the following parameters manually:

- **Reference speed**

  Configure the reference speed of the drive in accordance with the manufacturer's specifications in this field. The specification of the drive speed is a percentage of the reference speed in the range -200% to 200%.

- **Maximum speed**

  Configure the maximum speed of the drive in this field.

- **Reference torque**

  Configure the reference torque of the drive corresponding to its configuration in this field.

  The reference torque is needed for force/torque reduction, which is supported with telegram 10x.

Supplementary data

Select the "Torque data" check box if you want to configure the data connection of the torque data. If you have selected a drive with which the additional telegram 750 has been configured, the "Torque data" check box is preselected.

Data connection

In the drop-down list, define whether the data connection should be made via additional telegrams or data blocks:

- If you select the entry "Additional telegram" in the "Data connection" drop-down list, you can edit the "Additional telegram" drop-down list.
- If you select the "Data block" entry in the "Data connection" drop-down list, you can select the previously created data block which contains a tag structure of the "PD_TELx" data type ("x" stands for the additional telegram number that is used).

Data block / additional telegram

Select an additional telegram configured in the "Additional telegram" field.

Select the "Show all modules" check box if you want to display all submodules of the connected drive. You can also find self-defined additional telegrams with this function.

In the "Data block" field, select the data block which you want to use to integrate the torque data.

Note

Automatic transfer of drive parameters is only possible with SINAMICS drives as of V4.x. For this, "Drive" must be selected for the data connection in configuration window "Hardware interface > Drive".

Drive type: Analog drive connection

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 for the drive and transferred in the configuration of the technology object.

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

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

See also

Automatic transfer of drive and encoder parameters in the device (Page 34)

Drive and encoder connection (Page 26)

4.1.3 Extended Parameters (S7-1500, S7-1500T)

4.1.3.1 Configuration - Mechanics (S7-1500, S7-1500T)

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

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

See also

Mechanics (Page 47)

4.1.3.2 Configuration - Dynamic Defaults (S7-1500, S7-1500T)

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

The default values take 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 following equations show the relationship between the ramp-up time and acceleration and the ramp-down time and deceleration:

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

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

Note

A change in the 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 and deceleration ramp in the "Jerk" field. The value 0 means that jerk limiting is deactivated.
- Set the desired smoothing time for the acceleration ramp in the "Smoothing time" field.

Note

The jerk value is identical for the acceleration and deceleration ramp. The smoothing time in effect for the deceleration ramp results from the following relationships:

- **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 and deceleration ramp are equal.

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:

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

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

Motion jobs started in the user program are performed with the selected jerk.

See also

Velocity profile (Page 54)

4.1.3.3 Configuration - Emergency stop (S7-1500, S7-1500T)

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 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:

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

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

See also

Emergency stop deceleration (Page 56)

4.1.3.4 Limits (S7-1500, S7-1500T)

Configuration - Dynamic limits (S7-1500, S7-1500T)

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 following equations show the relationship between the ramp-up time and acceleration and the ramp-down time and deceleration:

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

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

Note

Change of maximum speed

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 desired smoothing time for the acceleration ramp in the "Smoothing time" field.

Note

Various acceleration and deceleration values

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 and deceleration ramp are equal.

If an error occurs, the axis decelerates with the configured emergency stop deceleration (Page 56) (alarm reaction "Stop with maximum dynamic values"). A configured jerk limit is not taken into account for this.

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

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

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

Motion jobs started in the user program are performed with the selected jerk.

Configuration - Torque limits (S7-1500, S7-1500T)

Configure the torque limiting of the drive in the "Torque limits" configuration window.

The configuration is only available if a drive that supports force/torque limiting is selected and a telegram 10x is used.

Effective

In the drop-down list, select whether the limit value is to be in effect "on load side" or "on motor side".

Torque limiting

Enter a default value for the torque limit in the specified unit of measure in this field.

The default value is in effect when the torque limiting is specified using Motion Control instruction "MC_TorqueLimiting", input parameter "Limit" < 0.

If the efficiency of the gear is crucial, you can set it in the "<TO>.Actor.Efficiency" tag.

See also

Force/torque limiting (Page 59)

4.2 Configuring the Positioning Axis technology object (S7-1500, S7-1500T)

4.2.1 Configuration - Basic Parameters (S7-1500, S7-1500T)

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

Name

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

Axis type

If you want to use the axis in the CPU exclusively as a virtual leading axis for synchronization, for example, select the "Virtual axis" check box. The configuration of a drive and encoder connection is not relevant.

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

Units of measure

In the drop-down list, select the desired units of measure for the position, velocity, torque and force of the axis.

If you wish to use six decimal places in the selected unit, select the check box "Use position values with higher resolution".

Modulo

Select the "Enable modulo" check box if you want to use a recurring system of units for the axis (e.g. 0° to 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).

Simulation

If you want to move a real axis in the simulation mode, select the "Activate simulation" check box.

In simulation mode, speed, positioning and synchronous axes can be simulated in the CPU without connected drives and encoders. Simulation mode is possible as of Technology Version V3.0 even without a configured drive and encoder connection.

For simulation mode without hardware connected to the CPU, you can influence the startup time of the CPU via the "Configuration time for central and distributed I/Os" parameter. You can find the parameter in the CPU properties in the "Startup" area navigation.

See also

Axis in simulation (Page 43)

Modulo setting (Page 23)

Mechanics (Page 47)

4.2.2 Hardware interface (S7-1500, S7-1500T)

4.2.2.1 Configuration - Drive (S7-1500, S7-1500T)

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 is performed via PROFIdrive telegrams.

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

Drive type: PROFIdrive

Data connection

In the drop-down list, select whether the data connection is to be made directly with the drive device or via an editable data block in the user program.

Drive/data block

In the "Drive" field, select an already configured PROFIdrive drive/slot. When you have selected a PROFIdrive drive, you can configure the PROFIdrive drive using the "Device configuration" and "Drive configuration" buttons.

If no PROFIdrive drive is available for selection, switch to the device configuration, and add a PROFIdrive drive in the network view. Switch to drive configuration to configure the drive.

Note

Option "Show all modules"

If a PROFIdrive that has already been configured is not available for selection, use the option "Show all modules" to display all reachable modules.

When you select the option "Show all modules", only the address range for each of the displayed modules is checked. If the address range of the module is large enough for the selected PROFIdrive frame, you can select the module. For this reason, make sure that you select a PROFIdrive drive.

If you have selected "Data block" under the data connection, select a previously created data block which contains a tag structure of the data type "PD_TELx" ("x" stands for the telegram number to be used).

Drive type: Analog drive connection

Analog output

In the "Analog output" field, select the PLC tag of the analog output via which the drive is to be controlled.

In order to be able to select an output, you first need to add an analog output module in the device configuration and define the PLC tag name for the analog output.

Activating enable output

Select the "Activate enable output" check box if the drive supports an enable.

Select the PLC tag of the digital output for the drive enable in the corresponding field. 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 be added in the device configuration and the PLC tag name must be defined for the digital output.

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

Select the "Enable ready input" check box if the drive can signal its readiness.

Select the PLC tag of the digital input via which the drive is to signal its operational readiness to the technology object in the corresponding field. The power module is switched on and the analog speed setpoint input is enabled.

In order to be able to select a ready input, you first need to add a digital input module in the device configuration and define the PLC tag name for the digital input.

Note

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

The following boundary conditions apply to the activated ready input:

- The axis is only enabled ("MC_Power Status" = TRUE) when a signal is present at the ready input.
- If a signal is not present at the ready input on an enabled axis, the axis is disabled with an error.
- If the axis is disabled with the instruction "MC_Power" ("Enable" = FALSE), the axis is disabled even when a signal is present at the ready input.

See also

Data connection drive/encoder via data block (Page 44)

4.2.2.2 Configuration - Encoder (S7-1500, S7-1500T)

For closed loop position control, positioning 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 telegram.

As well as the S7-1500, the S7-1500T also offers the possibility to configure up to four encoders and switch between the encoders. You control the switch in the user program with the Motion Control instruction "MC_SetSensor".

Encoder on startup (S7-1500T)

In the drop-down list, select the encoder that is to be active after startup of the CPU (STARTUP). The encoder must be configured and marked as "used".

This encoder is used after startup of the CPU and after a restart of the technology object. At an operating mode transition from STOP → RUN of the CPU (without restart of the technology object), the encoder that was also active before the STOP is still being used.

Use encoder (S7-1500T)

Select the "Use encoder" check box if you want to use this encoder alternatively for closed loop position control.

Data connection

In the drop-down list, select whether the data connection should be established directly with the encoder or via a data block that can be edited in the user program.

The selection is only possible for encoders that are connected via PROFIdrive and support parameter P979.

Encoder/data block

Select a previously configured encoder in this configuration field.

The following encoders can be selected:

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

  The encoder is configured via the configuration of the PROFIdrive drive. The drive evaluates the encoder signals and sends them to the controller in the PROFIdrive telegram.

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

  Select a previously configured technology module and the channel to be used. Only technology modules set to the "Position input 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 access the configuration of the technology module using the "Device configuration" button.

  You can operate the technology module centrally on an S7-1500 CPU or decentrally on a distributed I/O. Isochronous mode is not possible with central operation in the CPU.

  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)**

  In the "PROFIdrive encoder" field, select a configured encoder on PROFINET/PROFIBUS. When you have selected an encoder, you can configure the encoder 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.

  Note

  Option "Show all modules"

  If a PROFIdrive that has already been configured is not available for selection, use the option "Show all modules" to display all reachable modules.

  When you select the option "Show all modules", only the address range for each of the displayed modules is checked. If the address range of the module is large enough for the selected PROFIdrive frame, you can select the module. For this reason, make sure that you select a PROFIdrive encoder.

If you have selected "Data block" under the data connection, select in the "Data block" field a previously created data block which contains a tag structure of the data type "PD_TELx" ("x" stands for the telegram number to be used).

Encoder type

Select the encoder type of the encoder in the drop-down list. The following encoder types are available:

- Incremental (Page 32)
- Absolute (Page 32) (measuring range > traversing range)
- Cyclic absolute (Page 32) (measuring range < traversing range)

Recommended settings for absolute actual values: The "Cyclic absolute" encoder type is recommended. With this setting, the position of the zero crossing of the encoder is automatically taken into consideration by the technology object.

Note

Measuring range of the absolute encoder

Observe the boundary conditions with absolute values.

You can find more information in the section "Absolute actual value (Page 32)" of the "S7-1500/S7-1500T Axis functions" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766462).

See also

Data connection drive/encoder via data block (Page 44)

Using multiple encoders (Page 36)

"Drive and encoder connection" section in the "S7-1500/S7-1500T Axis functions" function manual (https://support.industry.siemens.com/cs/ww/en/view/109766462)

4.2.2.3 Configuration - Data exchange with the drive (S7-1500, S7-1500T)

Configure the data exchange with the drive in the "Data exchange with the drive" configuration window.

The configuration differs according to the selected drive type.

Drive type: PROFIdrive

Drive telegram

The telegram to the drive that is set in the device configuration is preselected in the drop-down list.

Automatically apply drive values during configuration (offline)

Select the check box if you want to transfer the offline values of the drive "Reference speed", "Maximum speed" and "Reference torque" to the configuration of the technology object in the project.

Automatically apply drive values at runtime (online)

Select the check box if you want to transfer the effective values "Reference speed", "Maximum speed" and "Reference torque" online in the drive to the CPU during runtime. The drive parameters are transferred from the bus after the (re-)initialization of the technology object or the (re)start of the drive or the CPU.

Alternatively, you must synchronize the following parameters manually:

- **Reference speed**

  Configure the reference speed of the drive in accordance with the manufacturer's specifications in this field. The specification of the drive speed is a percentage of the reference speed in the range -200% to 200%.

- **Maximum speed**

  Configure the maximum speed of the drive in this field.

- **Reference torque**

  Configure the reference torque of the drive corresponding to its configuration in this field.

  The reference torque is needed for force/torque reduction, which is supported with telegram 10x.

Supplementary data

Select the "Torque data" check box if you want to configure the data connection of the torque data. If you have selected a drive with which the supplemental telegram 750 has been configured, the "Torque data" check box is preselected.

Data connection

In the drop-down list, define whether the data connection should be made via supplemental telegrams or data blocks:

- If you select the entry "Supplemental telegram" in the "Data connection" drop-down list, you can edit the "Supplemental telegram" drop-down list.
- If you select the "Data block" entry in the "Data connection" drop-down list, you can select the previously created data block which contains a tag structure of the "PD_TELx" data type ("x" stands for the additional telegram number that is used).

Data block / supplemental telegram

Select an supplemental telegram configured in the "Supplemental telegram" field.

Select the "Show all modules" check box if you want to display all submodules of the connected drive. You can also find self-defined supplemental telegrams with this function.

In the "Data block" field, select the data block which you want to use to integrate the torque data.

Note

Automatic transfer of drive parameters is only possible with SINAMICS drives as of V4.x. To do this, set the "Drive" data connection in the configuration window "Hardware interface > Drive".

Drive type: Analog drive connection

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 for the drive and transferred in the configuration of the technology object.

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

Analog outputs can be overridden by approximately 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

Specify the maximum speed of the drive in this field.

See also

Automatic transfer of drive and encoder parameters in the device (Page 34)

4.2.2.4 Configuration - Data exchange with encoder (S7-1500, S7-1500T)

Configure detailed encoder parameters and the data exchange of the encoder in the "Data exchange with encoder" configuration window.

If you are using an S7-1500T CPU, you need to define the settings for each of the maximum four configured encoders.

The display and selection of the configuration parameters described here is dependent on the following parameters:

- Configuration window "Basic parameters": Drive type (linear/rotary)
- Configuration window "Hardware interface > Encoder": Encoder type (incremental/absolute/cyclic absolute)
- Configuration window - "Extended parameters > Mechanics": Encoder mounting type

Settings for (S7-1500T)

In the drop-down list, select the encoder for which you wish to edit the following configurations.

Encoder telegram

The telegram to the encoder that is set in the device configuration is preselected in the drop-down list.

Automatically apply encoder values during configuration (offline)

Select the check box if you want to transfer the offline values of the encoder to the configuration of the technology object in the project.

Automatically apply encoder values during runtime (online)

Select the check box if you want to transfer the effective values online in the encoder to the CPU during runtime. The encoder parameters are transferred from the bus after the (re-)initialization of the technology object and (re)start of the encoder or the CPU.

Note

Automatic transfer of encoder parameters is only possible with PROFIdrive encoders as of product version A16. For this, "Hardware interface > Encoder" must be selected as the "Encoder" data connection in the configuration window.

Alternatively, you must manually calibrate the following parameters, depending on encoder type.

Measuring system

In the drop-down list, select the measuring procedure. The options are "Linear" and "Rotary".

Additional parameters

Depending on the selected measuring system and the encoder type selected under "Technology object > Configurations > Hardware interface > Encoders", configure the parameters described below:

- Measuring system: Rotary; encoder type: Incremental

Parameter	Description
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

- Measuring system: Rotary; encoder type: Absolute

Parameter	Description
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

- Measuring system: Rotary; encoder type: Cyclic absolute

Parameter	Description
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

- Measuring system: Linear; encoder type: Incremental

Parameter	Description
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

- Measuring system: Linear; encoder type: Absolute

Parameter	Description
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

- Measuring system: Linear; encoder type: Cyclic absolute

Parameter	Description
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

See also

Automatic transfer of drive and encoder parameters in the device (Page 34)

Configuration - Mechanics (Page 121)

Configuration - Encoder (Page 112)

Configuration - Data exchange (Page 150)

4.2.3 Configuration - Leading value settings (S7-1500, S7-1500T)

In the "Leading value settings" configuration window, select the parameters of the leading value for cross-PLC synchronous operation.

Provision of leading value

In this area, define the settings for transferring the leading value to other CPUs:

Field	Description
Provide cross-PLC leading value	Select this check box to make the setpoint or actual value available as leading value for a cross-PLC synchronous operation.
Transfer area	In this drop-down list, select the output tag of the transfer area set up between the CPU of the leading axis and the CPUs of the following axes. You can find more information about the transfer range in the section "Setting up communication via Controller-Controller direct data exchange" of the documentation "S7-1500/S7-1500T Synchronous operation functions" (https://support.industry.siemens.com/cs/ww/en/view/109766464).

Delay time of the local leading value

In this area, configure the settings for local synchronous operation:

Field	Description
Allow system calculation	Select this check box to adapt the delay time of the local leading value in the system. System calculation is started when you trigger the calculation in the interconnection overview.
Delay time	If the "Allow system calculation" check box is cleared, this field can be edited. Enter the delay time in this field. The entered delay time determines the output delay of the leading value for the local following axes. (<TO>.CrossPlcSynchronousOperation.LocalLeadingValueDelayTime)
Interconnection overview	You open the interconnection overview via this link. With a cross-PLC synchronous operation, the interconnection overview contains an overview of the interconnected leading and following axes and their CPU assignment.

4.2.4 Extended Parameters (S7-1500, S7-1500T)

4.2.4.1 Configuration - Mechanics (S7-1500, S7-1500T)

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

Settings for (S7-1500T)

In the drop-down list, select the encoder for which the following configurations are to apply.

Encoder mounting type

In the drop-down list, select how the encoder is mounted to the mechanics.

The configuration differs depending on the axis type and the encoder mounting type selected in the "Basic parameters" configuration window.

Axis type: Linear

- Linear - On motor shaft (Page 122)
- Linear - On load side (Page 122)
- Linear - External Measuring System (Page 123)

Axis type: Rotary

- Rotary - On motor shaft (Page 123)
- Rotary - On load side (Page 124)
- Rotary - External Measuring System (Page 124)

Invert encoder direction

Select this check box if you must invert the direction of rotation of the encoder.

See also

Using multiple encoders (Page 36)

Axis type: Linear (S7-1500, S7-1500T)

Linear - On motor shaft (S7-1500, S7-1500T)

The encoder is connected to the motor shaft in a mechanically fixed manner. Motor and encoder form a unit.

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

Position parameters

In the "Leadscrew pitch" configuration field, configure the distance by which the load is moved when the leadscrew makes one revolution.

Linear - On load side (S7-1500, S7-1500T)

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

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

Position parameters

In the "Leadscrew pitch" configuration field, configure the distance by which the load is moved when the leadscrew makes one revolution.

Linear - External Measuring System (S7-1500, S7-1500T)

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

Distance per encoder revolution

In this configuration field, configure the linear load travel per encoder revolution.

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

Position parameters

In the "Leadscrew pitch" configuration field, configure the distance by which the load is moved when the leadscrew makes one revolution.

Axis type: Rotary (S7-1500, S7-1500T)

Rotary - On motor shaft (S7-1500, S7-1500T)

The encoder is connected to the motor shaft in a mechanically fixed manner. Motor and encoder form a unit.

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

Rotary - On load side (S7-1500, S7-1500T)

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

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

Rotary - External Measuring System (S7-1500, S7-1500T)

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

Distance per encoder revolution

In this configuration field, configure the linear load travel per encoder revolution.

Drive mechanism

Select the "Invert drive direction" check box if the direction of rotation of the drive is to be inverted.

Load gear

The gear ratio of the load gear is specified as the ratio between motor revolutions and load revolutions.

In this "Number of motor revolutions" configuration field, configure the integer number of motor revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

4.2.4.2 Configuration - Dynamic Defaults (S7-1500, S7-1500T)

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

The default values take 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 also act 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

Configure 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 following equations show the relationship between the ramp-up time and acceleration and the ramp-down time and deceleration:

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

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

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 and deceleration ramp in the "Jerk" field. The value 0 means that jerk limiting is deactivated.
- Set the desired smoothing time for the acceleration ramp in the "Smoothing time" field.

Note

The jerk value is identical for the acceleration and deceleration ramp. The smoothing time in effect for the deceleration ramp results from the following relationships:

- **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 and deceleration ramp are equal.

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:

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

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

Motion jobs started in the user program are performed with the selected jerk.

See also

Velocity profile (Page 54)

4.2.4.3 Configuration - Emergency stop (S7-1500, S7-1500T)

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 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 deceleration also changes (the emergency stop ramp-down time remains unchanged).

See also

Emergency stop deceleration (Page 56)

4.2.4.4 Limits (S7-1500, S7-1500T)

Configuration - Position limits (S7-1500, S7-1500T)

Configure the hardware and software limit switches of the axis in the "Position limits" 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.

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

Exception:

1. If a hardware limit switch is overtraveled during an active home position approach with activated direction reversal at the hardware limit switch, the axis stops with the configured maximum deceleration and continues the home position approach in the opposite direction.
2. If the hardware limit switches were deactivated using the Motion Control instruction "MC_WriteParameter (Page 249)".

Note

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

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

Input of negative/positive HW limit switch

In these fields, select the PLC tag of the digital input for the negative and positive hardware limit switch.

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 one position control cycle clock 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.

Level selection of negative/positive HW limit switch

Select the triggering signal level ("low level"/"high level") of the hardware limit switch in the drop-down list. With "Low level", the input signal is "FALSE" after the axis has reached or passed the hardware limit switch. With "High level", the input signal is "TRUE" after the axis has reached or passed the hardware limit switch.

Enable SW limit switches

This check box activates the high and low software limit switches. When software switches are activated, an active motion comes to a stop at the position of the software limit switch. The technological object signals an error. After acknowledgment of the error, the axis can again be moved in the direction of its operating range.

Note

Activated software limit switches act only on a homed axis.

Position of negative/positive SW limit switch

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

See also

Traversing range limitation (Page 49)

Configuration - Dynamic limits (S7-1500, S7-1500T)

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 following equations show the relationship between the ramp-up time and acceleration and the ramp-down time and deceleration:

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

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

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

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 and deceleration ramp are equal.

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:

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

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

Motion jobs started in the user program are performed with the selected jerk.

See also

Velocity profile (Page 54)

Configuration - Torque limits (S7-1500, S7-1500T)

Configure the force/torque limiting of the drive in the "Torque limiting" configuration window.

The configuration is only available if a drive that supports force/torque limiting is selected and a telegram 10x is used. Telegram 101 cannot be used.

Effective

In the drop-down list, select whether the limit value is to be in effect "on load side" or "on motor side".

Torque limits

Enter a default value for the torque limiting in the specified unit of measurement in this field.

The default value is in effect when the torque limiting is specified using Motion Control instruction "MC_TorqueLimiting", input parameter "Limit" < 0.

Torque limiting applies to the following axis configurations:

- Axis type is "Rotary" and limit value is in effect "On load side" or "On motor side"
- Axis type is "Linear" and limit value is in effect "On motor side"

Force limit

Enter a default value for the force limit in the specified unit of measure in this field.

The default value is in effect when the force limit is specified using Motion Control instruction "MC_TorqueLimiting", input parameter "Limit" < 0.

The force limit applies to the following axis configuration: Axis type is "Linear" and limit value is in effect "On load side"

If the efficiency of the gear and leadscrew is crucial, you can set them in the "<TO>.Actor.Efficiency" tag.

Position-related monitoring

As a result of the force/torque limiting on the drive, a larger following error may occur or the axis standstill may not be detected reliably in positioning monitoring.

To deactivate the monitoring of the following error and the positioning monitoring during force/torque limiting, select the "Deactivate position-related monitoring" option. If you want to activate the position-related monitoring, select the option "Leave position-related monitoring enabled".

Interconnection in the SINAMICS drive

The following interconnection is required in the SINAMICS drive:

- P1522 to a fixed value of +100%
- P1523 to a fixed value of -100% (e.g. through interconnection to fixed value parameter P2902[i]).

See also

Force/torque limiting (Page 59)

Configuration - Fixed stop detection (S7-1500, S7-1500T)

Configure the fixed stop detection in the configuration window.

A "Travel to fixed stop" can be realized by activating fixed stop detection using the Motion Control instruction "MC_TorqueLimiting" and a position-controlled motion job. The operation is also referred to as clamping.

Positioning tolerance

In this configuration field, configure the positioning tolerance that is regarded as a breaking away or turning back of the fixed stop when exceeded. To detect the breaking away or turning back of the fixed stop, the position setpoint must be located outside the positioning tolerance. The configured position tolerance must be less than the configured following error.

Following error

If the drive is stopped by a mechanical fixed stop during a motion job, the following error is increased. The accumulating following error serves as a criterion for fixed stop detection. In the "Following error" configuration field, configure the value of the following error starting from which the fixed stop detection is to take effect. The configured following error must be greater than the configured position tolerance.

Note

If the following error monitoring was activated in the position monitoring configuration, the "Maximum following error" configured there must be greater than the "Following error" of the fixed stop detection.

See also

Fixed stop detection (Page 61)

4.2.4.5 Homing (S7-1500, S7-1500T)

Homing means matching the position value of a technology object to the real, physical location of the drive. Absolute target positions of the axis can only be approached with a homed axis.

Operating modes of the Motion Control instruction "MC_Home"

In S7-1500 Motion Control, the axis is homed with the Motion Control instruction "MC_Home". The following operating modes are used in the process:

- **Active homing (incremental encoder)**

  With active homing, 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 (incremental encoder)**

  With passive homing, the Motion Control instruction "MC_Home" instruction does not carry out any homing motion. The traversing motion required for this must be implemented by the user with 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 (incremental encoder or absolute encoder)**

  The axis position is set without taking into consideration the home position switch. Active traversing motions are not aborted. The value of input parameter "Position" of Motion Control instruction "MC_Home" is set immediately as the actual position of the axis.

- **Direct homing relative (incremental encoder or absolute encoder)**

  The axis position is set without taking into consideration the home position 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".

See also

MC_Home: Home technology object, set home position V5 (Page 200)

Homing (Page 66)

Active homing (S7-1500, S7-1500T)

Configuration - Active homing (S7-1500, S7-1500T)

In the "Active Homing" configuration window, configure the parameters for active homing. "Active homing" is executed using the Motion Control instruction "MC_Home" with "Mode" = 3 and 5.

Note

Parameter "MC_Home.Mode" (S7-1500 CPU)

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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

Settings for (S7-1500T)

In the drop-down list, select the encoder to which the homing settings are to apply.

Select the homing mode

Select from among the following homing modes:

- Use zero mark via PROFIdrive telegram (Page 135)
- Use reference output cam and zero mark via PROFIdrive telegram (Page 136)
- Use homing mark via digital input (Page 137)

See also

Homing (Page 66)

Using multiple encoders (Page 36)

Homing mode "Use zero mark via PROFIdrive telegram" (S7-1500, S7-1500T)

Enable direction reversal at the hardware limit switch

Select this check box to use the hardware limit switch as a reversing output 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 this field, specify the velocity which is used to traverse to the home position offset.

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.

See also

Homing (Page 66)

Homing mode "Use reference output cam and zero mark via PROFIdrive telegram" (S7-1500, S7-1500T)

Enable direction reversal at the hardware limit switch

Select this check box to use the hardware limit switch as a reversing output 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 reference output cam is then searched for 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 the reference output cam search.

"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 reference output cam is searched for during the homing procedure. Any configured home position offset is traversed at 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 reference output cam 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.

See also

Homing (Page 66)

Homing mode "Use homing mark via digital input" (S7-1500, S7-1500T)

When a digital input is used as a homing mark, the accuracy of the homing process is not as high as for hardware-supported homing using zero marks. You can improve the accuracy by using a low homing velocity.

Pay attention to the setting of short filter times for the digital input as well.

Digital input homing mark/output cam

In this configuration field, select the PLC tag of the digital input that is to act as a homing mark (reference output cam). Also select the level at which the homing mark is to be detected.

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 output 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 homing mark 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 the homing mark search.

"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 for homing is to be approached.

Homing mark

Select the switch position of the "digital input" that is to be used as the homing mark.

When a "digital input" is crossed, two switching edges that are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated at 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 axis searches for the "digital input" during the home position approach. Any configured home position offset is traversed at the same velocity.

Homing velocity

In this field, specify the velocity at which the axis approaches the home position for homing.

Home position offset

If the homing mark position is different from the 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.

See also

Homing (Page 66)

Passive homing (S7-1500, S7-1500T)

Configuration - Passive homing (S7-1500, S7-1500T)

Configure the parameters for passive homing in the "Passive Homing" (homing on the fly) configuration window. The "Passive homing" homing function is executed using the Motion Control instruction "MC_Home" with "Mode" = 2, 8 and 10.

Note

Parameter "MC_Home.Mode" (S7-1500 CPU)

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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

Settings for

In the drop-down list, select the encoder for which the homing settings are to apply (only for S7-1500T).

Select the homing mode

Select from among the following homing modes:

- Use zero mark via PROFIdrive telegram (Page 140)
- Use reference output cam and zero mark via PROFIdrive telegram (Page 140)
- Use homing mark via digital input (Page 141)

See also

Using multiple encoders (Page 36)

Homing mode "Use zero mark via PROFIdrive telegram" (S7-1500, S7-1500T)

Homing direction

Select the direction in which the next zero mark should be approached for homing. The following options are available:

- **Positive**

  The axis moves in the direction of higher position values.
- **Negative**

  The 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Homing (Page 66)

Homing mode "Use reference output cam and zero mark via PROFIdrive telegram" (S7-1500, S7-1500T)

Homing direction

Select the direction in which the zero mark should be approached for homing. The next zero mark after leaving the reference output cam is used.

The following options are available:

- **Positive**

  The axis moves in the direction of higher position values.
- **Negative**

  The 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Homing (Page 66)

Homing mode "Use homing mark via digital input" (S7-1500, S7-1500T)

Digital input homing mark/output cam

In this dialog field, select a digital input that is to act as a homing mark (reference output cam). Also select the level at which the homing mark is to be detected.

Homing direction

Select the direction in which the homing mark for homing is to be approached.

The following options are available:

- **Positive**

  The axis moves in the direction of higher position values.

- **Negative**

  The 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 the homing mark.

When a "digital input" is crossed, two switching edges that are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated at 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Homing (Page 66)

4.2.4.6 Position monitoring functions (S7-1500, S7-1500T)

Configuration - Positioning monitoring (S7-1500, S7-1500T)

In the "Positioning monitoring" configuration window, configure the criteria for monitoring the target position.

Positioning window

Configure the size of the positioning window in this field. If the axis is located within this window, the position is considered to be "reached".

Tolerance time

In this field, configure the tolerance time within which the position value must reach the positioning window.

Minimum dwell time in positioning window

Configure the minimum dwell time in this field. The current position value must be located in the positioning window for at least the "minimum dwell time". At the end of the hold time, the corresponding positioning job reports "Done" = TRUE.

Recommended setting: To avoid longer pauses, set values between 0 ms and 20 ms for dynamic positioning tasks.

If one of the criteria is violated, then the axis is stopped and the technology alarm 541 "Position monitoring error" is displayed (alarm response: Remove enable).

See also

Position monitoring functions (Page 89)

Configuration - Following error (S7-1500, S7-1500T)

In the "Following Error" configuration window, configure the permissible deviation of the actual position of the axis from the position setpoint. The following error can be dynamically adapted to the current velocity of the axis.

Enable following error monitoring

Select this check box, if you want to enable following error monitoring. When following error monitoring is enabled, the axis is stopped in the error range (orange). The technology alarm 521 "Following error" is displayed (alarm response: remove enable).

When following error monitoring is disabled, the configured limits have no effect.

Maximum following error

Configure the following error that is permissible at maximum velocity in this field.

Warning level

In this field, configure a percentage of the current following error limit above which a 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, the technology alarm 522 "Warning following error tolerance" is output. This is a warning and contains no alarm response.

Following error

In this field, configure the permissible following error for low velocities (without dynamic adjustment of the following error).

Start of dynamic adjustment

Configure the velocity starting from which the following error is to be dynamically adjusted in this field. Starting from this velocity, the following error up to the maximum velocity will be adjusted to the maximum following error.

See also

Following error monitoring (Page 90)

Configuration - Standstill signal (S7-1500, S7-1500T)

In the "Standstill signal" configuration window, configure the criteria for standstill detection.

Standstill window

Configure the size of the standstill window in this field. For standstill to be indicated, the velocity of the axis must be within this window.

Minimum dwell time in standstill window

Configure the minimum dwell time in the standstill window in this field. The velocity of the axis must be in the standstill window for at least the specified duration.

If both criteria are met, the standstill of the axis is indicated.

See also

Standstill signal (Page 91)

4.2.4.7 Configuration - Control loop (S7-1500, S7-1500T)

In the "Control loop" configuration window, configure the precontrol and 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.

Drive optimized

When the drive is optimized, the status bit lights up green. Otherwise, the status bit is gray.

Optimizing values on the drive

Use the green arrow to navigate to "Automatic controller optimization" in the optimization mask of the drive. The optimization mask of the drive is opened in online or offline mode, depending on the mode you are in. You can perform the optimization on the drive and optionally go online with the drive. You get back to the previous mask using the "Window Switcher".

Applying values from the drive

When you click the "Apply values from drive" button, a dialog box opens with the columns "Current value", "New value" and "Value on drive". Depending on the status of the drive, the online or offline values for "Speed control loop substitute time" and "Gain (Kv factor)" are displayed there.

The "New value" column can be edited. 50% of the value calculated on the drive is determined as a new value for the default setting for the gain. The new value of the gain should correspond to a maximum of 30-50% of the value on the drive. You apply the set values by clicking on "Yes".

Precontrol

Configure the percentage velocity precontrol in this field.

Speed control loop substitute time

Configure the speed control loop substitute time in this field (T_{vtc}).

When speed precontrol is activated, the setpoint is delayed by the speed control loop substitute time before the control deviation is established. This prevents an overshoot or a leading of the actual value compared with the position setpoint. The speed control loop substitute time is a simplified substitute model of the dynamic behavior of the speed control loop. The speed control loop substitute time is included in the balancing filter.

Gain (Kv factor)

In the input field, enter the gain Kv of the position control loop.

Dynamic Servo Control (DSC)

For position-controlled axes (positioning axes/synchronous axes), the closed loop position control can occur either in the CPU or in the drive, provided the drive supports Dynamic Servo Control (DSC). Select your preferred control process:

- **Position control in the drive (DSC enabled)**
  With the Dynamic Servo Control (DSC) function, the position controller is executed in the drive in the cycle clock of the speed control loop. The setting of a significantly greater position controller gain factor Kv is thus enabled. This increases the dynamics for setpoint sequence and disturbance variable correction for highly dynamic drives.
- **Position control in the PLC**

Note

Dynamic Servo Control (DSC) is only possible with one of the following PROFIdrive telegrams:

- Standard telegram 5 or 6
- SIEMENS telegram 105 or 106

See also

Closed-loop control (Page 93)

Control structure (Page 94)

Function and structure of the optimization (Page 169)

4.2.4.8 Configuration - Actual value extrapolation (S7-1500T)

Configure the properties of the extrapolation for an actual value coupling for synchronous operation in the "Actual value extrapolation" configuration window. The values set here only apply when the actual values of this axis are used as leading value.

Position filter T1 and T2

Enter the time constants of the PT2 filter for smoothing the position.

Velocity filter T1 and T2 and tolerance band width

Enter the time constants of the PT2 filter for the smoothing of the actual velocity and the tolerance band width of the smoothed actual velocity.

For optimized application of the tolerance band, enter the same bandwidth for the tolerance band as the width of the noise signal.

Hysteresis value

Enter a value for application of the hysteresis function to the extrapolated actual value of the position. The specification is made in the configured length unit.

Leading axis dependent extrapolation time (read-only)

The leading axis-dependent time is calculated from the sum of the actual value acquisition time at the leading axis, (T_i), the time of the interpolator (T_{Ipo}) and the sum of position filters T1 and T2:

Leading axis dependent extrapolation time = $T_i + T_{Ipo} + T1 + T2$

Following axis dependent extrapolation time

Specify the following axis-related proportion for the extrapolation of the leading value. The value (unchanged or offset against user-specific runtimes) from the tag "<TO>.StatusPositioning.SetpointExecutionTime" of the following axis is used as the basis.

Time from cross-PLC synchronous operation (read-only)

The time from the cross-PLC synchronous operation corresponds to the value of the deceleration time set at the axis or encoder in "Configuration > Leading value settings".

Apply leading value velocity from differentiation

When you select this check box, the leading value velocity is taken from the differentiation of the extrapolated leading value position.

When you clear this check box, the filtered actual velocity is applied.

Include leading axis condition time

When you select this check box, the leading axis dependent extrapolation time is included in the calculation of the effective extrapolation time.

When you clear this check box, the leading axis dependent extrapolation time is not included in the calculation of the effective extrapolation time.

Effective extrapolation time (read-only)

The effective extrapolation time is the sum of the leading axis-dependent time, the following axis-dependent time and the delay time of cross-PLC synchronous operation.

4.3 Configuring the technology object external encoder (S7-1500, S7-1500T)

4.3.1 Configuration - Basic Parameters (S7-1500, S7-1500T)

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

Name

Define the name of the external encoder in this field. The technology object is listed under this name in the project tree. The tags of the external encoder can be used in the user program under this name.

External encoder type

In this selection, configure whether the external encoder records linear or rotary motions.

Units of measure

In the drop-down list, select the desired units of measure for the position and velocity of the external encoder.

If you wish to use six decimal places in the selected unit, select the check box "Use position values with higher resolution".

Modulo

Select the check box "Enable modulo", if you want to use a recurring measuring system 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).

See also

Modulo setting (Page 23)

External encoder technology object (Page 20)

4.3.2 Hardware interface (S7-1500, S7-1500T)

4.3.2.1 Configuration - Encoder (S7-1500, S7-1500T)

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 telegram. Configure the encoder and encoder type in the "Encoder" configuration window.

Data connection

In the drop-down list, select whether the data connection should be established directly with the encoder or via a data block that can be edited in the user program.

The selection is only possible for encoders that are connected via PROFIdrive and support parameter P979.

Encoder/data block

Select the encoder you have configured in the device configuration in this area.

The following encoders can be used:

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

  In the "Encoder" configuration field, select a previously configured technology module and the channel to be used. Only technology modules set to the "Position input for Motion Control" mode are displayed for selection.

  You can operate the technology module centrally on an S7-1500 CPU or decentrally on a distributed I/O. Isochronous mode is not possible with central operation in the CPU.

  You can identify the technology modules suitable for position detection for Motion Control in the documentation for the technology module and the catalog data.

- **Encoder via PROFINET/PROFIBUS (PROFIdrive)**

  In the " Encoder" configuration field, select a configured encoder on the PROFINET/PROFIBUS.

  Note

  Option "Show all modules"

  If a PROFIdrive that has already been configured is not available for selection, use the option "Show all modules" to display all reachable modules.

  When you select the option "Show all modules", only the address range for each of the displayed modules is checked. If the address range of the module is large enough for the selected PROFIdrive frame, you can select the module. For this reason, make sure that you select a PROFIdrive encoder.

If you have selected "Data block" under the data connection, select a previously created data block which contains a tag structure of the data type "PD_TELx" ("x" stands for the telegram number to be used).

Encoder type

Select the encoder type in this configuration field. The following encoder types are available for selection:

- Incremental (Page 32)
- Absolute (Page 32) (measuring range > traversing range)
- Cyclic absolute (Page 32) (measuring range < traversing range)

Recommended settings for absolute actual values: The "Cyclic absolute" encoder type is recommended. With this setting, the position of the zero crossing of the encoder is automatically taken into consideration by the technology object.

Note

Measuring range of the absolute encoder

Observe the boundary conditions with absolute values.

You can find more information in the section "Absolute actual value (Page 32)" of the "S7-1500/S7-1500T Axis functions" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766462).

See also

Data connection drive/encoder via data block (Page 44)

"Drive and encoder connection" section in the "S7-1500/S7-1500T Axis functions" function manual (https://support.industry.siemens.com/cs/ww/en/view/109766462)

4.3.2.2 Configuration - Data exchange (S7-1500, S7-1500T)

Configure detailed encoder parameters and the data exchange with the encoder in the "Data exchange with encoder" configuration window. The configuration varies according to the encoder connection:

- Encoder to technology module (Page 150)
- Encoder to PROFINET/PROFIBUS (Page 153)

Encoder to technology module (S7-1500, S7-1500T)

Data exchange with encoder

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

Encoder telegram

In the drop-down list for the technology module, select the telegram that you have configured in the technology module.

Automatically apply encoder values during configuration (offline)

Select the check box if you want to transfer the offline values of the encoder to the configuration of the technology object in the project.

Note

Automatic transfer of encoder parameters is only possible with PROFIdrive encoders as of product version A16. For this, "Hardware interface > Encoder" must be selected as the "Encoder" data connection in the configuration window.

Automatically apply encoder values during runtime (online)

Select the check box if you want to transfer the effective values online in the encoder to the CPU during runtime. The encoder parameters are transferred from the bus after the (re-)initialization of the technology object and (re)start of the encoder or the CPU.

Note

Automatic transfer of encoder parameters is only possible with PROFIdrive encoders as of product version A16. For this, "Hardware interface > Encoder" must be selected as the "Encoder" data connection in the configuration window.

Encoder type

Depending on the selected encoder type, configure the following parameters: The specifications must match those in the device configuration.

Encoder type	Rotary incremental
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

Encoder type	Rotary absolute
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Rotary cyclic absolute
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Linear incremental
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

Encoder type	Linear absolute
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Linear cyclic absolute
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

See also

Configuration - Data exchange (Page 150)

Encoder to PROFINET/PROFIBUS (Page 153)

Encoder to PROFINET/PROFIBUS (S7-1500, S7-1500T)

Data exchange with encoder

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

Encoder telegram

The telegram to the encoder that is set in the device configuration is preselected in the drop-down list.

Automatically apply encoder values during configuration (offline)

Select the check box if you want to transfer the offline values of the encoder to the configuration of the technology object in the project.

Note

Automatic transfer of encoder parameters is only possible with PROFIdrive encoders as of product version A16. For this, "Hardware interface > Encoder" must be selected as the "Encoder" data connection in the configuration window.

Automatically apply encoder values during runtime (online)

Select the check box if you want to transfer the effective values online in the encoder to the CPU during runtime. The encoder parameters are transferred from the bus after the (re-)initialization of the technology object and (re)start of the encoder or the CPU.

Note

Automatic transfer of encoder parameters is only possible with PROFIdrive encoders as of product version A16. For this, "Hardware interface > Encoder" must be selected as the "Encoder" data connection in the configuration window.

Encoder type

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

Encoder type	Rotary incremental
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

Encoder type	Rotary absolute
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Rotary cyclic absolute
Increments per revolution	Configure the number of increments that the encoder resolves per revolution in this field.
Number of revolutions	Configure the number of revolutions that the absolute encoder can detect in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Linear incremental
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.

Encoder type	Linear absolute
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

Encoder type	Linear cyclic absolute
Distance between two increments	Configure the distance between two increments of the encoder in this field.
Bits for fine resolution in the incremental actual value (Gx_XIST1)	Configure the number of bits for fine resolution within the incremental actual value (Gx_XIST1) in this field.
Bits for fine resolution in the absolute actual value (Gx_XIST2)	Configure the number of bits for fine resolution within the absolute actual value (Gx_XIST2) in this field.

See also

Configuration - Data exchange (Page 150)

Encoder to technology module (Page 150)

4.3.3 Configuration - Leading value settings (S7-1500, S7-1500T)

In the "Leading value settings" configuration window, select the parameters of the leading value for cross-PLC synchronous operation.

Provision of leading value

In this area, define the settings for transferring the leading value to other CPUs:

Field	Description
Provide cross-PLC leading value	Select this check box to make the actual value available as leading value for a cross-PLC synchronous operation.
Transfer area	In this drop-down list, select the output tag of the transfer area set up between the CPU of the leading axis and the CPUs of the following axes. You can find more information about the transfer range in the section "Setting up communication via Controller-Controller direct data exchange" of the documentation "S7-1500/S7-1500T Synchronous operation functions" (https://support.industry.siemens.com/cs/ww/en/view/109766464).

Delay time of the local leading value

In this area, configure the settings for local synchronous operation:

Field	Description
Allow system calculation	Select this check box to adapt the delay time of the local leading value in the system. System calculation is started when you trigger the calculation in the interconnection overview.
Delay time	If the "Allow system calculation" check box is cleared, this field can be edited. Enter the delay time in this field. The entered delay time determines the output delay of the leading value for the local following axes. (<TO>.CrossPlcSynchronousOperation.LocalLeadingValueDelayTime)
Interconnection overview	You open the interconnection overview via this link. With a cross-PLC synchronous operation, the interconnection overview contains an overview of the interconnected leading and following axes and their CPU assignment.

4.3.4 Extended Parameters (S7-1500, S7-1500T)

4.3.4.1 Configuration - Mechanics (S7-1500, S7-1500T)

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 157)
- Rotary (Page 157)

See also

External encoder technology object (Page 20)

Mechanics (Page 47)

Linear (S7-1500, S7-1500T)

Encoder

If you would like to invert the actual value of the encoder, select the check box "Invert encoder direction".

Load gear

The gear ratio of the measuring gearbox is specified as the ratio between encoder revolutions and load revolutions.

In the "Number of encoder revolutions" configuration field, configure the integer number of encoder revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

If no load gear is present, select the same values for the number of encoder revolutions and load revolutions.

Position parameters

In the "Leadscrew pitch" configuration field, configure the distance by which the load is moved when the leadscrew makes one revolution.

See also

Configuration - Mechanics (Page 156)

Rotary (Page 157)

Mechanics (Page 47)

Rotary (S7-1500, S7-1500T)

Encoder

If you would like to invert the actual value of the encoder, select the check box "Invert encoder direction".

Load gear

The gear ratio of the measuring gearbox is specified as the ratio between encoder revolutions and load revolutions.

In the "Number of encoder revolutions" configuration field, configure the integer number of encoder revolutions.

In this "Number of load revolutions" configuration field, configure the integer number of load revolutions.

If no load gear is present, select the same values for the number of encoder revolutions and load revolutions.

See also

Configuration - Mechanics (Page 156)

Linear (Page 157)

Mechanics (Page 47)

4.3.4.2 Homing (S7-1500, S7-1500T)

Configuration - Homing (S7-1500, S7-1500T)

Configure the parameters for homing the external encoder in the "Homing" configuration window. Homing is executed using the Motion Control instruction "MC_Home" with "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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

Select the homing mode

Select from among the following homing modes:

- Reference output cam and zero mark via PROFIdrive telegram (Page 159)
- Use zero mark via PROFIdrive telegram (Page 160)
- Homing mark via digital input (Page 160)

Reference output cam and zero mark via PROFIdrive telegram (S7-1500, S7-1500T)

Homing direction

Select the direction in which the zero mark should be approached for homing. The next zero mark after leaving the reference output cam 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Configuration - Homing (Page 158)

Use zero mark via PROFIdrive telegram (Page 160)

Homing mark via digital input (Page 160)

Use zero mark via PROFIdrive telegram (S7-1500, S7-1500T)

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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Configuration - Homing (Page 158)

Reference output cam and zero mark via PROFIdrive telegram (Page 159)

Homing mark via digital input (Page 160)

Homing mark via digital input (S7-1500, S7-1500T)

Digital input homing mark

In this configuration field, select a digital input that is to act as a homing mark (reference output cam). Also select the level at which the homing mark is to be detected.

Homing direction

Select the direction in which the homing mark for homing is to be approached.

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 the homing mark.

When a "digital input" is crossed, two switching edges that are spatially separated from one another are generated. The selection of the positive or negative side ensures that the homing mark is always evaluated at 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Configuration - Homing (Page 158)

Use zero mark via PROFIdrive telegram (Page 160)

Reference output cam and zero mark via PROFIdrive telegram (Page 159)

4.3.4.3 Configuration - Actual value extrapolation (S7-1500T)

Configure the properties of the extrapolation for an actual value coupling for synchronous operation in the "Actual value extrapolation" configuration window. The values set here only apply when the actual values of this axis are used as leading value.

Position filter T1 and T2

Enter the time constants of the PT2 filter for smoothing the position.

Velocity filter T1 and T2 and tolerance band width

Enter the time constants of the PT2 filter for the smoothing of the actual velocity and the tolerance band width of the smoothed actual velocity.

For optimized application of the tolerance band, enter the same bandwidth for the tolerance band as the width of the noise signal.

Hysteresis value

Enter a value for application of the hysteresis function to the extrapolated actual value of the position. The specification is made in the configured length unit.

Leading axis dependent extrapolation time (read-only)

The leading axis-dependent time is calculated from the sum of the actual value acquisition time at the leading axis, (T_i), the time of the interpolator (T_{Ipo}) and the sum of position filters T1 and T2:

Leading axis dependent extrapolation time = $T_i + T_{Ipo} + T1 + T2$

Following axis dependent extrapolation time

Specify the following axis-related proportion for the extrapolation of the leading value. The value (unchanged or offset against user-specific runtimes) from the tag "<TO>.StatusPositioning.SetpointExecutionTime" of the following axis is used as the basis.

Time from cross-PLC synchronous operation (read-only)

The time from the cross-PLC synchronous operation corresponds to the value of the deceleration time set at the axis or encoder in "Configuration > Leading value settings".

Apply leading value velocity from differentiation

When you select this check box, the leading value velocity is taken from the differentiation of the extrapolated leading value position.

When you clear this check box, the filtered actual velocity is applied.

Include leading axis condition time

When you select this check box, the leading axis dependent extrapolation time is included in the calculation of the effective extrapolation time.

When you clear this check box, the leading axis dependent extrapolation time is not included in the calculation of the effective extrapolation time.

Effective extrapolation time (read-only)

The effective extrapolation time is the sum of the leading axis-dependent time, the following axis-dependent time and the delay time of cross-PLC synchronous operation.

Commissioning (S7-1500, S7-1500T) 5

5.1 Axis control panel (S7-1500, S7-1500T)

5.1.1 Function and structure of the axis control panel (S7-1500, S7-1500T)

You traverse individual axes with the axis control panel. A user program is not necessary for the operation of the axis control panel. With the axis control panel, you assume master control for a technology object and control the motions 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 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:

- 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 tree under "Technology object > Commissioning".

The axis control panel is divided into the following areas:

- Master control
- Axis
- Operating mode
- Modify
- Axis status
- Actual values

Elements of the axis control panel

The following table lists the elements of the axis control panel:

Area	Element	Description
Master control		In the "Master control" area, you assume master control of the technology object or return it to your user program.
	"Activate" button	With the "Activate" button, you set up an online connection to the CPU and take over master control for the selected technology object. • 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. • If the axis control panel is covered by a dialog, such as "Save as", during its operation with the axis control panel, the axis is stopped with maximum deceleration and the master control is returned to the user program. If the "Stop" button is covered during operation with the axis control panel, for example by scrolling or by another window, the master control is retained but the axis is stopped with maximum deceleration. If you change to another window within the TIA Portal, to the project tree for example, during operation with the axis control panel, the master control and motion of the axis is maintained, provided that the axis control panel is embedded in the TIA Portal. If the axis control panel is replaced by the TIA Portal and you change to another window within the TIA Portal, to the project tree for example, the master control is retained but the axis is stopped with maximum deceleration. If you change to another window outside the TIA Portal during operation with the axis control panel, the master control is retained but the axis is stopped with maximum deceleration. • When you click the "Activate" button, a warning message is displayed. In the warning, you can adapt the sign-of-life monitoring (100 to 60000 ms). 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 message "Error during commissioning" is entered in the message display log. Sign-of-life failure between controller and TIA Portal" is displayed. To eliminate this error, adapt the sign-of-life monitoring in the warning. • 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 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 take effect until leading control has been returned.

Area	Element	Description
		Therefore, make any necessary changes before master control is assumed again. • If master control has been taken over for the technology object, the axis control panel is blocked for access by another instance 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, you can 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.
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 configured value in the "Technology object > Configuration > Extended parameters > Limits > Dynamics limits". (Velocity/speed setpoint, "Jog" and "Positioning" modes only)
	Acceleration	Acceleration with which the axis is traversed. Default: 10% of the configured value in the "Technology object > Configuration > Extended parameters > Limits > Dynamics limits".
	Deceleration	Deceleration with which the axis is traversed. Default: 10% of the configured value in the "Technology object > Configuration > Extended parameters > Limits > Dynamics limits".
	Jerk	Jerk with which the axis is traversed. Default: 100% of the configured value in "Technology objects > Configuration > Extended parameters > Limits > Dynamic limits".
	"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. If the "Stop" button is covered during operation with the axis control panel, for example by scrolling or by another window, the master control is retained but the axis is stopped with maximum deceleration.

Area	Element	Description
Axis status		The "Axis status" area displays the status of the axis and the status of the drive.
	Drive ready	Drive is ready to execute setpoints.
	Error	An error occurred at the technology object.
	Enabled	The technology object has been enabled. The axis can be moved with motion jobs.
	Homed	The technology object is homed.
	More	The "More" link takes you to the window "Technology object > Diagnostics > Status and error bits".
	Active errors	The error that occurred most recently is displayed in the "Active errors" text field.
	"Confirm" button	With the "Confirm" button, you acknowledge pending errors.
	Alarm display	You can access the alarm display in the Inspector window by clicking on the "Alarm display" link.
Actual 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

Parameter values that you use in the axis control panel are discarded when the axis control panel is closed.

To use the parameter values in the user program, transfer the values to the configuration.

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 66) 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".

Operating mode	Description
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.

5.1.2 Using the axis control panel (S7-1500, S7-1500T)

You traverse individual axes with the axis control panel. You assume master control of a technology object and control the motions of the axis.

Requirement

- The project has been created and downloaded to the CPU.
- The CPU must be in the RUN mode.
- 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 instance 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. To assume master control of the technology object and to set up an online connection to the CPU, click "Activate" in the "Master control" area.

   A warning message is displayed.
2. If necessary, adapt the sign-of-life monitoring and click "OK".
3. To enable the technology object, click the "Enable" button in the "Axis" area.
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. Depending on the mode selected, click the "Start", "Forward" or "Backward" button to start the job.
7. Click the "Stop" button to stop the job.
8. Repeat steps 4 through 6 for additional jobs.
9. To disable the technology object, click the "Disable" button in the "Axis" area.
10. To return master control to your user program, click the "Deactivate" button in the "Master control" area.

5.2 Optimization (S7-1500, S7-1500T)

5.2.1 Function and structure of the optimization (S7-1500, S7-1500T)

The "Optimization" function supports you in determining the optimal precontrol and gain (Kv factor) for the closed loop position control of the axis. The axis velocity profile is recorded by means of the Trace function for this purpose for the duration of a configurable positioning movement. You can then evaluate the recording, and adjust the precontrol and gain accordingly.

WARNING
Uncontrolled axis motions During operation with the optimization, the axis can execute uncontrolled motions (for example, due to erroneous configuration of the drive or the technology object). In addition, when a leading axis is moved, any synchronized following axis is also moved. Therefore, perform the following protective measures before operation with the optimization: • 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 "Optimization" function for the positioning axis and synchronous axis technology objects can be found in the project tree under "Technology object > Commissioning".

The "Tuning" dialog is divided into the following areas:

- Master control
- Axis
- Measurement configuration
- Optimize position controller
- Run measurement
- 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	With the "Activate" button, you set up an online connection to the CPU and take over master control for the selected technology object. • 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 "Activate" button, a warning message is displayed. You can adapt the sign-of-life monitoring here (100 to 60000 ms). 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 message "Error during commissioning. Sign-of-life failure between controller and TIA Portal" is displayed in the message display log. To eliminate this error, adapt the sign-of-life monitoring in the warning. • 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 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 take effect 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, you can 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
Measurement configuration		In the "Measurement configuration" area, you configure the settings for a test step.
	Distance	Travel distance for a test step
	Measurement duration	Time for a test step
	"Customize dynamics" check box	The "Dynamics adapt" check box allows you to adapt the acceleration, deceleration and maximum velocity. As long as the "Commissioning" working area is open, the previously set values are displayed when the check box is selected again.
	Acceleration	Presetting of the acceleration for a test step
	Deceleration	Default setting for delaying a test step
	Maximum velocity	Presetting of the maximum velocity for a test step
Optimize position controller		In the "Optimize position controller" area, you make the settings for optimization of the controller characteristics. You open a list of values using the symbol next to a field. The list of values contains the following values of the respective parameter: • Online actual value • Online start value • Project start value Enter the new value in the text field for the actual value. The new value is applied by clicking the "Forward" or "Backward" button in the "Run measurement" area.
	Precontrol	Current percentage velocity precontrol of the position controller
	Speed control loop substitute time	Current speed control loop substitute time With velocity precontrol, a simplified speed control loop model can be generated using the speed control loop substitute time. This prevents the velocity variable being overridden by the position controller during the acceleration and deceleration phases. To accomplish this, the position setpoint of the position controller is delayed by the amount of the speed control loop substitute time in relation to the velocity precontrol.
	Gain	Current gain of the position controller (Kv)
Run measurement		In the "Run measurement" area, you perform the test steps.
	"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.
	"Stop" button	You stop a test step with the "Stop" button. The axis decelerates with the configured maximum deceleration. If another window is superimposed on the "Stop" button, the axis stops.
Trace		The Trace function is displayed in the lower area of the "Tuning" dialog. With each test step, a Trace recording of the required parameters is automatically started and displayed after completion of the test step. After master control has been returned, the Trace recording is deleted. You can find a full description of the trace function in the section on using the "trace and logic analyzer function".

Note

No automatic transfer of the parameters to the technology object

The configured parameter values are discarded after master control is returned.

Transfer the values as needed into your configuration. You can apply the values for the gain, precontrol and speed control loop substitute time in your configuration using the "Project start value" value.

See also

Closed-loop control (Page 93)

5.2.2 Optimize position controller (S7-1500, S7-1500T)

Requirements

- The CPU must be in the 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. If necessary, configure values for the distance, duration, and dynamics of a test step in the "Measurement configuration" area.
5. If necessary, configure values for the precontrol and speed control loop substitute time of a test step in the "Configure position controller" area.
6. Enter a start value for the gain. Start with a low value.

7. 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 can 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.

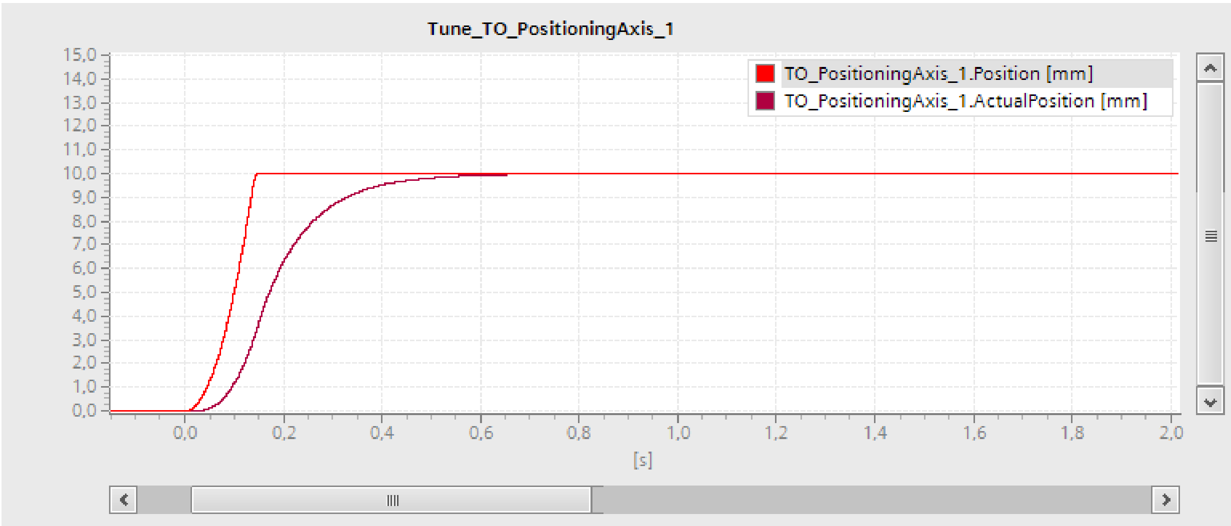
   ---

8. 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.

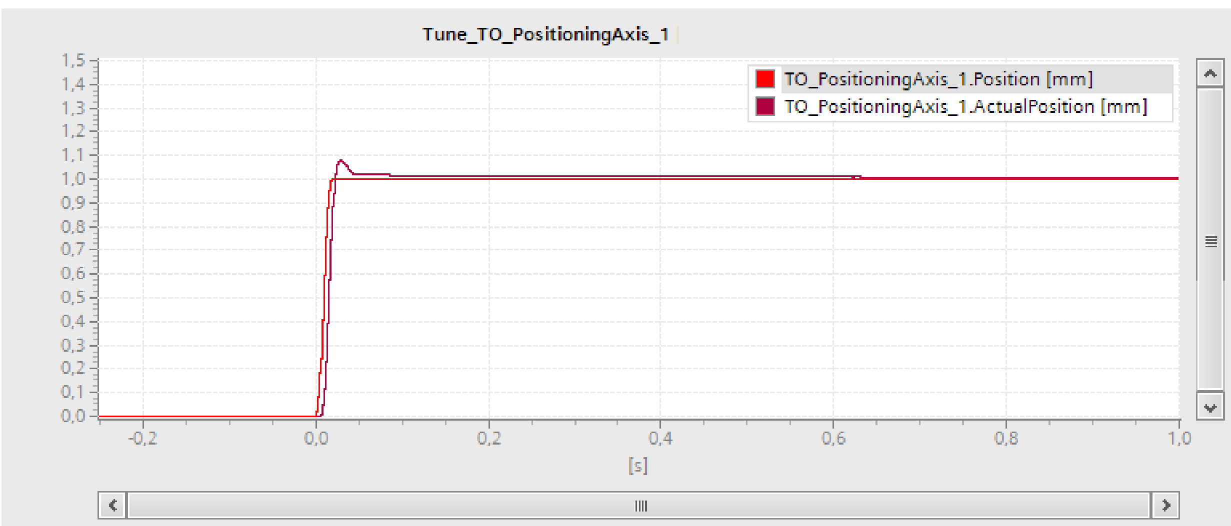
When adjusting the gain, pay attention to the following properties of the curve:

- 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).

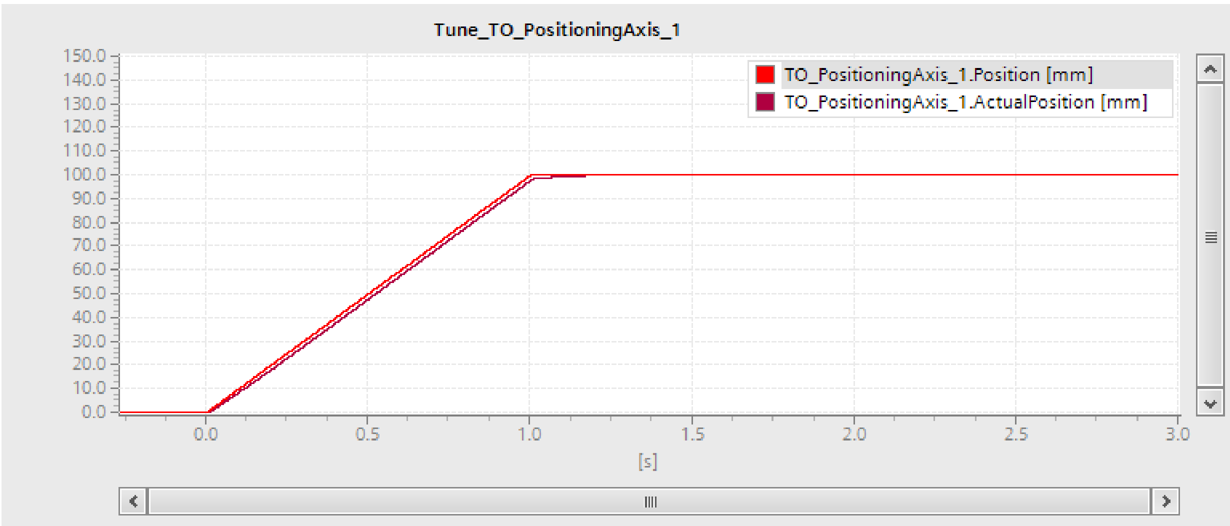
The following trace recording shows a curve with a long settling time:



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 parameter values of the position controller to the project

To transfer the determined parameter values of the position controller to your project, follow these steps:

1. Click the icon next to the field of the respective parameter.

   A list of values is displayed.
2. Enter the measured value in the "Project start value" field 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.

Diagnostics (S7-1500, S7-1500T) 6

The "Diagnostics" section is limited to the description of the diagnostic view of the Speed axis, Positioning axis and External encoder technology objects in the TIA Portal.

You will find a description of Motion Control diagnostics in the following sections of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459):

- Diagnostics concept
- Technology alarms
- Errors in Motion Control instructions

A comprehensive description of the system diagnostics of the S7-1500 CPU can be found in the "Diagnostics" function manual (https://support.automation.siemens.com/WW/view/en/59192926).

6.1 Speed-controlled axis technology object (S7-1500, S7-1500T)

6.1.1 Status and error bits (S7-1500, S7-1500T)

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
Simulation active	The axis is simulated in the CPU. Setpoints are not output to the drive.
Enabled	The technology object has been enabled. The axis can be moved with motion jobs. (<TO>.StatusWord.X0 (Enable))
Error	An error 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 active. 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	Drive is ready to execute setpoints. (<TO>.StatusDrive.InOperation)
Restart required	Data relevant for the restart has been changed. The changes are applied only after a restart of the technology object. (<TO>.StatusWord.X3 (OnlineStartValuesChanged))

Motion status

The following table shows the possible axis motion status values:

Status	Description
Done (no job running)	No motion job is running for the technology object. (<TO>.StatusWord.X6 (Done))
Jog	The axis is being moved with a job for jog mode of Motion Control instruction "MC_MoveJog" or from the axis control panel. (<TO>.StatusWord.X9 (JogCommand))
Speed setpoint	The axis is traversed with a job with speed setpoint of the Motion Control instruction "MC_MoveVelocity" or using the axis control panel. (<TO>.StatusWord.X10 (VelocityCommand))
Constant speed	The axis is moved with constant speed or is stationary. (<TO>.StatusWord.X12 (ConstantVelocity))
Accelerating	Axis is being accelerated. (<TO>.StatusWord.X13 (Accelerating))
Decelerating	The axis is being decelerated. (<TO>.StatusWord.X14 (Decelerating))
Torque limiting enabled	At least the threshold value (default 90%) of the preset force/torque limitation acts on the axis. (<TO>.StatusWord.X27 (InLimitation))
Active stop job	The axis is stopped and disabled by Motion Control instruction "MC_Stop". (<TO>.StatusWord2.X0 (StopCommand))

Warnings

The following table shows the possible warnings:

Warning	Description
Configuration	One or several configuration parameters are adapted internally at a given time. (<TO>.WarningWord.X1 (ConfigWarning))
Job rejected	A job cannot be executed. A Motion Control instruction cannot be executed because necessary requirements have not been met. (<TO>.WarningWord.X3 (CommandNotAccepted))
Dynamic limitation	The dynamic values are limited to the dynamic limits. (<TO>.WarningWord.X6 (DynamicWarning))

Error

The following table shows the possible errors:

Error	Description
System	A system-internal error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	A configuration error has occurred. 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 (ConfigFault))
User program	An error occurred in the user program with a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Drive	An error occurred in the drive. (<TO>.ErrorWord.X4 (DriveFault))
Data exchange	Communication with a connected device is faulty. (<TO>.ErrorWord.X7 (CommunicationFault))
I/O	An error occurred accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))
Job rejected	A job cannot be executed. A Motion Control instruction cannot be executed because necessary requirements have not been met (e.g. technology object not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
Dynamic limitation	The dynamic values are limited to the dynamic limits. (<TO>.ErrorWord.X6 (DynamicError))

Alarm display

For additional information and to acknowledge the error, go to the Inspector window by clicking on the "Alarm display" link.

Additional information

An option for evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

See also

"StatusWord" tag (speed axis) (Page 285)

"ErrorWord" tag (speed axis) (Page 288)

"WarningWord" tag (speed axis) (Page 290)

6.1.2 Motion status (S7-1500, S7-1500T)

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.

"Setpoints" 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)

"Current values" area

The following table shows the meaning of the status data:

Status	Description
Actual speed	Actual speed of the axis (<TO>.ActualSpeed)

"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)
Jerk	Configured maximum jerk (<TO>.DynamicLimits.MaxJerk)

6.1.3 PROFIdrive telegram (S7-1500, S7-1500T)

The "Technology object > Diagnostics > PROFIdrive telegram" diagnostics function is used in the TIA Portal to monitor the PROFIdrive telegram 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 telegram from the drive to the controller:

- Status words "ZSW1" and "ZSW2"
- The speed setpoint (NSET) that was output to the drive
- The actual speed that was signaled from the drive (NACT)

6.2 Positioning axis technology object (S7-1500, S7-1500T)

6.2.1 Status and error bits (S7-1500, S7-1500T)

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
Simulation active	The axis is simulated in the CPU. Setpoints are not output to the drive. (<TO>.StatusWord.X25 (AxisSimulation))
Enabled	The technology object has been enabled. You can move the axis with motion jobs. (<TO>.StatusWord.X0 (Enable))
Position-controlled mode	The axis is in position-controlled mode. (Inversion of <TO>.StatusWord.X28 (NonPositionControlled))
Homed	The technology object is homed. The relationship between the position in the technology object and the mechanical position was successfully created. (<TO>.StatusWord.X5 (HomingDone))
Error	An error 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 active. The axis control panel has master control over the technology object. You cannot control the axis from the user program. (<TO>.StatusWord.X4 (ControlPanelActive))
Drive ready	Drive is ready to execute setpoints. (<TO>.StatusDrive.InOperation)
Encoder values valid	The actual encoder values are valid. (<TO>.StatusSensor[1].State)
Actual encoder values valid (S7-1500T)	The actual encoder values of encoder 1, encoder 2, encoder 3 or encoder 4 are valid. (<TO>.StatusSensor[1..4].State)
Active encoder	Encoder is operational. (<TO>.OperativeSensor)

Status	Description
Active encoder (S7-1500T)	The encoder in effect operationally is encoder 1, encoder 2, encoder 3 or encoder 4. (<TO>.OperativeSensor)
Restart required	Data relevant for the restart has been changed. The changes are applied only after a 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:

Status	Description
Negative SW limit switch approached.	The negative software limit switch was reached. (<TO>.StatusWord.X15 (SWLimitMinActive))
Positive SW limit switch approached.	The positive software limit switch was reached. (<TO>.StatusWord.X16 (SWLimitMaxActive))
Negative HW limit switch approached.	The negative hardware limit switch has been approached or overtraveled. (<TO>.StatusWord.X17 (HWLimitMinActive))
Positive HW limit switch approached.	The positive hardware limit switch has been approached or overtraveled. (<TO>.StatusWord.X18 (HWLimitMaxActive))

Motion status

The following table shows the possible axis motion status values:

Status	Description
Done (no job running)	No job active at technology object. (<TO>.StatusWord.X6 (Done))
Homing job	The technology object executes a homing job of the Motion Control instruction "MC_Home" or from the axis control panel. (<TO>.StatusWord.X11 (HomingCommand))
Jog	The axis is being moved with a job for jog mode of Motion Control instruction "MC_MoveJog". (<TO>.StatusWord.X9 (JogCommand))
Velocity specification	The axis is traversed with a job with velocity specification of the Motion Control instruction "MC_MoveVelocity" or from the axis control panel. (<TO>.StatusWord.X10 (VelocityCommand))
Positioning job	The axis is traversed with a positioning job of Motion Control instruction "MC_MoveAbsolute" or "MC_MoveRelative" or from the axis control panel. (<TO>.StatusWord.X8 (PositioningCommand))
Constant velocity	The axis is moved with constant velocity or is stationary. (<TO>.StatusWord.X12 (ConstantVelocity))
Standstill	The axis is in standstill. (<TO>.StatusWord.X7 (StandStill))

Status	Description
Accelerating	Axis is being accelerated. (<TO>.StatusWord.X13 (Accelerating))
Decelerating	The axis is being decelerated. (<TO>.StatusWord.X14 (Decelerating))
Torque limiting enabled	At least the threshold value (default 90%) of the preset force/torque limitation acts on the axis. (<TO>.StatusWord.X27 (InLimitation))
Active stop job	The axis is stopped and disabled by Motion Control instruction "MC_Stop". (<TO>.StatusWord2.X0 (StopCommand))

Warnings

The following table shows the possible warnings:

Warning	Description
Configuration	One or more configuration parameters are being internally adapted temporarily. (<TO>.WarningWord.X1 (ConfigWarning))
Job rejected	Job cannot be executed. You cannot execute a Motion Control instruction because necessary requirements are not fulfilled. (<TO>.WarningWord.X3 (CommandNotAccepted))
Dynamic limitation	The dynamic values are limited to the dynamic limits. (<TO>.WarningWord.X6 (DynamicWarning))

Error

The following table shows the possible errors:

Error	Description
System	A system-internal error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	A configuration error has occurred. 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 (ConfigFault))
User program	An error occurred in the user program with a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Drive	An error occurred in the drive. (<TO>.ErrorWord.X4 (DriveFault))
Encoder	An error occurred in the encoder system. (<TO>.ErrorWord.X5 (SensorFault))

Error	Description
Encoder (S7-1500T)	An error has occurred in the encoder system of encoder 1, encoder 2, encoder 3 or encoder 4. (<TO>.ErrorWord.X5 (SensorFault))
Data exchange	Communication with a connected device is faulty. (<TO>.ErrorWord.X7 (CommunicationFault))
I/O	An error occurred accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))
Job rejected	A job cannot be executed. You cannot execute a Motion Control instruction because necessary requirements are not fulfilled (for example, technology object not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
Homing	An error occurred during a homing process. (<TO>.ErrorWord.X10 (HomingFault))
Positioning	The positioning axis was not positioned correctly at the end of a positioning motion. (<TO>.ErrorWord.X12 (PositioningFault))
Dynamic limitation	The dynamic values are limited to the dynamic limits. (<TO>.ErrorWord.X6 (DynamicError))
Following error	The maximum permitted following error has been exceeded. (<TO>.ErrorWord.X11 (FollowingErrorFault))
SW limit switch	A software limit switch has been reached. (<TO>.ErrorWord.X8 (SwLimit))
HW limit switch	A hardware limit switch has been reached or overtraveled. (<TO>.ErrorWord.X9 (HWLimit))
Adaptation	An error occurred during data adaption. (<TO>.ErrorWord.X15 (AdaptionError))

Alarm display

For additional information and to acknowledge the error, go to the Inspector window by clicking on the "Alarm display" link.

Additional information

An option for evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

See also

"StatusWord" tag (positioning axis) (Page 321)

"ErrorWord" tag (positioning axis) (Page 325)

"WarningWord" tag (positioning axis) (Page 327)

6.2.2 Motion status (S7-1500, S7-1500T)

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.

"Setpoints" 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 during execution of a positioning job. (<TO>.StatusPositioning.TargetPosition)
Position setpoint	Setpoint position of the axis (<TO>.Position)
Velocity setpoint	Velocity setpoint of the axis (<TO>.Velocity)
Velocity override	Percentage correction of the velocity specification The velocity setpoint specified in Motion Control instructions or set by the axis control panel is superimposed with an override signal and corrected as a percentage. Valid velocity correction values range from 0.0 % to 200.0 %. (<TO>.Override.Velocity)

"Current values" area

The following table shows the meaning of the status data:

Status	Description
Operative encoder	Operative encoder of the axis
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)
Following error	Following error of the axis (<TO>.StatusPositioning.FollowingError)

"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)
Jerk	Configured maximum jerk (<TO>.DynamicLimits.MaxJerk)

6.2.3 PROFIdrive telegram (S7-1500, S7-1500T)

The "Technology object > Diagnostics > PROFIdrive telegram" diagnostics function is used in the TIA Portal to monitor the PROFIdrive telegrams 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 telegram from the drive to the controller:

- Status words "ZSW1" and "ZSW2"
- The speed setpoint (NSET) that was output to the drive
- The actual speed that was signaled from the drive (NACT)

"Encoder" area

in the areas "Encoder" for CPU S7-1500 or "Encoder 1" to "Encoder 4" for CPU S7-1500T, the following parameters from the PROFIdrive telegram are displayed by the encoder to the controller.

- Status word "Gx_ZSW"
- The actual position value "Gx_XIST1" (cyclic actual encoder value)
- The actual position value "Gx_XIST2" (absolute encoder value)

6.3 Technology object external encoder (S7-1500, S7-1500T)

6.3.1 Status and error bits (S7-1500, S7-1500T)

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
Encoder enabled	The technology object has been enabled. (<TO>.StatusWord.X0 (Enable))
Homed	The technology object is homed. The relationship between the position in the technology object and the mechanical position was successfully created. (<TO>.StatusWord.X5 (HomingDone))
Error	An error 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 actual encoder values are valid. (<TO>.StatusSensor[n].State)
Restart required	Data relevant for the restart has been changed. The changes are applied only after a restart of the technology object. (<TO>.StatusWord.X3 (OnlineStartValuesChanged))

Motion status

The following table shows the possible states of the job execution:

Status	Description
Done (no job running)	No Motion Control job is running for the technology object. (Enable by "MC_Power" job excepted) (<TO>.StatusWord.X6 (Done))
Homing job	The technology object executes a homing job of the Motion Control instruction "MC_Home". (<TO>.StatusWord.X11 (HomingCommand))

Error

The following table shows the possible errors:

Error	Description
System	A system-internal error has occurred. (<TO>.ErrorWord.X0 (SystemFault))
Configuration	A configuration error has occurred. 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 (ConfigFault))
User program	An error occurred in the user program with a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Encoder	An error occurred in the encoder system. (<TO>.ErrorWord.X5 (SensorFault))
Data exchange	Missing or faulty communication. (<TO>.ErrorWord.X7 (CommunicationFault))
Adaptation	An error occurred during data adaption. (<TO>.ErrorWord.X15 (AdaptionError))

Alarm display

For additional information and to acknowledge the error, go to the Inspector window by clicking on the "Alarm display" link.

Additional information

An option for evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

See also

"StatusWord" tag (external encoder) (Page 340)

"ErrorWord" tag (external encoder) (Page 342)

"WarningWord" tag (external encoder) (Page 344)

6.3.2 Motion status (S7-1500, S7-1500T)

You use the "Technology object > Diagnostics > Motion status" diagnostic function in the TIA Portal to monitor the actual 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)

6.3.3 PROFIdrive telegram (S7-1500, S7-1500T)

The "Technology object > Diagnostics > PROFIdrive telegram" diagnostic function is used in the TIA Portal to monitor the PROFIdrive telegram of the encoder. The display of the diagnostics function is available in technology object online mode.

"Encoder" area

This area displays the following parameters contained in the PROFIdrive telegram 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 (S7-1500, S7-1500T)

7

7.1 MC_Power V5 (S7-1500, S7-1500T)

7.1.1 MC_Power: Enable, disable technology object V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_Power", a technology object is enabled or disabled and, if necessary, a configured drive is switched on or off.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis
- External encoder

Requirement

- The technology object has been configured correctly.
- Cyclic BUS communication is established between controller and encoder ("<TO>.StatusSensor[1..4].CommunicationOK" = TRUE).
- Cyclic BUS communication is established between controller and drive ("<TO>.StatusDrive.CommunicationOK" = TRUE).
- The status of the active encoder is valid ("<TO>.StatusSensor[1..4].State" = 2).
- The optional data adaption (Page 34) has been completed ("<TO>.StatusDrive.AdaptionState" = 2 and "<TO>.StatusSensor[1..4].AdaptionState" = 2).

Override response

- An "MC_Power" job cannot be aborted by any other Motion Control job.
- An "MC_Power" job with 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 on the corresponding technology object in accordance with the selected "StopMode". This process cannot be canceled by the user.

Parameters

The following table shows the parameters of Motion Control instruction "MC_Power":

<table>
<tr><th>Parameters</th><th>Declara-tion</th><th>Data type</th><th>Default value</th><th colspan="2">Description</th></tr>
<tr><td>Axis</td><td>INPUT</td><td>TO_SpeedAxis
TO_PositioningAxis
TO_SynchronousAxis
TO_ExternalEncoder</td><td>-</td><td colspan="2">Technology object</td></tr>
<tr><td rowspan="2">Enable</td><td rowspan="2">INPUT</td><td rowspan="2">BOOL</td><td rowspan="2">FALSE</td><td>TRUE</td><td>The technology object is enabled.</td></tr>
<tr><td>FALSE</td><td>The technology object is disabled.
All current jobs at the technology object are aborted in accordance with the configured "StopMode".</td></tr>
<tr><td rowspan="3">StartMode</td><td rowspan="3">INPUT</td><td rowspan="3">DINT</td><td rowspan="3">1</td><td>0</td><td>Enable positioning axis/synchronous axis not position-controlled</td></tr>
<tr><td>1</td><td>Enable positioning axis/synchronous axis position-controlled</td></tr>
<tr><td colspan="2">The parameter initially takes effect when the positioning axis is enabled ("Enable" changes from "FALSE" to "TRUE") and when the axis is enabled after acknowledgment of an interrupt that caused the axis to be disabled.
This parameter is ignored when a speed axis or an external encoder is used.</td></tr>
<tr><td rowspan="3">StopMode</td><td rowspan="3">INPUT</td><td rowspan="3">INT</td><td rowspan="3">0</td><td colspan="2">Not applicable to the technology object external encoder
If you disable a technology object with a negative edge at parameter "Enable", the axis decelerates in accordance with the selected "StopMode".</td></tr>
<tr><td>0</td><td>Emergency stop
When the technology object is disabled, the axis is braked to a standstill without jerk limit, using the emergency stop deceleration configured in "Technology object > Configuration > Extended parameters > Emergency stop". The drive is then switched off and the technology object is locked.
(<TO>.DynamicDefaults.EmergencyDeceleration)</td></tr>
<tr><td>1</td><td>Immediate stop
When a technology object is disabled, the setpoint zero is output. The axis is braked to a standstill according to the configuration in the drive. The drive is then switched off and the technology object is locked.</td></tr>
</table>

Parameters	Declara-tion	Data type	Default value	Description	
				2	Stop with maximum dynamic values When the technology object is disabled, the axis is braked to a standstill using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic limits". The configured maximum jerk is hereby taken into account. The drive is then switched off and the technology object is locked. (<TO>.DynamicLimits.MaxDeceleration; <TO>.DynamicLimits.MaxJerk)
Status	OUTPUT	BOOL	FALSE	Technology object enable status	
				FALSE	Disabled • The technology object does not accept any Motion Control jobs. • Speed control and positioning control are not active. • The actual values of the technology object are not checked for validity.
				TRUE	Enabled • The enabled technology object accepts Motion Control jobs. • Speed control and positioning control are active. • The actual values of the technology object are valid.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
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 for parameter "ErrorID"	

Enabling technology objects

To enable a technology object, set the "Enable" parameter to "TRUE".

The following two cases are differentiated:

- Enable at a standstill
- Enable in motion of axis

Enable at a standstill

Depending on the "StartMode" parameter, the position is held ("StartMode" = 1) or the velocity setpoint zero is output ("StartMode" = 0). When the "Status" parameter shows the value "TRUE", the technology object is enabled.

Enable in motion of axis

If "StartMode" = 1, the position at the time of the setting of the "Enable" input takes effect as the position setpoint for the position controller. The axis is braked to a standstill and adjusted to the set position depending on the maximum deceleration configured under "Technology object > Configuration > Extended parameters > Dynamic limits". If monitoring operation or dynamic limits are hereby exceeded, this leads to corresponding alarm reactions.

If "StartMode" = 0, the axis is braked as much as possible by the specification of the velocity setpoint zero. Monitoring operations and dynamic limits are not active in this case.

When the "Status" parameter shows the value "TRUE", the technology object is enabled.

Note

Automatic enable after acknowledgment of a technology alarm

If the technology object is disabled due to a technology alarm, the technology object will be enabled again automatically 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, it is braked to a standstill according to the selected "StopMode".

When the "Busy" and "Status" parameters show the value "FALSE", the disabling of the technology object is complete and, if necessary, a configured drive switched on or off.

Drive connection by means of PROFIdrive

When a drive is connected using PROFIdrive, the setpoint, enable and drive status are transmitted via the PROFIdrive telegram.

- **Enable technology object and activate drive**

  With "Enable" = TRUE parameter, the technology object is enabled. The drive is enabled according to the PROFIdrive standard.

  When the "<TO>.StatusDrive.InOperation" tag shows the value "TRUE", the drive is ready to execute setpoints. The "Status" parameter is set to the value "TRUE".

- **Disable technology object and deactivate drive**

  With the "Enable" = FALSE parameter, 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 activate drive**

  With "Enable" = TRUE parameter, the enable output ("Enable drive output") is set.

  When the drive returns the readiness signal via the ready input ("Drive ready input"), the "Status" parameter and the technology object's "<TO>.StatusDrive.InOperation" tag are set to "TRUE", and the setpoint is switched to the analog output.

- **Disable technology object and deactivate drive**

  With the "Enable" = FALSE parameter, 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 enable output is set to "FALSE".

Additional information

Additional information on enabling and disabling technology objects and drives can be found in the section ""MC_Power" function diagrams (Page 346)".

See also

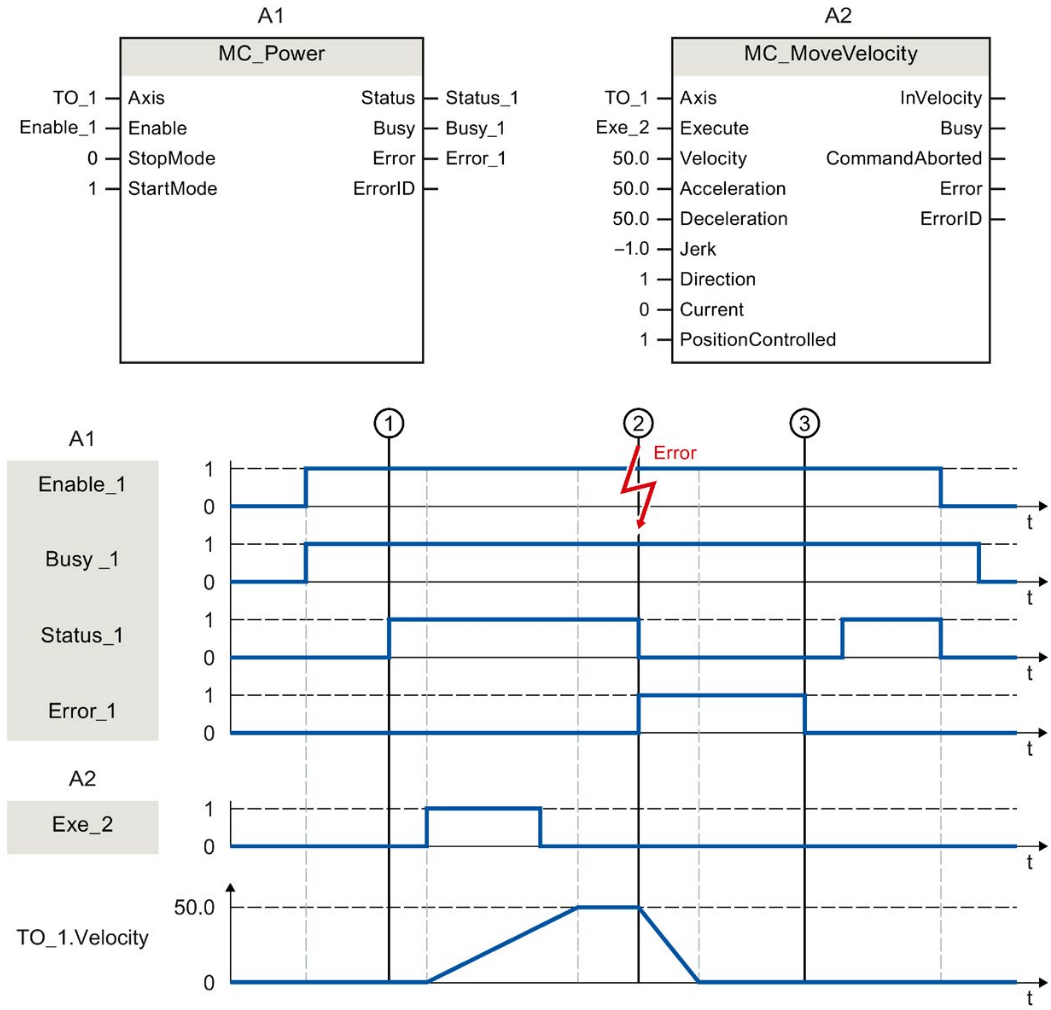
Automatic transfer of drive and encoder parameters in the device (Page 34)

Emergency stop deceleration (Page 56)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.1.2 MC_Power: Function chart V5 (S7-1500, S7-1500T)

Function chart: Enabling a technology object and example of alarm response



A technology object is enabled with "Enable_1= TRUE". The successful enable 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 "TO_1.Velocity".

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 to a standstill according to the configuration in the drive. 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. The successful enable can be read from "Status_1". Finally, the technology object is disabled with "Enable_1" = FALSE.

7.2 MC_Reset V5 (S7-1500, S7-1500T)

7.2.1 MC_Reset: Acknowledge alarms, restart technology object V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_Reset", you acknowledge all technology alarms that can be acknowledged in the user program. Acknowledgment also resets the "Error" and "Warning" bits in the technology object data block. An acknowledgment of alarms in the drive is also possible without a pending error at the technology object.

With "Restart" = TRUE, you start reinitialization (restart) of technology objects. Upon restart of the technology object, the new configuration data are applied in the technology object data block.

Applies to

- All technology objects

Requirement

- The technology objects speed axis, positioning axis, synchronous axis and external encoder.

  For a restart, the technology object must be disabled.

  ("MC_Power.Status" = FALSE and "MC_Power.Busy" = FALSE)
- Cyclic BUS communication is established between controller and encoder ("<TO>.StatusSensor[1..4].CommunicationOK" = TRUE).
- Cyclic BUS communication is established between controller and drive ("<TO>.StatusDrive.CommunicationOK" = TRUE).

Override response

- An "MC_Reset" job cannot be aborted by any other Motion Control job.
- A "MC_Reset" job with "Restart" = TRUE cancels all running Motion Control jobs.

Parameters

The following table shows the parameters of Motion Control instruction "MC_Reset":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis TO_ExternalEncoder TO_LeadingAxisProxy TO_OutputCam TO_CamTrack TO_MeasuringInput TO_Cam TO_Kinematics	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Restart	INPUT	BOOL	FALSE	TRUE	Reinitialization of the technology object and acknowledgment of pending technology alarms. The technology object is reinitialized with the configured start values.
				FALSE	Acknowledgment of queued technology alarms
Done	OUTPUT	BOOL	FALSE	TRUE	Technology alarms have been acknowledged. The restart has been executed.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

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 acknowledgment of the error with a positive edge at parameter "Execute".

   When the "Done" parameter shows the value "TRUE", the error has been acknowledged.

If you acknowledge multiple pending alarms, the pending alarms are displayed once more briefly in the "ErrorDetail.Number" tag without being signaled again. Check whether all alarms have been acknowledged after a restart with "MC_Reset.Done" = TRUE has been completely processed.

Note

Acknowledge technology alarms with "Restart" = FALSE

To acknowledge only the technology alarms, set "Restart" = FALSE. The technology object cannot be used during a restart. All technology alarms on axes and encoders are acknowledged, even if they are not enabled or not effective.

Restarting a technology object

To restart a technology object, follow these steps:

1. Check the requirements indicated above.
2. Set the parameter "Restart" = TRUE.
3. Perform the restart with a positive edge at parameter "Execute".

   When the "Done" parameter shows the value "TRUE", the restart of the technology object is complete.

You can find additional information on restarting in the "Restarting technology objects" section of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.3 MC_Home V5 (S7-1500, S7-1500T)

7.3.1 MC_Home: Home technology object, set home position V5 (S7-1500, S7-1500T)

Description

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

Homing is performed 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" of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

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 offset to the actual position ("Mode" = 1)	X	X	X	X
Set setpoint position (direct absolute) ("Mode" = 11) Relative shift of the setpoint position ("Mode" = 12)	X	X	X	X
Absolute encoder adjustment ("Mode" = 6, 7)	-	X	-	X

Requirement

- The technology object has been configured correctly.
- "Mode" = 2, 3, 5, 8, 10
  The technology object is enabled.
- "Mode" = 0, 1, 6, 7, 8, 11, 12
  The actual encoder values are valid (<TO>.StatusSensor[1..4].State = 2).
- "Mode" = 6, 7

  The axis is in position-controlled mode.

Override response

The override response for "MC_Home" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_Home":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis TO_ExternalEncoder	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start 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 positioning axis/synchronous axis technology object performs a homing movement according to the configuration. After the completion of the motion, the axis is positioned at the value of the "Position" parameter.
				4	Reserved
				5	Active homing ("Position" parameter has no effect) The positioning axis/synchronous axis technology object performs a homing movement according to the configuration. After completion of the motion, the axis is positioned at the home position configured under "Technology object > Configuration > Extended parameters > Homing > Active homing". (<TO>.Homing.HomePosition)

Parameter	Declara-tion	Data type	Default value	Description	
				6	Absolute encoder adjustment (relative) The current position is shifted by the value of parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[1..4].AbsEncoderOffset)
				7	Absolute encoder adjustment (absolute) The current position is set to the value of parameter "Position". The calculated absolute value offset is stored retentively in the CPU. (<TO>.StatusSensor[1..4].AbsEncoderOffset)
				8	Passive homing When the homing mark is detected, the actual value is set to the value of the "Position" parameter.
				9	Abort passive homing An active job for passive homing is aborted.
				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)
				11	Set setpoint position (absolute) The setpoint position of the technology object is set to the value of the "Position" parameter. The following error remains.
				12	Shift the setpoint position (relative) The setpoint position of the technology object is shifted by the value of the "Position" parameter. The following error remains.
ReferenceMark-Position	OUTPUT	LREAL	0.0	Display of the position at which the technology object was homed (valid when "Done" = TRUE)	
Done	OUTPUT	BOOL	FALSE	TRUE	Job is completed.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.

Parameter	Declaration	Data type	Default value	Description	
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

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:**
  - Error in 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

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.

   When the "Done" parameter shows the value "TRUE", 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)).

Abort of a passive homing process with "Mode" = 9

With "Mode" = 9, the technology object is not homed. When an active "MC_Home" job for passive homing ("Mode" = 2, 8, 10) is overridden by another "MC_Home" job with "Mode" = 9, the running job is aborted with parameter "CommandAborted" = TRUE. The overriding job with "Mode" = 9 signals successful execution with parameter "Done" = TRUE.

Additional information

An option for evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

Homing (Page 66)

7.4 MC_Halt V5 (S7-1500, S7-1500T)

7.4.1 MC_Halt: Pause axis V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_Halt", you brake an axis until it comes to a standstill.

You define the dynamic behavior of the braking operation with parameters "Jerk" and "Deceleration".

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_Halt" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_Halt":

Parameters	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant-acceleration velocity profile; the specified jerk is used
				= 0.0	Trapezoid velocity profile
				< 0.0	The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
AbortAcceleration	INPUT	BOOL	FALSE	FALSE	The current acceleration at the start of the job is reduced using the configured jerk. Afterwards, the deceleration builds up
				TRUE	The acceleration is set to 0.0 at the start of the job, and the deceleration immediately builds up.
Done	OUTPUT	BOOL	FALSE	TRUE	Velocity zero has been reached.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

Braking an axis with "MC_Halt"

Proceed as follows to decelerate an axis to a standstill:

1. Check the requirements indicated above.
2. Set the necessary values for the parameters "Deceleration", "Jerk" and "AbortAcceleration".
3. Start the "MC_Halt" job with a positive edge at parameter "Execute".

   The current motion state is indicated in parameters "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)).

Braking an axis with active force/torque limit

To brake an axis with active force/torque limiting, use the Motion Control instruction "MC_Stop" with "Emergency stop" mode ("Mode" = 0).

Additional information

Information on the evaluation of the individual bits can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

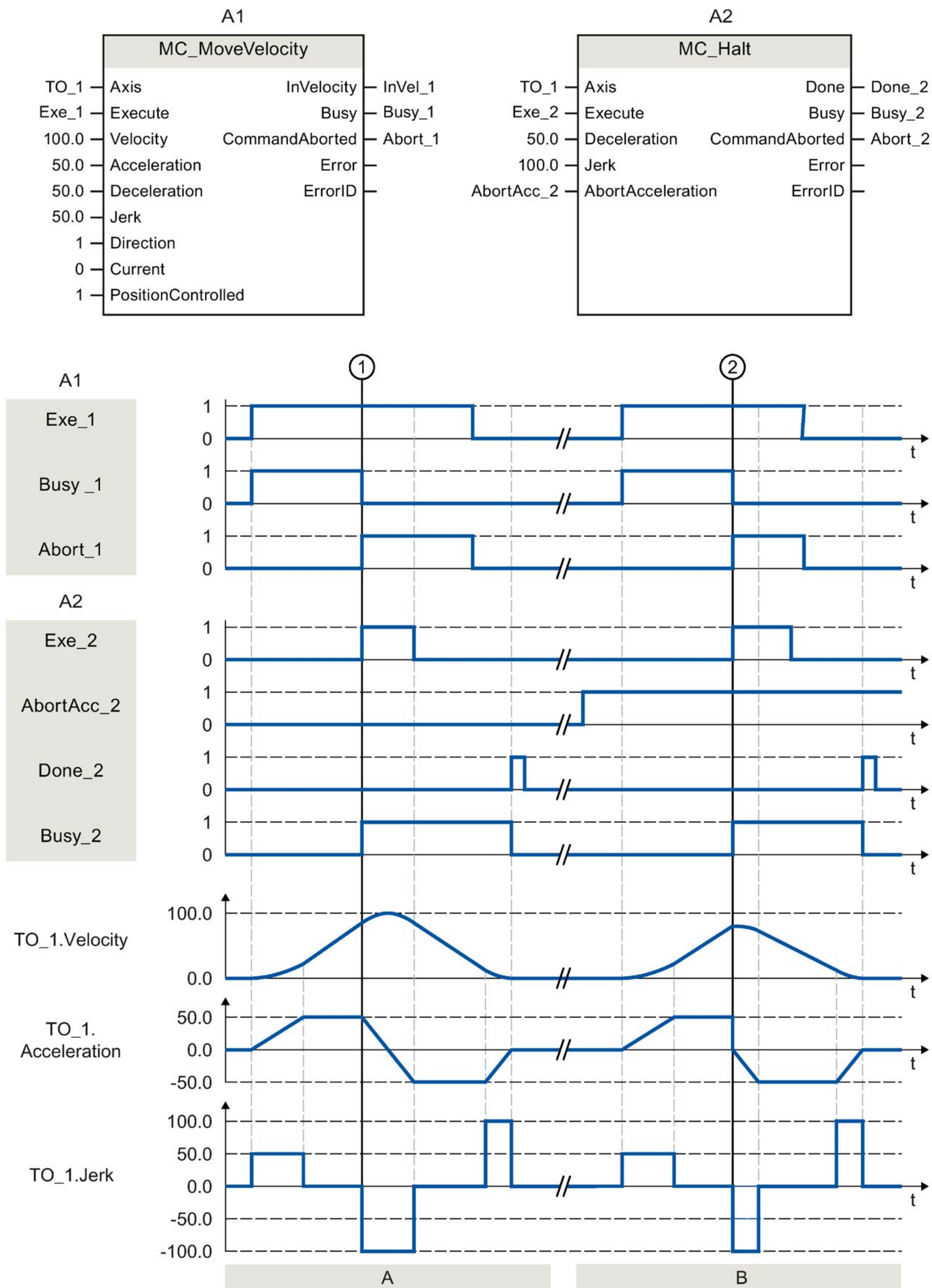
See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.4.2 MC_Halt: Function chart V5 (S7-1500, S7-1500T)

Function chart: Pausing an axis and the overriding job characteristics



Section A	An axis is moved with an "MC_MoveVelocity" job (A1). At time ①, the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job abort is signaled via "Abort_1". With "AbortAcc_2" = FALSE, the current acceleration is reduced with the specified jerk. Afterward, the deceleration builds up and the axis is braked to a standstill. The completion of the "MC_Halt" job is reported via "Done_2".
Section B	The axis is moved with an "MC_MoveVelocity" job (A1). At time ②, the "MC_MoveVelocity" job is overridden by an "MC_Halt" job (A2). The job abort is signaled via "Abort_1". With "AbortAcc_2" = TRUE, the current acceleration is set to zero immediately and the deceleration builds up. The axis is braked to a standstill. The completion of the "MC_Halt" job is reported via "Done_2".

7.5 MC_MoveAbsolute V5 (S7-1500, S7-1500T)

7.5.1 MC_MoveAbsolute: Position axis absolutely V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MoveAbsolute", you can move an axis to an absolute position.

You define the dynamic behavior of the motion with parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.
- The technology object is homed.

Override response

The override response for "MC_MoveAbsolute" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MoveAbsolute":

Parameters	Declara-tion	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Position	INPUT	LREAL	0.0	Absolute target position	
Velocity	INPUT	LREAL	-1.0	Velocity setpoint for the positioning	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The velocity configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant acceleration velocity profile The specified value is used.
				= 0.0	Trapezoid velocity profile
				< 0.0	The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)

Parameters	Declaration	Data type	Default value	Description	
Direction	INPUT	INT	1	Motion direction of the axis This parameter is only evaluated when the modulo function is enabled. "Technology object > Configuration > Basic parameters > Enable modulo"	
				1	Positive direction
				2	Negative direction
				3	Shortest distance
Done	OUTPUT	BOOL	FALSE	TRUE	The target position has been reached. The minimum dwell time has expired (<TO>.PositioningMonitoring.MinDwellTime).
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

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 in the "Position" parameter.
3. Start the "MC_MoveAbsolute" job with a positive edge at parameter "Execute".

   The current motion state is indicated in parameters "Busy", "Done" and "Error".

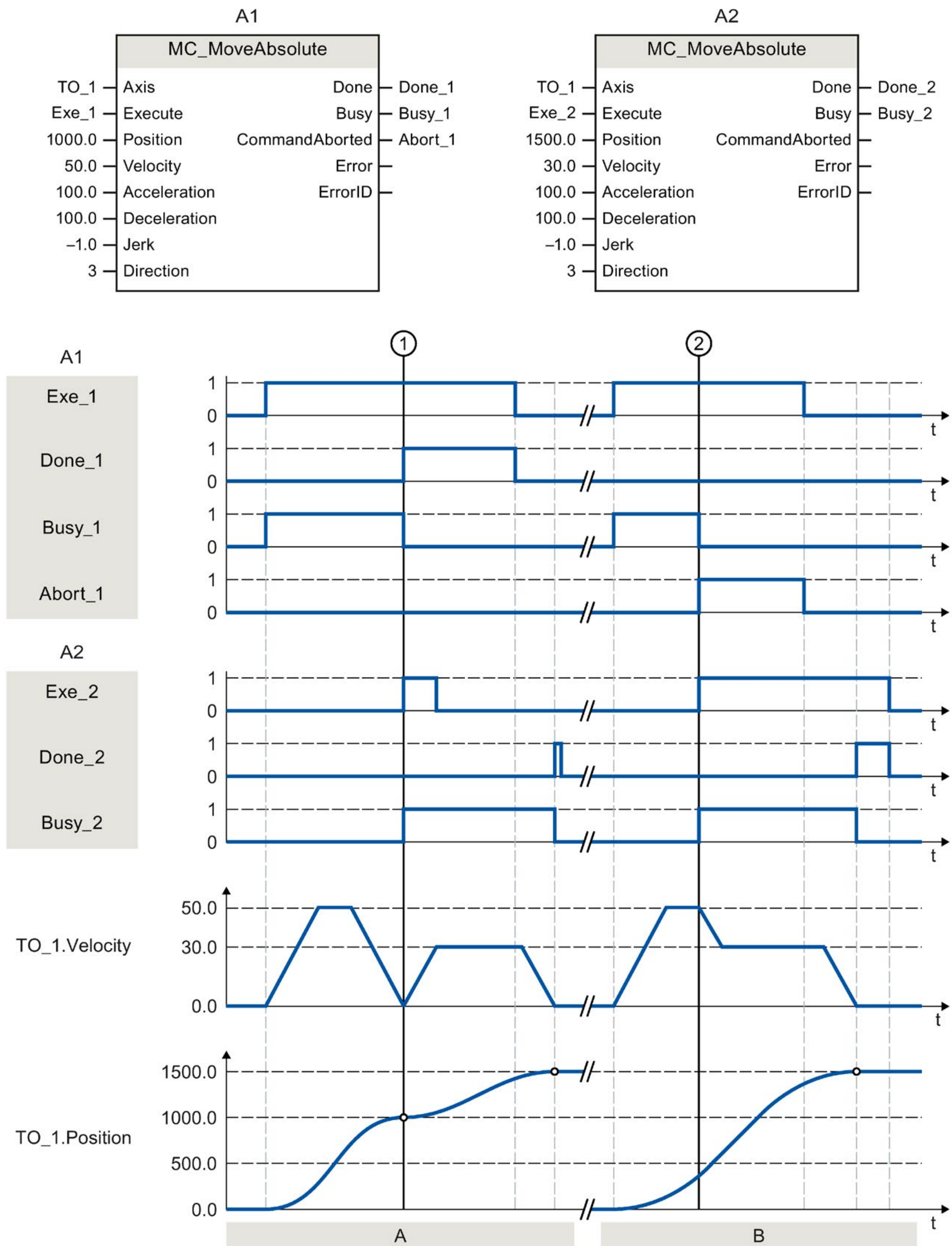
See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.5.2 MC_MoveAbsolute: Function chart V5 (S7-1500, S7-1500T)

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	An active "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".

7.6 MC_MoveRelative V5 (S7-1500, S7-1500T)

7.6.1 MC_MoveRelative: Position axis relatively V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MoveRelative", you move an axis relative to its position when execution of the job began.

You define the dynamic behavior of the motion with parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MoveRelative" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MoveRelative":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Distance	INPUT	LREAL	0.0	Distance for the positioning process (negative or positive)	

Parameter	Declaration	Data type	Default value	Description	
Velocity	INPUT	LREAL	-1.0	Velocity setpoint for the positioning	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The velocity configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant acceleration velocity profile The specified value is used.
				= 0.0	Trapezoid velocity profile
				< 0.0	The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
Done	OUTPUT	BOOL	FALSE	TRUE	The target position has been reached. The minimum dwell time has expired (<TO>.PositioningMonitoring.MinDwellTime).
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

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 parameter "Execute".

   The current motion state is indicated in parameters "Busy", "Done" and "Error".

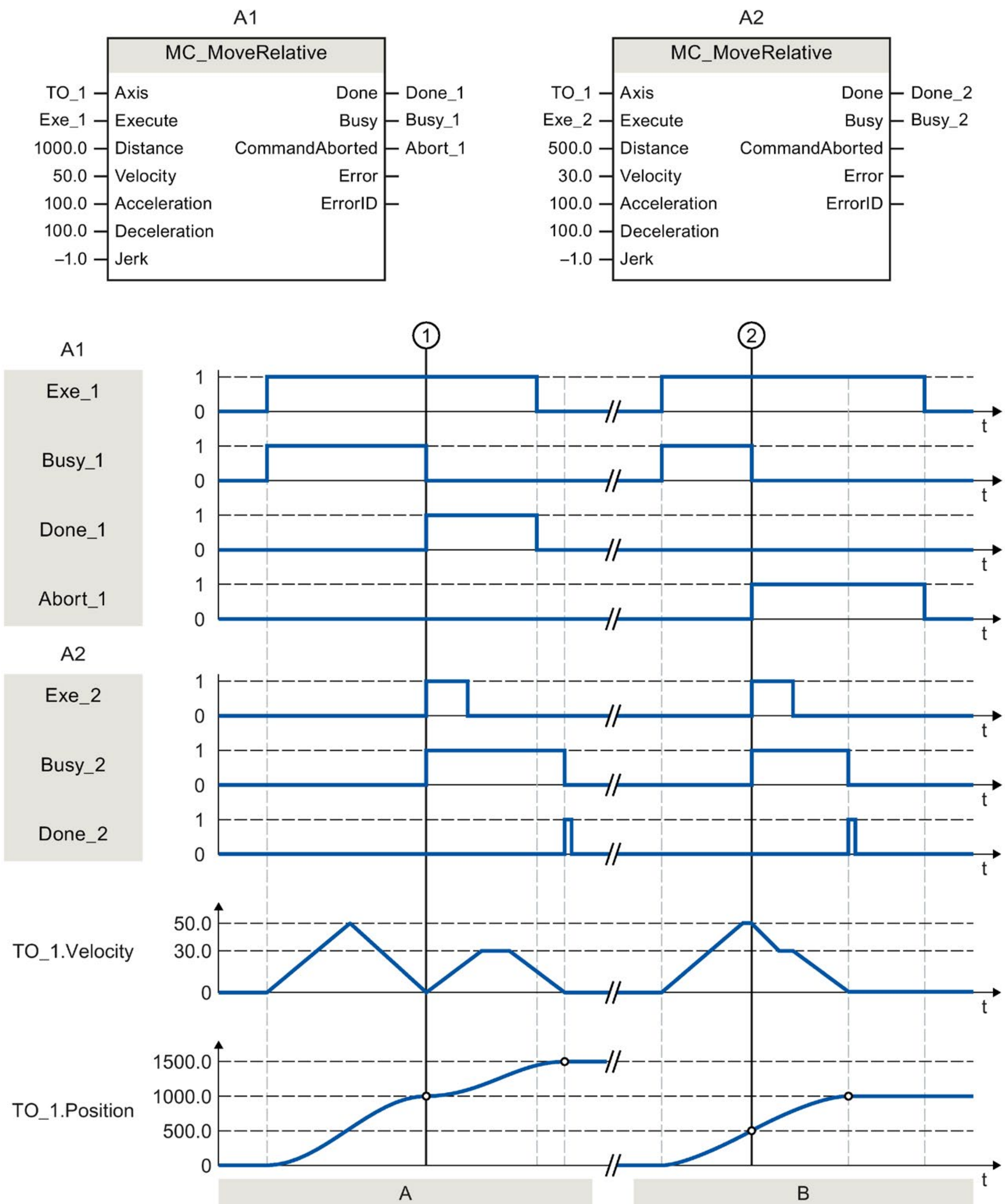
See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.6.2 MC_MoveRelative: Function chart V5 (S7-1500, S7-1500T)

Function chart: Relative positioning of an axis, and the overriding job characteristics



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 new target position is reached, this is signaled via "Done_2". Since "Exe_2" was previously reset, "Done_2" is applied only to one cycle.
Section B	An active "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".

7.7 MC_MoveVelocity V5 (S7-1500, S7-1500T)

7.7.1 MC_MoveVelocity: Move axis with velocity/speed setpoint V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MoveVelocity", you move an axis at constant velocity/speed.

You define the dynamic behavior of the motion with parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis/synchronous axis:

  A velocity is specified in the "Velocity" parameter.
- Speed axis:

  A speed is specified in the "Velocity" parameter.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MoveVelocity" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MoveVelocity":

Parameters	Declara-tion	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Velocity	INPUT	LREAL	100.0	Velocity setpoint/speed setpoint for the motion ("Velocity" = 0.0 is permitted)	
Acceleration	INPUT	LREAL	-1.0	Acceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant acceleration velocity profile The specified value is used.
				= 0.0	Trapezoid velocity profile
				< 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 The value of "Velocity" is used.
				2	Negative direction of rotation The value of "Velocity" is used.

Parameters	Declara-tion	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".
PositionControlled	INPUT	BOOL	TRUE	FALSE	Non position-controlled operation
				TRUE	Position-controlled mode
				The parameter applies as long as the "MC_MoveVelocity" job is being executed. After this, the setting of the following job applies. This parameter is ignored when a speed axis is used.	
InVelocity	OUTPUT	BOOL	FALSE	TRUE	The velocity setpoint/speed setpoint has been reached. A velocity setpoint/speed setpoint is output.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing the job. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID for parameter "ErrorID"	

Behavior with setpoint velocity/speed zero ("Velocity" = 0.0)

An "MC_MoveVelocity" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the velocity setpoint/speed setpoint 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 "Velocity" parameter, specify the velocity/speed, with which the axis should be moved.
3. Start the "MC_MoveVelocity" job with a positive edge at parameter "Execute".

   The current motion state is indicated in parameters "Busy", "InVelocity" and "Error".

   If the "InVelocity" parameter shows the value "TRUE", the velocity/speed setpoint has been 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

Response to a change in the override

If the velocity/speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), the "InVelocity" parameter is reset during the acceleration or deceleration. When the newly calculated velocity/speed is reached ("Velocity" × "Override" %), then "InVelocity" is set again.

Additional information

An option for evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

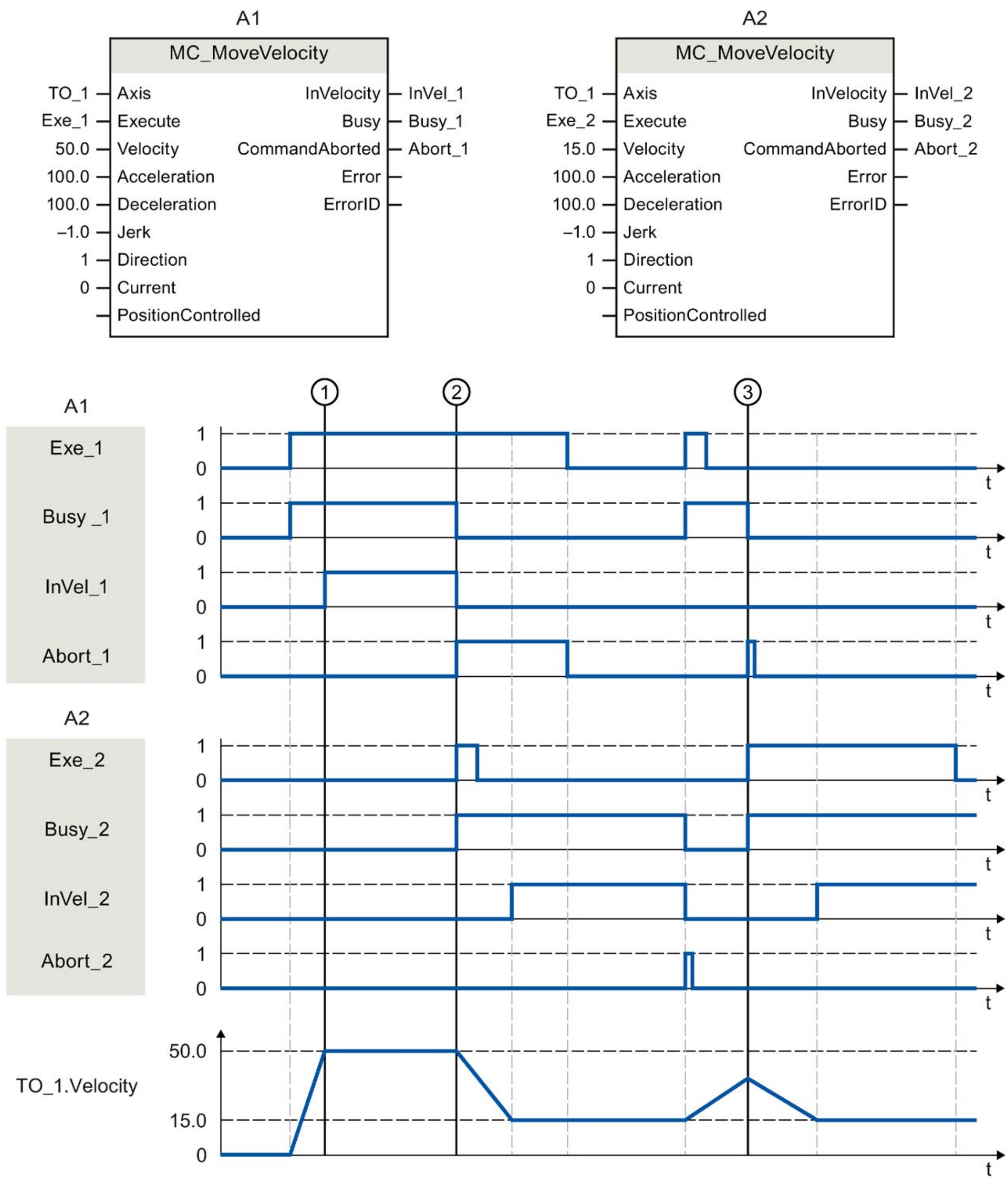
See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.7.2 MC_MoveVelocity: Function chart V5 (S7-1500, S7-1500T)

Function chart: Moving an axis with velocity specification, and the response to an overriding job



An "MC_MoveVelocity" job (A1) initiated via "Exe_1" accelerates the axis and signals at time ① via "InVel_1" that the velocity setpoint 50.0 has been reached.

At time ②, the job is overridden by another "MC_MoveVelocity" job (A2). The abort is signaled via "Abort_1". When the new velocity setpoint 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 velocity setpoint 50.0. Before the velocity setpoint 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 velocity setpoint 15.0 is reached, this is signaled via "InVel_2". The axis then continues moving at the constant velocity 15.0.

7.8 MC_MoveJog V5 (S7-1500, S7-1500T)

7.8.1 MC_MoveJog: Move axis in jog mode V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MoveJog", you move an axis in jog mode.

You define the dynamic behavior of the motion with parameters "Velocity", "Jerk", "Acceleration" and "Deceleration".

- Positioning axis/synchronous axis:

  A velocity is specified in the "Velocity" parameter.
- Speed axis:

  A speed is specified in the "Velocity" parameter.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MoveJog" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MoveJog":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
JogForward	INPUT	BOOL	FALSE	TRUE	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	TRUE	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	Velocity setpoint/speed setpoint for the motion	
				≥ 0.0	The specified value is used.
				< 0.0	The absolute value of the specified value is used.
Acceleration	INPUT	LREAL	-1.0	Acceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant acceleration velocity profile The specified value is used.
				= 0.0	Trapezoid velocity profile
				< 0.0	The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)

Parameter	Declaration	Data type	Default value	Description	
PositionControlled	INPUT	BOOL	TRUE	FALSE	Non position-controlled operation
				TRUE	Position-controlled mode
				The parameter applies as long as the "MC_MoveJog" job is being executed. After this, the setting of the following job applies. This parameter is ignored when a speed axis is used.	
InVelocity	OUTPUT	BOOL	FALSE	TRUE	The velocity setpoint/speed setpoint has been reached. A velocity setpoint/speed setpoint is output.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

Behavior with setpoint velocity/speed zero ("Velocity" = 0.0)

An "MC_MoveJog" job with "Velocity" = 0.0 stops the axis with the configured deceleration. When the velocity setpoint/speed setpoint 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 parameters "Busy", "InVelocity" and "Error".

   If both "JogForward" and "JogBackward" are set to TRUE, the axis is braked at the last valid deceleration. The error 16#8007 (incorrect direction specification) is output.

Note

Response to a change in the override

If the velocity/speed is influenced during constant motion by a change in the override (<TO>.Override.Velocity), 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 evaluating the individual status bits can be found in the section "Evaluating StatusWord, ErrorWord and WarningWord" of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

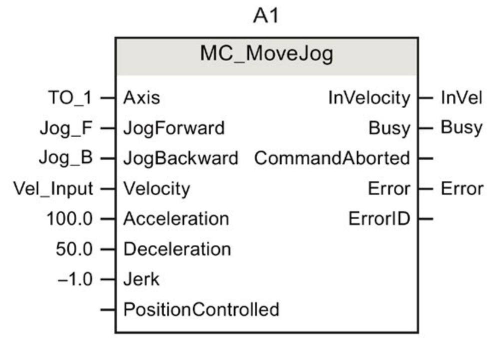
See also

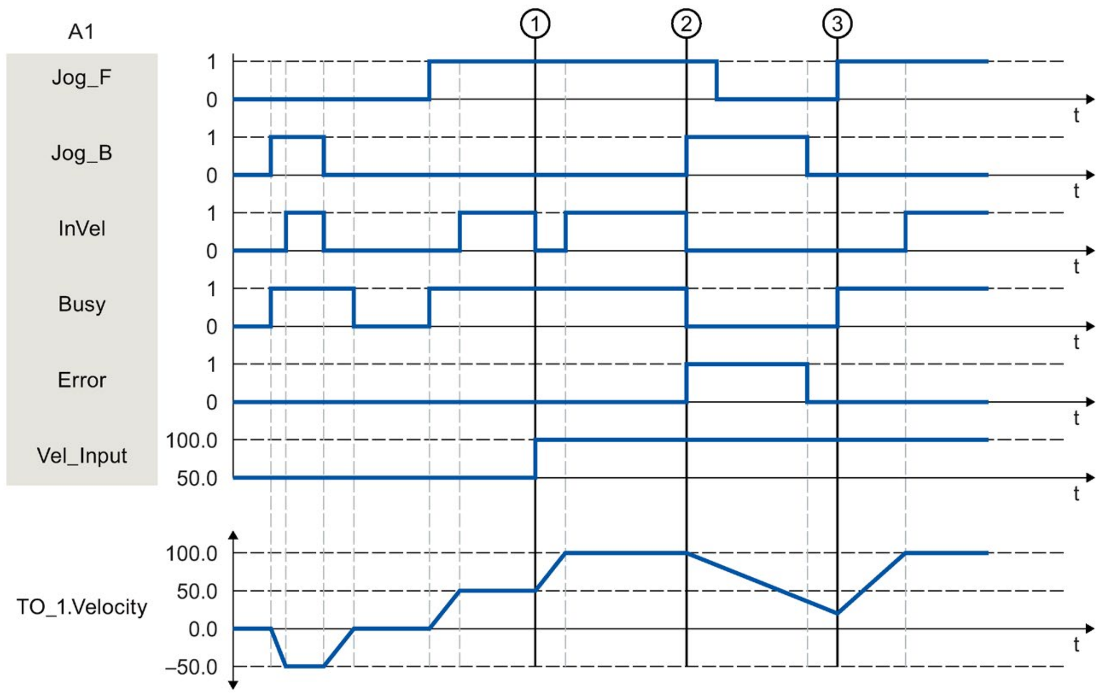
Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.8.2 MC_MoveJog: Function chart V5 (S7-1500, S7-1500T)

Function chart: Moving an axis in jog mode





The axis is moved in the negative direction in jog mode via "Jog_B". When the velocity setpoint -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 velocity setpoint 50.0 is reached, this is signaled via "InVel" = TRUE.

At the time ①, if "Jog_F" is set, the velocity setpoint is changed to 100.0 by means of "Vel_Input". Alternatively, you can also change the velocity setpoint using the velocity override. "InVel" is reset. Axis is being accelerated. When the new velocity setpoint 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 velocity setpoint 100.0 is reached, this is signaled via "InVel" = TRUE.

7.9 MC_MoveSuperimposed V5 (S7-1500, S7-1500T)

7.9.1 MC_MoveSuperimposed: Position axes overlapping V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MoveSuperimposed", you start a relative positioning motion that is superimposed on a active basic motion.

You define the dynamic behavior of the motion with 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 dynamics 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 dynamics 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 dynamics 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.
  - An "MC_MoveSuperimposed" job on a leading axis in synchronous operation affects the leading axis and the following axis.
  - An "MC_MoveSuperimposed" job on a following axis in synchronous operation only affects the following axis.

It is always the dynamics of the total motion that is displayed in the technology data block and in the TIA Portal.

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MoveSuperimposed" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MoveSuperimposed":

Parameters	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Axis technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Distance	INPUT	LREAL	0.0	Additional distance for the overlapping positioning process (negative or positive)	
VelocityDiff	INPUT	LREAL	-1.0	Maximum velocity deviation compared to the active motion	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The velocity configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Velocity)
Acceleration	INPUT	LREAL	-1.0	Acceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The acceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Acceleration)
Deceleration	INPUT	LREAL	-1.0	Deceleration	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)

Parameters	Declaration	Data type	Default value	Description	
Jerk	INPUT	LREAL	-1.0	Jerk	
				> 0.0	Constant acceleration velocity profile The specified value is used.
				= 0.0	Trapezoid velocity profile
				< 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 processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing the job. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	0	Error ID for parameter "ErrorID"	

Starting superimposed positioning motion

To start a superimposed positioning motion with Motion Control instruction "MC_MoveSuperimposed", 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 parameter "Execute".

   The current motion state is indicated in parameters "Busy", "Done" and "Error".

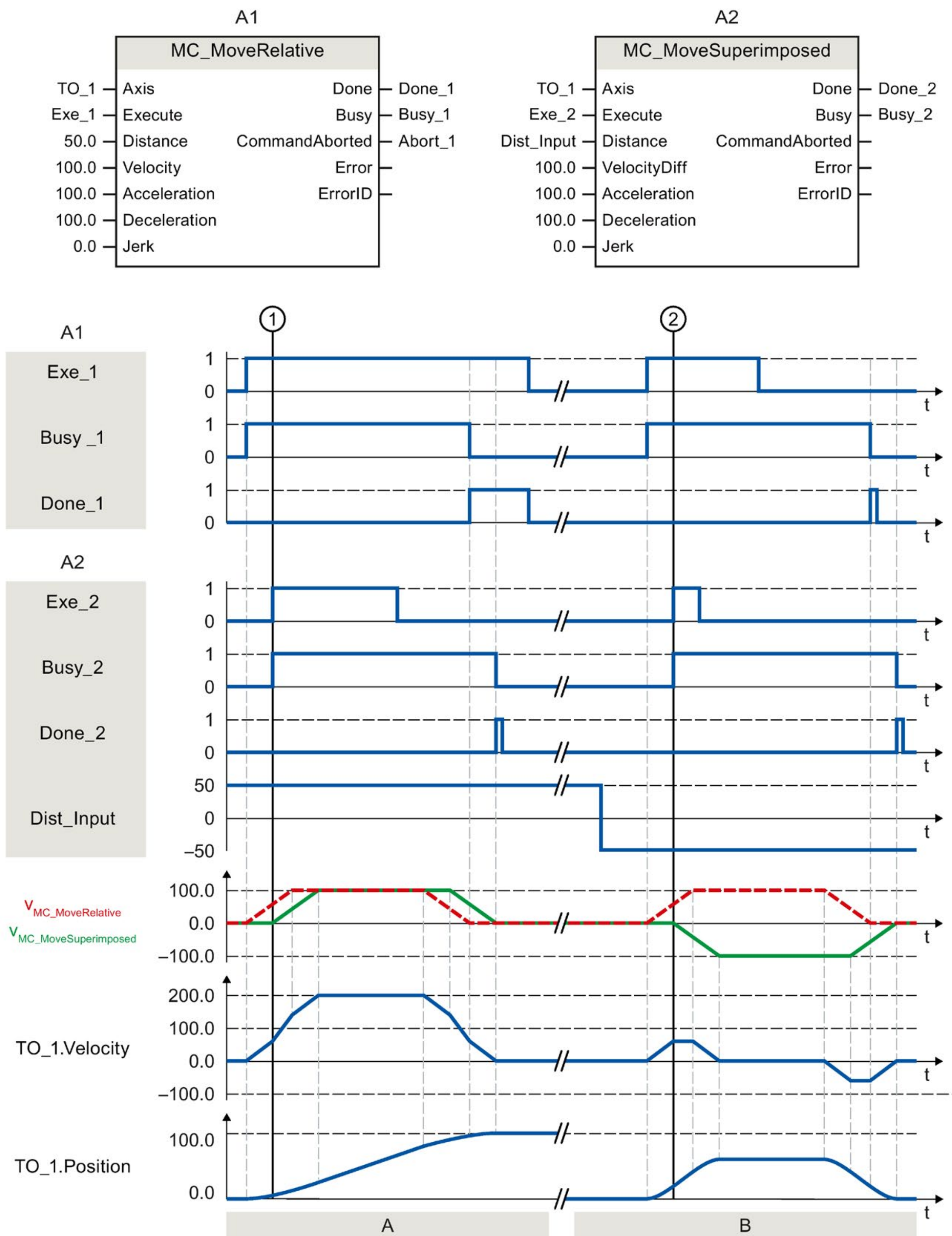
See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.9.2 MC_MoveSuperimposed: Function chart V5 (S7-1500, S7-1500T)

Function chart: Positioning axes overlapping



Section A	Using "Exe_1", an "MC_MoveRelative" job with a distance of 50.0 is initiated. At time ①, using "Exe_2", an "MC_MoveSuperimposed" job with a distance of 50.0 is initiated. The axis is moved with the added dynamic values of both jobs by the distance 50 + 50 = 100.0. When the axis reaches the target position, this is signaled via "Done_2".
Section B	Using "Exe_1", an "MC_MoveRelative" job with a distance of 50.0 is initiated. At time ②, using "Exe_2", a MC_MoveSuperimposed job with a distance of -50.0 is initiated. The axis reverses and is moved with the added dynamic values of both jobs by the distance 50.0 - 50.0 = 0.0. When the axis reaches the target position, this is signaled via "Done_2".

7.10 MC_SetSensor V5 (S7-1500T)

7.10.1 MC_SetSensor: Switch alternative encoder to operative encoder V5 (S7-1500T)

Description

With the Motion Control instruction "MC_SetSensor", you switch over the encoder for closed loop position control of the axis.

The actual value of the addressed encoder can be adapted without switchover using parameter "Mode" 2 and 3.

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object and the alternative encoder have been configured correctly.
- No restart command and no "MC_Home" job running.

Override response

- An "MC_SetSensor" job is not aborted by any other Motion Control job.
- A new "MC_SetSensor" job does not abort any active Motion Control jobs.

Parameters

The following table shows the parameters of Motion Control instruction "MC_SetSensor":

Parameters	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
Sensor	INPUT	INT	1	Number of the new encoder (1 to 4).	
Mode	INPUT	DINT	0	The mode determines the position alignment between the old encoder and new encoder.	
				0	Switch over encoder and transfer actual position to the new encoder With this encoder switchover, step changes in the positioning control are prevented. Bumpless switchover of the encoders is possible.
				1	Switch over encoder without aligning the actual position **Note** When closed loop position control is active, an additional difference of the two encoders acts as additional control deviation and can trigger a compensating motion.
				2	Transfer actual value The actual position is transferred to the encoder specified in the "Sensor" parameter.
				3	Transfer actual value The actual position of the "Reference encoder" ("ReferenceSensor" parameter) is transferred to the encoder specified in the "Sensor" parameter.
ReferenceSensor	INPUT	INT	1	Number of the reference encoder (see parameter "Mode" = 3)	
Done	OUTPUT	BOOL	FALSE	TRUE	Encoder for closed loop position control of the axis was switched over.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job has been aborted.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

Changing to absolute encoder

When you switch the encoder to an absolute encoder and transfer the actual value ("Mode" = 2, 3), the actual value is calculated with the value of the absolute encoder and the absolute value offset. When switching to a different encoder, calculation of the actual value is canceled. The absolute encoder once again returns the absolute value + absolute value offset (<TO>.StatusSensor[1..4].AbsEncoderOffset) without calculation by the "MC_SetSensor" job.

See also

Using multiple encoders (Page 36)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.11 MC_Stop V5 (S7-1500, S7-1500T)

7.11.1 MC_Stop: Stop axis and prevent new motion jobs V5 (S7-1500, S7-1500T)

Description

With the "MC_Stop" Motion Control instruction, you stop all movements of an axis and prevent new motion jobs for the technology object. The axis brakes to a standstill and remains switched on.

The standstill position is derived from the stop ramp. Three modes, which you define with the "Mode" parameter, are available for this purpose:

- "Mode" = 0: The dynamic response of the braking operation is determined by the configured emergency stop ramp.
- "Mode" = 2: The dynamic response of the braking operation is determined by the maximum dynamic values of the technology object.
- "Mode" = 3: The dynamic response of the braking operation is determined with parameters "Jerk" and "Decelaration" of the "MC_Stop" job.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

- An "MC_Stop" job is not triggered by other movements.
- An "MC_Stop" job is aborted by an "MC_Power" job with "Enable" = FALSE.
- An "MC_Stop" job does not abort any synchronous operation function in simulation.
- An "MC_Stop" job is aborted by another "MC_Stop" job with a stop response that is the same or higher.

  Significance of stop responses (descending): "Mode" = 0 > "Mode" = 2 > "Mode" = 3

You can find more information on the override response of an "MC_Stop" job in the section "Override response of Motion Control jobs V5 (Page 271)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_Stop":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	The motion is stopped and new motion jobs are prevented.
				FALSE	Motion jobs can be executed again.
Mode	INPUT	DINT	0	Mode for dynamic behavior	
				0	Emergency stop The technology object is braked to a standstill without jerk limit, using the emergency stop deceleration configured in "Technology object > Configuration > Extended parameters > Emergency stop". (<TO>.DynamicDefaults.EmergencyDeceleration)
				1	Not permitted
				2	Stop with maximum dynamic values The technology object is braked to a standstill using the maximum deceleration configured in "Technology object > Configuration > Extended parameters > Dynamics limits". The configured maximum jerk is hereby taken into account. (<TO>.DynamicLimits.MaxDeceleration, <TO>.DynamicLimits.MaxJerk)
				3	Stop with specified dynamic response The technology object is stopped with the specified values at the parameters "Deceleration" and "Jerk".
Deceleration	INPUT	LREAL	-1.0	When "Mode" = 3: Deceleration for the braking ramp	
				> 0.0	The specified value is used.
				= 0.0	Not permitted
				< 0.0	The deceleration configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Deceleration)

Parameter	Declaration	Data type	Default value	Description	
Jerk	INPUT	LREAL	-1.0	When "Mode" = 3: Jerk for the braking ramp	
				> 0.0	The specified value is used.
				= 0.0	No jerk limitation
				< 0.0	The jerk configured in "Technology object > Configuration > Extended parameters > Dynamic defaults" is used. (<TO>.DynamicDefaults.Jerk)
AbortAcceleration	INPUT	BOOL	FALSE	TRUE	Acceleration is set to 0.0. The configured deceleration is built up immediately.
				FALSE	The acceleration is reduced using the configured jerk. The configured deceleration then builds up.
Done	OUTPUT	BOOL	FALSE	TRUE	Standstill is reached.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted during execution either by "MC_Power" with "Enable" = FALSE or another "MC_Stop" job.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

Braking an axis with "MC_Stop"

Proceed as follows to decelerate an axis to a standstill:

1. Check the requirements indicated above.
2. Set the necessary values for the parameters "Mode", "Deceleration", "Jerk" and "AbortAcceleration".
3. Start the "MC_Stop" job with a positive edge at parameter "Execute".

   The current motion state is indicated in parameters "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)).

   As long as "Execute" = TRUE, the technology object cannot execute motion jobs.

Braking an axis with active force/torque limiting

Use the "Emergency stop" mode ("Mode" = 0) to brake an axis with active force/torque limitation.

Additional information

Information on the evaluation of the individual bits can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" documentation (https://support.industry.siemens.com/cs/ww/en/view/109766459).

See also

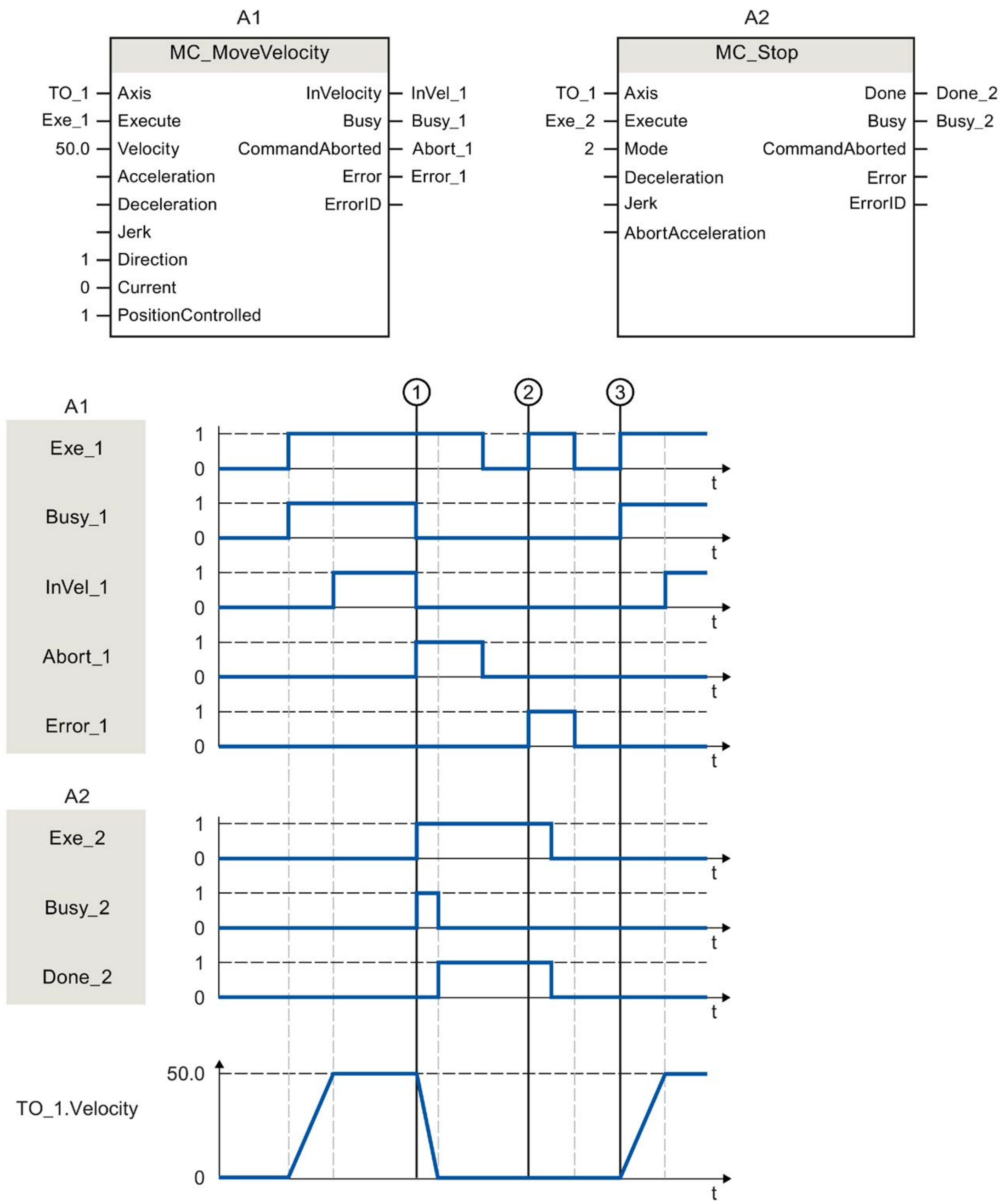
Override response V5: Homing and motion jobs (Page 271)

Emergency stop deceleration (Page 56)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.11.2 MC_Stop: Function chart V5 (S7-1500, S7-1500T)

Function chart: Braking an axis and the overriding job characteristics



An axis is moved with an "MC_MoveVelocity" job (A1). At time ①, the "MC_MoveVelocity" job is overridden by an "MC_Stop" job (A2). The job abort is signaled via "Abort_1". Afterwards, the configured deceleration builds up and the axis is braked to a standstill. While the axis is braking, "Busy_2" = TRUE. The completion of the "MC_Stop" job is reported via "Done_2".

At time ②, with an active "MC_Stop" job (A1), an "MC_MoveVelocity" job (A2) is executed. Because the axis is disabled by an "MC_Stop" job, the "MC_MoveVelocity" job is rejected. The error is signaled by "Error_1". "Exe_2" is subsequently reset to FALSE.

At time ③, the axis is moved by an "MC_MoveVelocity" job (A1) with positive edge.

7.12 MC_SetAxisSTW V5 (S7-1500, S7-1500T)

7.12.1 MC_SetAxisSTW: Control bits of control word 1 and 2 V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_SetAxisSTW", you control selected bits in control word 1 (STW1) and control word 2 (STW2) of the PROFIdrive telegram. This provides the possibility of directly controlling bits not used by the technology object. The bits to be controlled are specified via the parameters "STW1" and "STW2". The controlled bits remain effective until an "MC_SetAxisSTW" job is reset, the technology object is restarted or the CPU transitions from "RUN" to "STOP".

The following bits can be controlled in STW1:

- 8
- 9
- 11 to 15

Bits 0 to 11 can be controlled in STW2.

For the meaning of the bits to be controlled, refer to the "SINAMICS S120/S150" list manual (https://support.industry.siemens.com/cs/ww/en/view/109763271).

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object is interconnected with a drive telegram.
- The technology object is not in simulation.
- The technology object has been enabled.
- A permissible bit masking is set.

Override response

- A new "MC_SetAxisSTW" job does not abort any active Motion Control jobs.
- An "MC_SetAxisSTW" job is only aborted by another "MC_SetAxisSTW" job.

Parameters

The following table shows the parameters of Motion Control instruction "MC_SetAxisSTW":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
STW1	INPUT	WORD	16#0000	Set bits for STW1	
STW1BitMask	INPUT	WORD	16#0000	Bit masking for STW1	
STW2	INPUT	WORD	16#0000	Set bits for STW2	
STW2BitMask	INPUT	WORD	16#0000	Bit masking for STW2	
Done	OUTPUT	BOOL	FALSE	TRUE	The job is completed.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

See also

Override response V5: Homing and motion jobs (Page 271)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.13 MC_WriteParameter V5 (S7-1500, S7-1500T)

7.13.1 MC_WriteParameter: Write parameter V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_WriteParameter", you can change selected parameters of the technology objects in runtime. The changes take effect directly or after a restart, depending on the corresponding parameter.

With a "RUN → STOP → RUN" transition of the CPU, the parameter value is retained. The changed parameter value is reset to the start value in the event of a POWER OFF, memory reset or a restart of the technology object.

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.

Parameters

The following table shows the parameters of Motion Control instruction "MC_WriteParameter":

Parameter	Declara-tion	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge
ParameterNumber	INPUT	DINT	0	Index of the parameter to be changed	
Value	INPUT	Variant (BOOL, INT, DINT, UDINT, LREAL)	-	Variant pointer to the value to be written (source address)	
Done	OUTPUT	BOOL	FALSE	TRUE	Job is completed.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred during processing. The job is rejected. The cause of the error can be found in the "ErrorID" parameter.
ErrorID	OUTPUT	WORD	16#0000	Error ID for parameter "ErrorID"	

Modifiable parameters

The following table shows the parameters that can be changed with the Motion Control instruction "MC_WriteParameter":

Tag	Index	Technology object	Data type	Description		Effective-ness
PostionLimits_ HW.Active	1000	Positioning axis Synchronous axis	BOOL	Enabling/disabling hardware limit switch The negative and the positive hardware limit switches (Page 83) are activated or deactivated with this parameter,		Direct
				FALSE	HW limit switch deactivated	
				TRUE	HW limit switch activated	

See also

Override response V5: Homing and motion jobs (Page 271)

Direct homing (Page 83)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

Tags of the positioning axis technology object (Page 293)

7.14 MotionIn (S7-1500T)

7.14.1 MC_MotionInVelocity V5 (S7-1500T)

7.14.1.1 MC_MotionInVelocity: Specify motion setpoints V5 (S7-1500T)

Description

With the Motion Control instruction "MC_MotionInVelocity", you specify cyclically applicable calculated motion setpoints for velocity and acceleration as a basic motion for the axis. No velocity profile is calculated for this, the values are directly active at the technology object. The dynamic limits are not in effect. The motion setting using "MotionIn" can be superimposed with an "MC_MoveSuperimposed" job (Page 233).

With the "Velocity" parameter, you specify the desired velocity and with "Acceleration" the desired acceleration. The setpoint velocity and setpoint acceleration are effective when the parameter "Enable" = TRUE and at least the value for the "Velocity" parameter needs to be specified.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MotionInVelocity" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Note

Dynamic deviation possible

Pay attention to consistent specifications relating to velocity and acceleration when the "MotionIn" instruction is overridden by another Motion Control instruction.

When the "MotionIn" instruction is overridden, make sure that the new acceleration specifications are coordinated with the currently effective acceleration because the last effective acceleration value will be applied.

Parameters

The following table shows the parameters of Motion Control instruction "MC_MotionInVelocity":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge The specified setpoints are used as long as the parameter is set to "TRUE".
				FALSE	End of the job with negative edge If the parameter is set from "TRUE" to "FALSE", the setpoints are set to 0.0.
Velocity	INPUT	LREAL	0.0	Velocity setpoint Observe the dynamic limits.	
Acceleration	INPUT	LREAL	0.0	Setpoint acceleration Observe the dynamic limits.	
PositionControlled	INPUT	BOOL	TRUE	TRUE	Position-controlled mode
				FALSE	Controlled running
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

See also

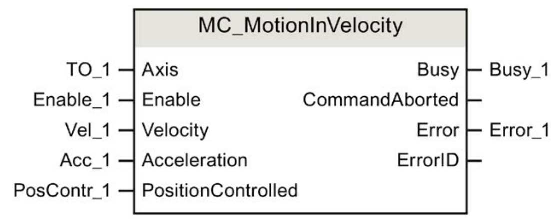
Override response V5: Homing and motion jobs (Page 271)

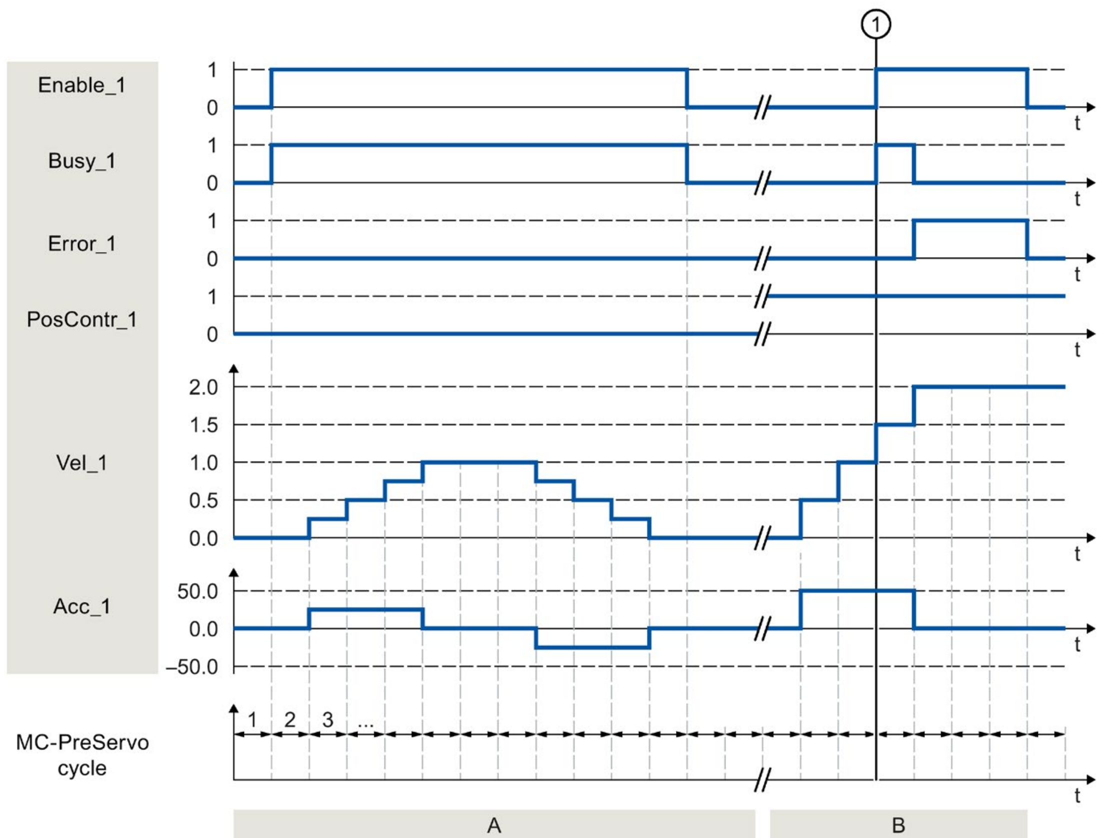
Motion specification via "MotionIn" (Page 57)

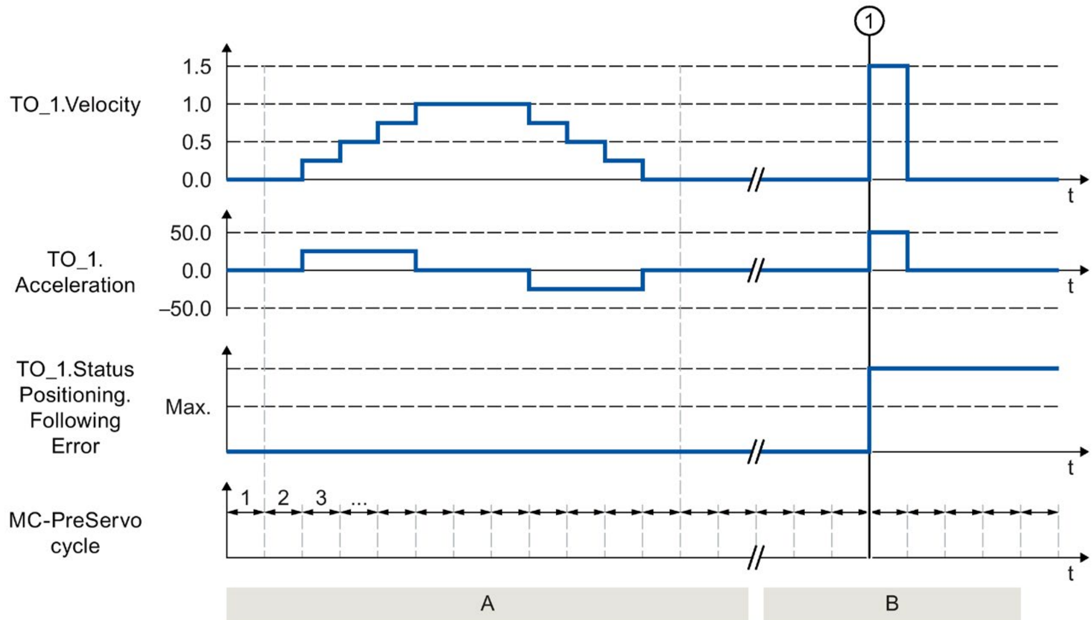
Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.14.1.2 MC_MotionInVelocity: Function chart V5 (S7-1500T)

Function chart: Specify motion setpoints







Section A	With "Enable_1 = TRUE" the technology object is specified cyclic in the MC-PreServo-clock velocity "Vel_1" and acceleration "Acc_1". These specifications are applied directly as setpoint velocity "TO_1.Velocity" and setpoint acceleration "TO_1.Acceleration", without hereby calculating a velocity profile. As the position monitoring "PosContr_1" is set to FALSE, no following error "TO_1.StatusPositioning.FollowingError" is determined.
Section B	The velocity and acceleration specifications are not active as long as "Enable_1" is set to FALSE. At time ①, "Enable_1" is set to TRUE. As the position monitoring "PosContr_1" is set to TRUE, a following error "TO_1.StatusPositioning.FollowingError" is determined. The velocity specification "Vel_1" and the acceleration default "Acc_1" cause a setpoint jump which exceeds the maximum permissible following error. With active position lag monitoring, the technology alarm 521 is output, and the technology object is disabled. With deactivated following error monitoring, the setpoint jump is executed with maximum dynamic.

7.14.2 MC_MotionInPosition V5 (S7-1500T)

7.14.2.1 MC_MotionInPosition: Specify motion setpoints V5 (S7-1500T)

Description

With the Motion Control instruction "MC_MotionInPosition", you specify the cyclic, applicable motion setpoints for position, velocity and acceleration as basic motion for the axis. No velocity profile is calculated for this, the values are directly active at the technology object. The dynamic limits are not in effect. The motion setting using "MotionIn" can be superimposed with an "MC_MoveSuperimposed" job (Page 233).

With the "Position" parameter, you specify the set position. With the "Velocity" parameter, you specify the setpoint velocity. With the "Acceleration" parameter, you specify the setpoint acceleration.

The setpoint velocity is used as a feedforward control value when velocity feedforward control is activated. The setpoint position, setpoint velocity and setpoint acceleration are effective when the parameter "Enable" = TRUE and at least the values for the "Position" and "Velocity" parameters are specified.

Applies to

- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.

Override response

The override response for "MC_MotionInPosition" jobs is described in section "Override response V5: Homing and motion jobs (Page 271)".

Note

Dynamic deviation possible

Pay attention to consistent specifications relating to velocity and acceleration when the "MotionIn" instruction is overridden by another Motion Control instruction.

When the "MotionIn" instruction is overridden, make sure that the new acceleration specifications are coordinated with the currently effective acceleration because the last effective acceleration value will be applied.

Parameters

The following table shows the parameters of Motion Control instruction "MC_MotionInPosition":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	Start job with a positive edge The specified setpoints are used as long as the parameter is set to "TRUE".
				FALSE	End of the job with negative edge If the parameter is set from "TRUE" to "FALSE", the setpoints are set to 0.0. The most recently specified value remains active for the position setpoint.
Position	INPUT	LREAL	0.0	Position setpoint	
Velocity	INPUT	LREAL	0.0	Velocity setpoint Observe the dynamic limits.	
Acceleration	INPUT	LREAL	0.0	Setpoint acceleration Observe the dynamic limits.	
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The job was aborted by another job during execution.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for the parameter "ErrorID"	

See also

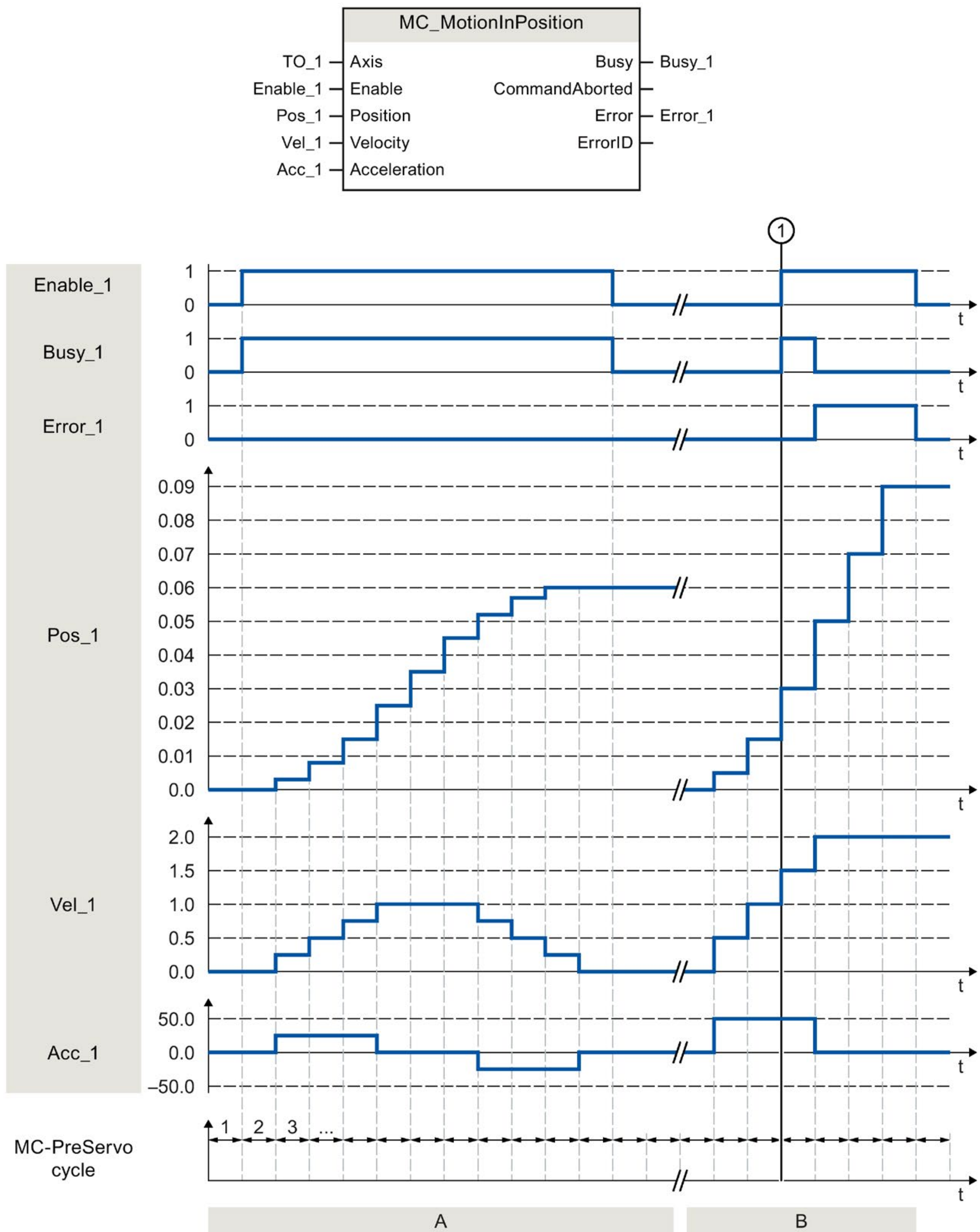
Override response V5: Homing and motion jobs (Page 271)

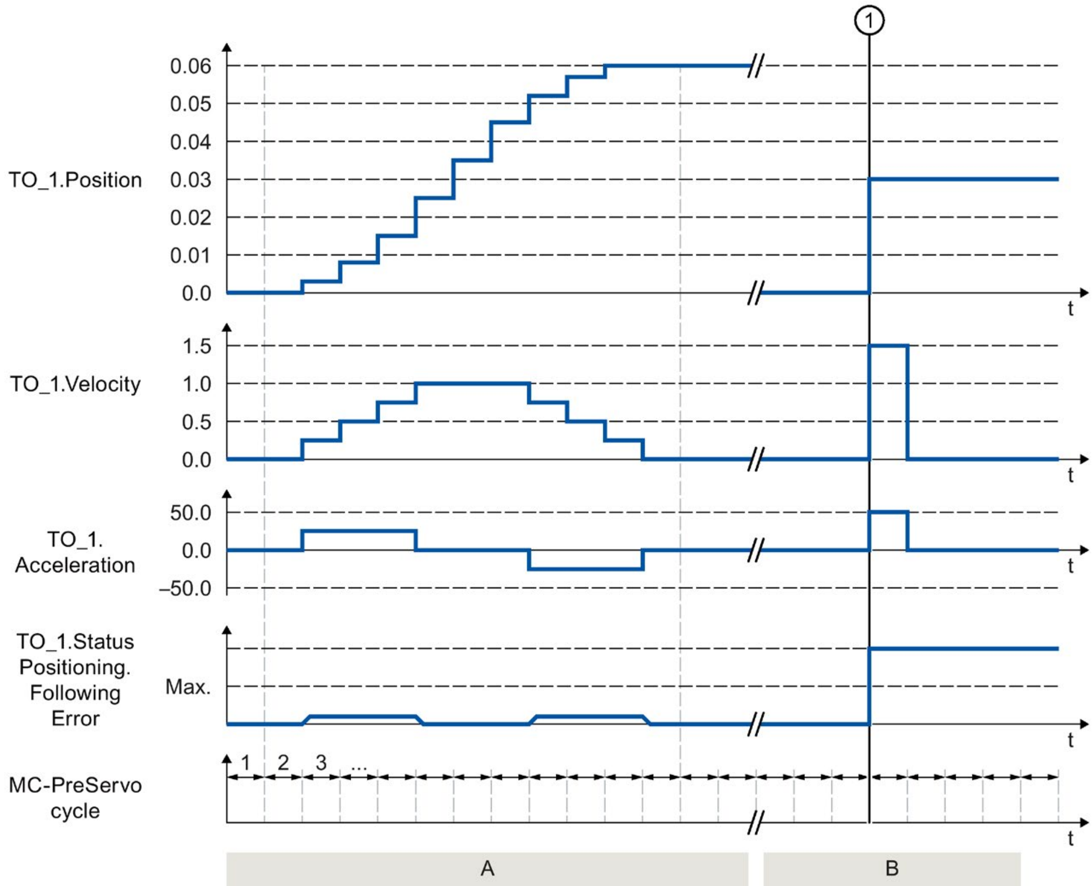
Motion specification via "MotionIn" (Page 57)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.14.2.2 MC_MotionInPosition: Function chart V5 (S7-1500T)

Function chart: Specify motion setpoints





Section A	With "Enable_1 = TRUE" the technology object is specified cyclic in the MC-PreServo-clock position "Pos_1", velocity "Vel_1" and acceleration "Acc_1". These specifications are applied directly as set position "TO_1.Position", setpoint velocity "TO_1.Velocity" and setpoint acceleration "TO_1.Acceleration", without hereby calculating a velocity profile.
Section B	The position, velocity and acceleration specifications are not active as long as "Enable_1" is set to FALSE. At time ①, "Enable_1" is set to TRUE. The default position setting "Pos_1" causes a setpoint jump which exceeds the maximum permissible following error. With active position lag monitoring, the technology alarm 521 is output, and the technology object is disabled. With deactivated following error monitoring, the setpoint jump is executed with maximum dynamic.

7.15 Torque data (S7-1500, S7-1500T)

7.15.1 MC_TorqueAdditive V5 (S7-1500, S7-1500T)

7.15.1.1 MC_TorqueAdditive: Specify additive torque V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_TorqueAdditive", you specify an additive torque for the drive to which the technology object is assigned. The torque data are transferred via the telegram 750.

With the "Value" parameter, you specify the additive setpoint torque. The specification of the additive torque setpoint is overriding. An additional torque may be positive or negative. If you invert the setpoint for the technology object, the value for the additive torque is also inverted and transferred inverted to the drive.

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The technology object has been enabled.
- The drive is connected via PROFIdrive telegram.
- Telegram 750 is configured.

  Telegram 750 is available for SINAMICS drives V4.9 and higher.

Override response

- An "MC_TorqueAdditive" job is not aborted by any other Motion Control job.
- A new "MC_TorqueAdditive" job does not abort any active Motion Control jobs.

Parameters

The following table shows the parameters of Motion Control instruction "MC_TorqueAdditive":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	The specified setpoint is used as long as the parameter is set to TRUE.
				FALSE	The additive torque transferred to the drive is zero.
Value	INPUT	LREAL	0.0	Additive setpoint torque Permissible values: -1.0E12 to 1.0E12	
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

See also

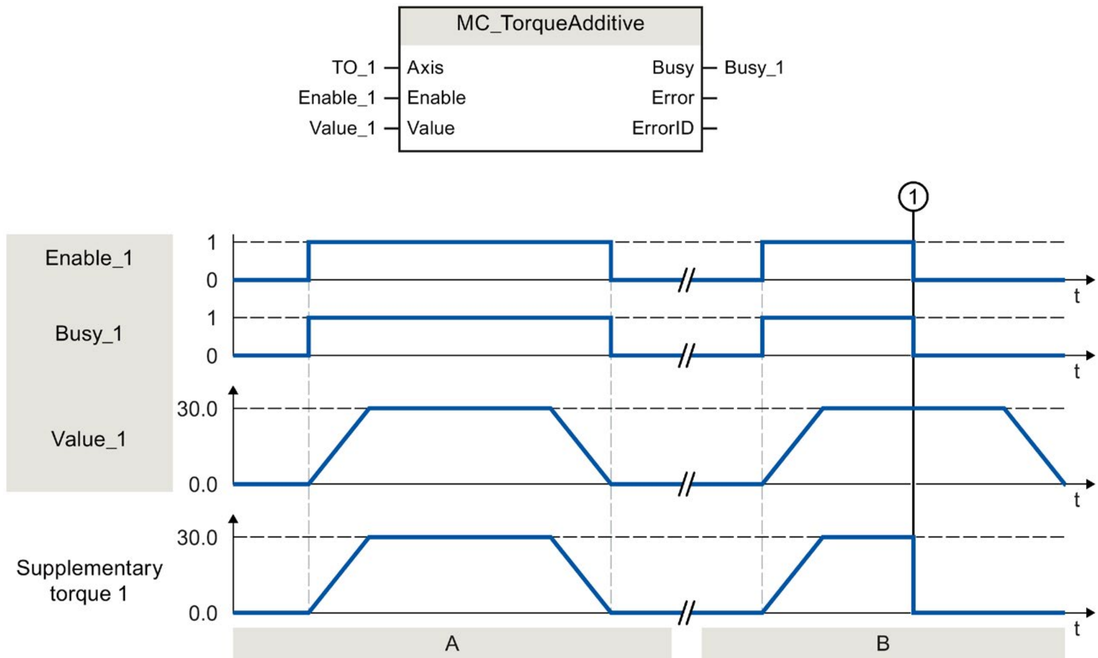
PROFIdrive telegrams (Page 27)

Additive setpoint torque (Page 62)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.15.1.2 MC_TorqueAdditive: Function chart V5 (S7-1500, S7-1500T)

Function chart: Activate/deactivate additive setpoint torque



Section A	With "Enable_1 = TRUE", an additive setpoint torque "Value_1" is specified for the drive assigned to the technology object. This setting is transferred to the drive parameter "p1511 - Supplementary torque 1" using telegram 750.
Section B	With "Enable_1 = TRUE", an additive setpoint torque "Value_1" is specified for the drive assigned to the technology object. This setting is transferred to the drive parameter "p1511 - Supplementary torque 1" using telegram 750. The additive setpoint torque is first built up. At time ①, "Enable_1" is already set to FALSE, before the additive setpoint torque is reduced again. The reduction of the torque setpoint is transmitted directly to the drive.

7.15.2 MC_TorqueRange V5 (S7-1500, S7-1500T)

7.15.2.1 MC_TorqueRange: Set high and low torque limits V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_TorqueRange", you can specify an upper and lower torque limit to the drive assigned to the technology object. The torque data are transferred via the telegram 750.

With the "UpperLimit" parameter you specify the upper torque limit and with "LowerLimit" the lower torque limit. The specification of the torque limits has smoothing effect on the movements. If you invert the setpoints for the technology object, the values for the high and low torque limit are also inverted and transferred inverted to the drive.

If the high and low torque limits are active, the following monitors and limits are disabled by default:

- Following error monitoring
- Time limitations for positioning and standstill monitoring

Monitoring remains in effect if you have selected the option "Leave position-related monitoring enabled" under "Technology object > Configuration > Extended parameters > Limits > Torque limit".

Applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirement

- The technology object has been configured correctly.
- The drive is connected via PROFIdrive telegram.
- Telegram 750 is configured.

  Telegram 750 is available for SINAMICS drives V4.9 and higher.

Override response

- An "MC_TorqueRange" job is not aborted by any other Motion Control job.
- A new "MC_TorqueRange" job does not abort any active Motion Control jobs.
- If the torque limiting is active via the "MC_TorqueLimiting" job, the "MC_TorqueRange" job is rejected with an error message and vice versa. The functions do not override one another.

Parameters

The following table shows the parameters of Motion Control instruction "MC_TorqueRange":

Parameter	Declaration	Data type	Default value	Description	
Axis	INPUT	TO_SpeedAxis TO_PositioningAxis TO_SynchronousAxis	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	The specified values are used as long as the TRUE parameter is set.
				FALSE	No values for the high and low torque limit are transferred to the drive.
UpperLimit	INPUT	LREAL	1.0 E12	Upper torque limit (in the configured unit) Permitted value range: -1.0 E12 to 1.0 E12 The value of the parameter "UpperLimit" must not be greater than the value of the parameter "LowerLimit".	
LowerLimit	INPUT	LREAL	-1.0 E12	Lower torque limit (in the configured unit) Permitted value range: -1.0 E12 to 1.0 E12 The value of the parameter "LowerLimit" must not be less than the value of the parameter "UpperLimit".	
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

See also

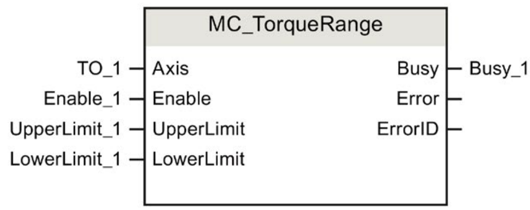
PROFIdrive telegrams (Page 27)

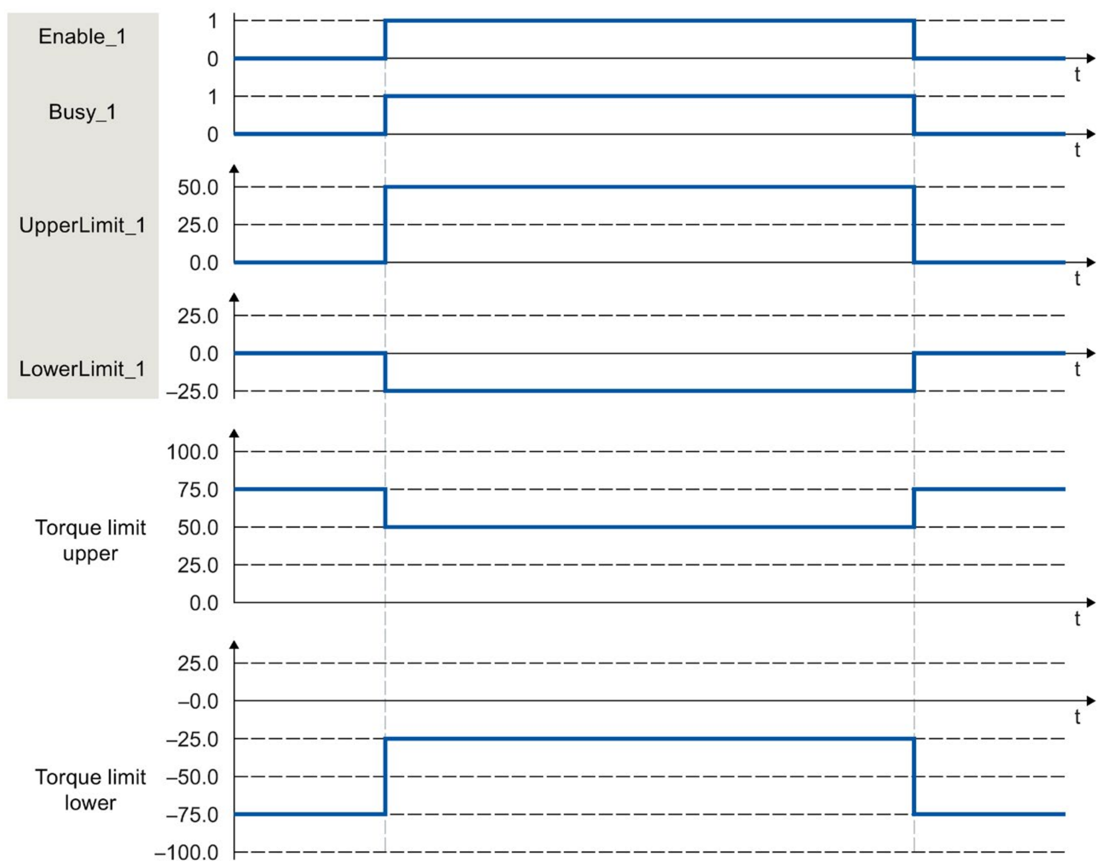
Permissible torque range (Page 63)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

7.15.2.2 MC_TorqueRange: Function chart V5 (S7-1500, S7-1500T)

Function chart: Set high and low torque limits





With "Enable_1 = TRUE" an upper torque limit "UpperLimit_1" and a lower torque limit "LowerLimit_1" are specified to the drive assigned to the technology object. These settings are transferred directly to the drive parameters "p1522 - Torque limit upper" and "p1523 - Torque limit lower" using telegram 750. If "Enable_1" is reset to FALSE, the upper and lower torque limits are no longer active.

7.15.3 MC_TorqueLimiting V5 (S7-1500, S7-1500T)

7.15.3.1 MC_TorqueLimiting: Activate/deactivate force/torque limit / fixed stop detection V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_TorqueLimiting", you activate and assign parameters for force/torque limiting and fixed stop detection. Together with a position-controlled motion job, a "Travel to fixed stop" can be realized with the fixed stop detection. In the axis configuration, you can configure whether the force/torque limiting is to relate to the drive side or the load side.

The functions of the Motion Control instruction "MC_TorqueLimiting" can be activated and deactivated before and during a motion job.

Force/torque limiting applies to

- Speed axis
- Positioning axis
- Synchronous axis

Requirements for force/torque limiting

- The technology object and the reference torque of the drive have been configured correctly.
- No errors that prevent enabling are pending for the technology object (the technology object must not be enabled).
- The drive must support force/torque reduction. Only PROFIdrive drives with SIEMENS telegram 10x support force/torque limiting.
- Interconnection in the SINAMICS drive:
  - P1522 to a fixed value of 100 %
  - P1523 to a fixed value of -100% (e.g. through interconnection to fixed value parameter P2902[i]).
  - P2194 Threshold value for the parameter "InLimitation" must be < 100% (default 90%)

Fixed stop detection applies to

- Synchronous axis
- Positioning axis

Requirement for fixed stop detection

- The fixed stop detection can only be applied to position-controlled axes. For fixed stop detection, the axis must be enabled as position-controlled. Motion jobs must be executed as position-controlled.
- The technology object has been configured correctly.
- When a drive and telegram that support force/torque limiting are used, the reference torque of the drive must be correctly configured for the technology object.
- No errors that prevent enabling are pending for the technology object (the technology object must be enabled).

Override response

- An "MC_TorqueLimiting" job cannot be aborted by any other Motion Control job.
- A new "MC_TorqueLimiting" job does not abort any active Motion Control jobs.
- If the high and low torque limiting is active via the "MC_TorqueRange" job, the "MC_TorqueLimiting" job is rejected with an error message and vice versa. The functions do not override one another.

Parameters

The following table shows the parameters of Motion Control instruction "MC_TorqueLimiting":

<table>
<tr><th>Parameter</th><th>Declara-tion</th><th>Data type</th><th>Default value</th><th colspan="2">Description</th></tr>
<tr><td>Axis</td><td>INPUT</td><td>TO_SpeedAxis
TO_PositioningAxis
TO_SynchronousAxis</td><td>-</td><td colspan="2">Technology object</td></tr>
<tr><td>Enable</td><td>INPUT</td><td>BOOL</td><td>FALSE</td><td>TRUE</td><td>Activate function corresponding to input parameter "Mode"</td></tr>
<tr><td rowspan="3">Limit</td><td rowspan="3">INPUT</td><td rowspan="3">LREAL</td><td rowspan="3">-1.0</td><td colspan="2">Value of force/torque limiting (in the configured unit of measurement)1)
If the drive and telegram do not support force/torque limiting, the specified value is irrele-vant.</td></tr>
<tr><td>≥ 0.0</td><td>The value specified at the parameter is used.</td></tr>
<tr><td>< 0.0</td><td>The value configured in the "Torque limiting" configuration window is used.
Tag Torque Limit:
<TO>.TorqueLimiting.LimitDefaults.Tor que
Tag Force Limit:
<TO>.TorqueLimiting.LimitDefaults.For ce</td></tr>
</table>

Parameter	Declaration	Data type	Default value	Description	
Mode	INPUT	DINT	0	0	Force/torque limiting[1]
				1	Fixed stop detection[1] If drive and telegram support force/torque limiting, this is applied.
InClamping	OUTPUT	BOOL	FALSE	TRUE	"Mode" = 1: The drive is kept at the fixed stop (clamping[2]). The axis position is within the positioning tolerance.
InLimitation	OUTPUT	BOOL	FALSE	TRUE	"Mode" = 0 and 1: The value specified at parameter "Limit" has exceeded the threshold value set in the drive. In case of SINAMICS drives default setting P2194 = 90%.
Busy	OUTPUT	BOOL	FALSE	TRUE	The job is being processed.
Error	OUTPUT	BOOL	FALSE	TRUE	An error occurred while processing 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 for parameter "ErrorID"	

1) Changes to input parameters "Limit" and "Mode" are also applied at the cyclic call of the Motion Control instruction when "Enable" = TRUE.

2) If "InClamping" = TRUE, all motion and synchronization jobs are canceled.

See also

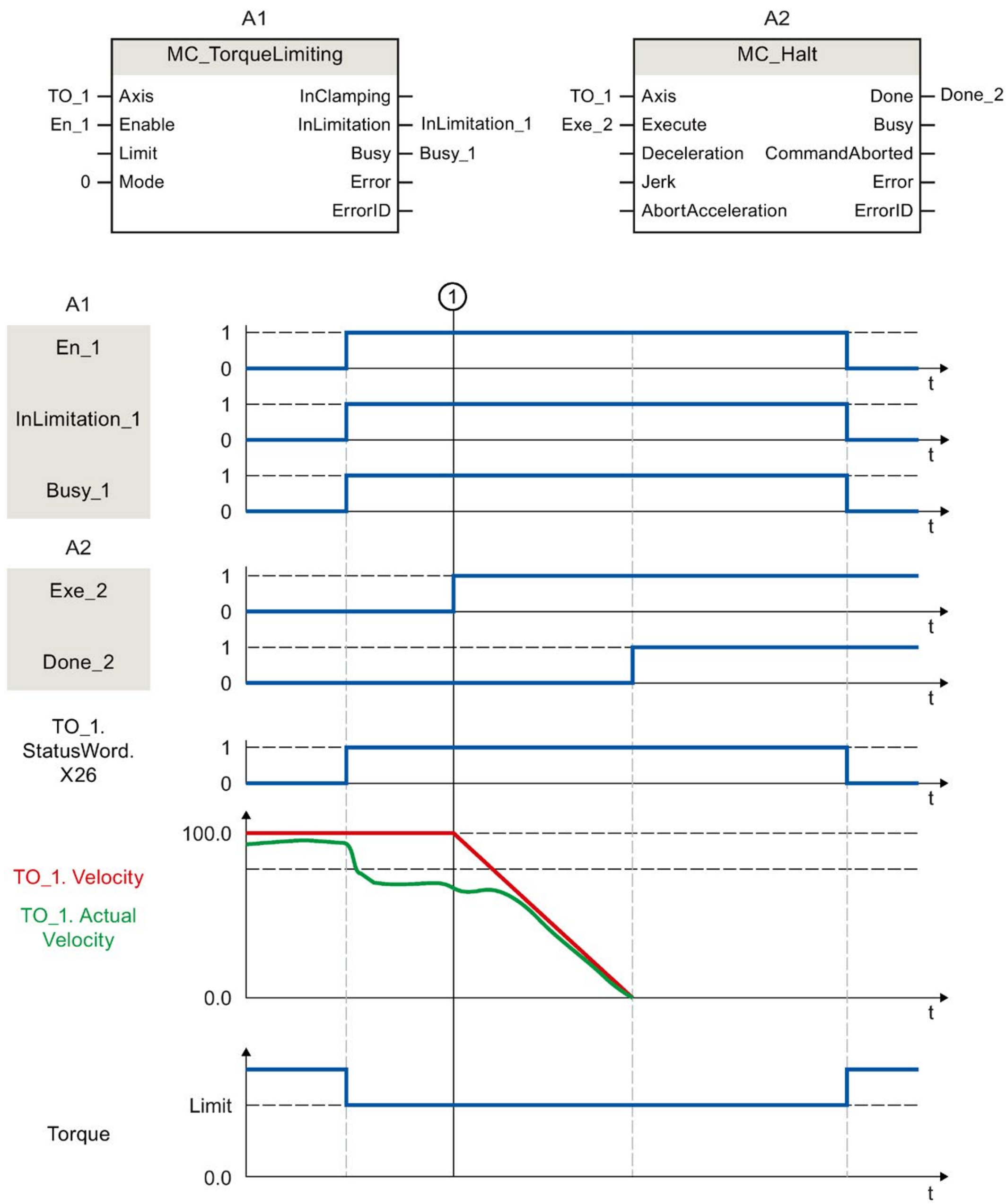
Fixed stop detection (Page 61)

Force/torque limiting (Page 59)

Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview". (https://support.industry.siemens.com/cs/ww/en/view/109766459)

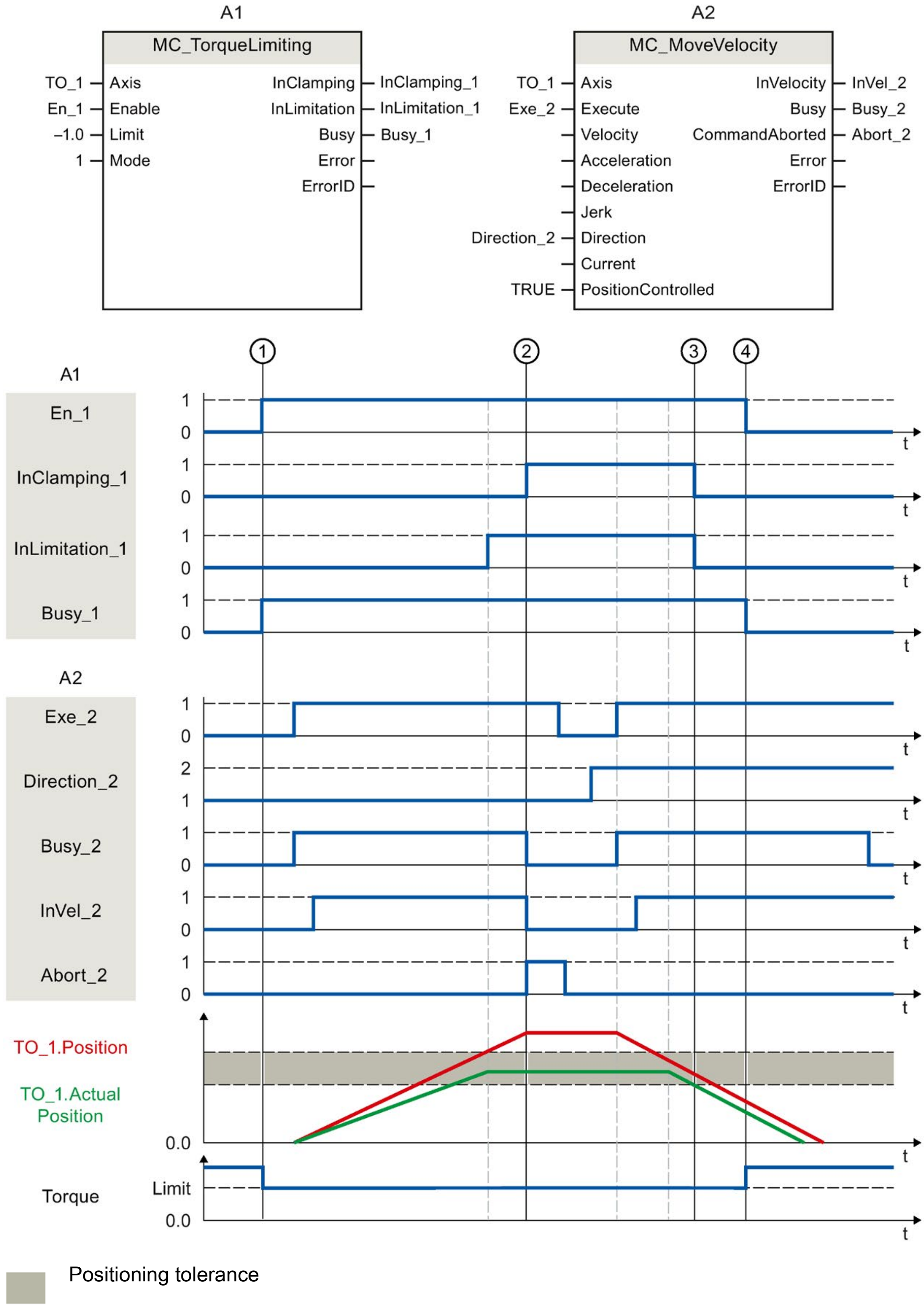
7.15.3.2 MC_TorqueLimiting: Function chart V5 (S7-1500, S7-1500T)

Function chart: Pausing an axis when the torque limit is reached



At time ①, an "MC_Halt" job (A2) is executed on an axis with active torque limiting "MC_TorqueLimiting" (A1). Torque limiting is still active ("MC_TorqueLimiting.Enable" = TRUE) and any accumulated following error is retained and will be reduced with the time. When the actual velocity is "0.0" and the minimum dwell time in the standstill window has elapsed, the tag "MC_Halt.Done" shows = TRUE. When position monitoring is activated, reaching of the target position is also monitored.

Function chart: Torque limiting with fixed stop detection (mode = 1)



At time ①, a "MC_TorqueLimiting" job (A1) is initiated via "En_1". An "MC_MoveVelocity" job (A2) is executed on the axis with active torque limiting. The torque limiting is still active "MC_TorqueLimiting.Enable" = TRUE. When the following error limit ② is reached, the "MC_MoveVelocity" job is aborted with "Abort" = TRUE. The drive is kept at the fixed stop (clamping). The actual position of the axis is within the positioning tolerance. An "MC_MoveVelocity" job is once again called via the two tags "Execute" = TRUE and "Direction_2" = TRUE and the axis moves with constant velocity in the opposite direction. The clamping is hereby reduced when the positioning tolerance ③ is exited. At time ④, the torque limiting is cancelled.

7.16 Override response of Motion Control jobs V5 (S7-1500, S7-1500T)

7.16.1 Override response V5: Homing and motion jobs (S7-1500, S7-1500T)

The following table shows how a new Motion Control job affects active homing and motion jobs:

⇒ Active job ⇓ New job	MC_Home "Mode" = 2, 8, 10	MC_Home ("Mode" = 3, 5)	MC_Halt MC_Move-Absolute MC_Move-Relative MC_Move-Velocity MC_MoveJog	MC_Stop	MC_Move-Superimposed	MC_MotionIn-Velocity MC_MotionIn-Position
MC_Home "Mode" = 3, 5	A	A	A	-	A	A
MC_Home "Mode" = 9	A	-	-	-	-	-
MC_Halt **MC_MoveAbsolute** **MC_MoveRelative** **MC_MoveVelocity** **MC_MoveJog** **MC_MotionInVelocity** **MC_MotionInPosition**	-	A	A	-	A	A
MC_Move Superimposed	-	-	-	-	A	-
MC_Stop	A	A	A	B	A	A
MC_GearIn	-	A	A	-	A	-
MC_GearInPos **MC_CamIn** waiting[1)]	-	-	-	-	-	-
MC_GearInPos **MC_CamIn** active[2)]	-	A	A	-	A	-
MC_LeadingValue Additive	-	-	-	-	-	-

A The running job is aborted with "CommandAborted" = TRUE.

B An "MC_Stop" job is aborted by another "MC_Stop" job with a stop response that is the same or higher.

- No effect. Running job continues to be executed.

1) The status "Busy" = TRUE, "StartSync" = FALSE, "InSync" = FALSE corresponds to a waiting synchronous operation.

2) The status "Busy" = TRUE, "StartSync" or "InSync" = TRUE corresponds to an active synchronous operation.

Note

Fixed stop

With an active force and torque limitation with "MC_TorqueLimiting", running jobs are aborted if the drive is held at the fixed stop with "InClamping" = TRUE.

7.16.2 Override response V5: Synchronous operation jobs (S7-1500, S7-1500T)

The following table shows how a new Motion Control job affects the motion of the axis on active synchronous operation jobs:

⇒ Active job ⇓ New job	MC_GearIn	MC_GearInPos MC_CamIn waiting[1)]	MC_GearInPos MC_CamIn active[2)]	MC_Phasing-Absolute MC_Phasing-Relative	MC_Leading-ValueAdditive
MC_Home "Mode" = 3, 5	A	-	-	-	-
MC_Halt	A	-	A	A	-
MC_MoveAbsolute MC_MoveRelative MC_MoveVelocity MC_MoveJog	A	-	A	A	-
MC_MotionInVelocity MC_MotionInPosition	A	A	A	-	-
MC_MoveSuperimposed	-	-	-	-	-
MC_Stop	A	A	A	A	A
MC_GearIn	A	A	A	A	-
MC_GearInPos MC_CamIn waiting[1)]	-	A	-	-	-
MC_GearInPos MC_CamIn active[2)]	A	A	A	A	-
MC_PhasingAbsolute MC_PhasingRelative	-	-	-	A	-
MC_LeadingValueAdditive	-	-	-	-	A

A The running job is aborted with "CommandAborted" = TRUE.

- No effect. Running job continues to be executed.

1) A waiting synchronous operation job ("Busy" = TRUE, "StartSync" = FALSE, "InSync" = FALSE) does not abort any active jobs. Abort with an "MC_Power" job is possible.

2) The status "Busy" = TRUE, "StartSync" or "InSync" = TRUE corresponds to active synchronous operation.

Note

Fixed stop

With an active force and torque limitation with "MC_TorqueLimiting", running jobs are aborted if the drive is held at the fixed stop with "InClamping" = TRUE.

7.16.3 Override response V5: Measuring input jobs (S7-1500, S7-1500T)

The following table shows which new Motion Control jobs will override active measuring input jobs:

⇒ Active job ⇓ New job	MC_MeasuringInput	MC_MeasuringInputCyclic
MC_Home "Mode" = 2, 3, 5, 8, 9, 10	A	A
MC_Home "Mode" = 0, 1, 6, 7, 11, 12	-	-
MC_MeasuringInput MC_MeasuringInputCyclic MC_AbortMeasuringInput	A	A

A The running job is aborted with "CommandAborted" = TRUE.

\- No effect. Running job continues to be executed.

7.16.4 Override response V5: Kinematics motion commands (S7-1500T)

Single axis jobs are not overridden by kinematics jobs.

The following table shows how a new Motion Control job affects active kinematics motion jobs:

⇒ Active job ⇓ New job	MC_MoveLinearAbsolute MC_MoveLinearRelative MC_MoveCircularAbsolute MC_MoveCircularRelative MC_MoveDirectAbsolute MC_MoveDirectRelative MC_TrackConveyorBelt MC_DefineWorkspaceZone MC_DefineKinematicsZone MC_SetWorkspaceZoneActive MC_SetWorkspaceZoneInactive MC_SetKinematicsZoneActive MC_SetKinematicsZoneInactive MC_SetOcsFrame	MC_GroupInterrupt	MC_GroupStop
MC_Home MC_MoveSuperimposed	N	N	N
MC_Halt MC_MoveAbsolute MC_MoveRelative MC_MoveVelocity MC_MoveJog MC_Stop MC_GearIn MC_GearInPos MC_CamIn MC_MotionInVelocity MC_MotionInPosition	A	A	A
MC_GroupStop	A	A	N
MC_GroupInterrupt MC_GroupContinue	B	A	N

⇒ Active job ⇓ New job	MC_MoveLinearAbsolute MC_MoveLinearRelative MC_MoveCircularAbsolute MC_MoveCircularRelative MC_MoveDirectAbsolute MC_MoveDirectRelative MC_TrackConveyorBelt MC_DefineWorkspaceZone MC_DefineKinematicsZone MC_SetWorkspaceZoneActive MC_SetWorkspaceZoneInactive MC_SetKinematicsZoneActive MC_SetKinematicsZoneInactive MC_SetOcsFrame	MC_GroupInterrupt	MC_GroupStop
MC_MoveLinearAbsolute MC_MoveLinearRelative MC_MoveCircularAbsolute MC_MoveCircularRelative MC_MoveDirectAbsolute MC_MoveDirectRelative MC_TrackConveyorBelt MC_DefineWorkspaceZone MC_DefineKinematicsZone MC_SetWorkspaceZoneActive MC_SetWorkspaceZoneInactive MC_SetKinematicsZoneActive MC_SetKinematicsZoneInactive	-	-	N
MC_SetOcsFrame	C, -	-	N

A The running job is aborted with "CommandAborted" = TRUE.

B Running job is interrupted or resumed.

C Synchronization of the OCS with the conveyor belt is aborted with "MC_SetOcsFrame" = TRUE.

N Not permitted. Running job continues to be executed. The new job is rejected.

\- No effect. Running job continues to be executed. A new kinematics job is added to the job sequence.

Appendix (S7-1500, S7-1500T)　A

A.1 Tags of the speed axis technology object (S7-1500, S7-1500T)

A.1.1 Legend (S7-1500, S7-1500T)

<table>
<tr><td>Tag</td><td colspan="2">Name of the tag</td></tr>
<tr><td>Data type</td><td colspan="2">Data type of the tag</td></tr>
<tr><td>Values</td><td colspan="2">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".</td></tr>
<tr><td rowspan="5">W</td><td colspan="2">Effectiveness of changes in the technology data block</td></tr>
<tr><td>DIR</td><td>Direct:
Values are changed via direct assignment and take effect at the start of the next MC-Servo [OB91].</td></tr>
<tr><td>CAL</td><td>At call of Motion Control instruction:
Values are changed directly and take effect at the start of the next MC-Servo [OB91] after the call of the corresponding Motion Control instruction in the user program.</td></tr>
<tr><td>RES</td><td>Restart:
Changes to the start value in the 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.</td></tr>
<tr><td>RON</td><td>Read only:
The tag cannot and must not be changed during runtime of the user program.</td></tr>
<tr><td>Description</td><td colspan="2">Description of the tag</td></tr>
</table>

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) (S7-1500, S7-1500T)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description
Velocity	LREAL	-	RON	Velocity setpoint/speed setpoint
ActualSpeed	LREAL	-	RON	With analog setpoint = 0.0: Actual speed of the motor
Acceleration	LREAL	-	RON	Setpoint acceleration
VelocitySetpoint	LREAL	-1.0E12 to 1.0E12	RON	Output velocity setpoint/speed setpoint

A.1.3 "Simulation" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Simulation.<tag name>" contains the configuration of the simulation mode. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description	
Simulation.	TO_Struct_AxisSimulation				
Mode	UDINT	0, 1	RES[1]	Simulation mode	
				0	No simulation, normal operation
				1	Simulation mode

[1] Technology version V2.0: RON

A.1.4 "VirtualAxis" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.VirtualAxis.<tag name>" contains the configuration of the simulation mode. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 276)

Tag		Data type	Values	W	Description	
VirtualAxis.		TO_Struct_VirtualAxis				
	Mode	UDINT	0, 1	RON	Virtual axis	
					0	No virtual axis
					1	Axis is always and exclusively operated as virtual axis

A.1.5 "Actor" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Actor.<tag name>" contains the controller-side configuration of the drive.

Tags

Legend (Page 276)

Tag		Data type	Values	W	Description	
Actor.		TO_Struct_Actor				
	Type	DINT	0, 1	RON	Drive connection	
					0	Analog output
					1	PROFIdrive telegram
	InverseDirection	BOOL	-	RES	Inversion of the setpoint	
					FALSE	No
					TRUE	Yes
	DataAdaption	DINT	0, 1	RES	Automatic transfer of the drive values reference speed, maximum speed and reference torque in the device	
					0	No automatic transfer, manual configuration of values
					1	Automatic transfer of values configured in the drive to the configuration of the technology object
	Efficiency	LREAL	0.0 to 1.0	RES	Efficiency of gear	

Tag	Data type	Values	W	Description
Interface.	TO_Struct_ActorInterface			
AddressIn	VREF	0 to 65535	RON	Input address for the PROFIdrive telegram
AddressOut	VREF	0 to 65535	RON	Output address for the PROFIdrive telegram or the analog setpoint
EnableDriveOutput	BOOL	-	RES	"Enable output" for analog drives FALSE: Disabled TRUE: Enabled
EnableDrive OutputAddress	VREF	0 to 65535	RON	Address for the "Enable output" for analog setpoint
DriveReadyInput	BOOL	-	RES	"Ready input" for analog drives The analog drive signals its readiness to receive speed setpoints. FALSE: Disabled TRUE: Enabled
DriveReadyInput Address	VREF	0 to 65535	RON	Address for the "Enable input" for analog setpoint
EnableTorqueData	BOOL	-	RES	Torque data FALSE: Disabled TRUE: Enabled
TorqueData AddressIn	VREF	0 to 65535	RON	Input Address of the Telegram 750
TorqueData AddressOut	VREF	0 to 65535	RON	Output address of the telegram 750
DriveParameter.	TO_Struct_ActorDriveParameter			
ReferenceSpeed	LREAL	0.0 to 1.0E12	RES	Reference value (100%) for the speed setpoint (N-set) of the drive The speed setpoint is transferred in the PROFIdrive telegram as a normalized 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%, provided the drive permits this.
MaxSpeed	LREAL	0.0 to 1.0E12	RES	Maximum value for the speed setpoint of the drive (N-set) (PROFIdrive: MaxSpeed ≤ 2 × ReferenceSpeed Analog setpoint: MaxSpeed ≤ 1.17 × ReferenceSpeed)
ReferenceTorque	LREAL	0.0 to 1.0E12	RES	Reference torque of drive (p2003) Valid for the standard motor setting.

A.1.6 "TorqueLimiting" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.TorqueLimiting.<tag name>" contains the configuration of the torque limiting.

Tags

Legend (Page 276)

Tag			Data type	Values	W	Description	
TorqueLimiting.			TO_Struct_TorqueLimiting				
	LimitBase		DINT	0, 1	RES	Torque limiting	
						0	Motor side
						1	Load side
	PositionBased Monitorings		DINT	0, 1	RES	Positioning and following error monitoring	
						0	Monitoring deactivated
						1	Monitoring activated
	LimitDefaults.		TO_Struct_ TorqueLimitingLimitDefaults				
		Torque	LREAL	0.0 to 1.0E12	CAL	Limiting torque	
		Force	LREAL	0.0 to 1.0E12	CAL	Limiting force	

A.1.7 "LoadGear" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.LoadGear.<tag name>" contains the configuration of the load gear.

Tags

Legend (Page 276)

Tag		Data type	Value range	W	Description
LoadGear.		TO_Struct_LoadGear			
	Numerator	UDINT	1 to 4294967295	RES	Load gear numerator
	Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.1.8 "Units" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description	
Units.	TO_Struct_Units / TO_Struct_ExternalEncoder_Units				
VelocityUnit	UDINT	-	RON	Unit for velocity	
				1082	1/s
				1083	1/min
				1528	1/h
TimeUnit	UDINT	-	RON	Unit for time	
				1054	s
TorqueUnit	UDINT	-	RON	Unit for torque	
				1126	Nm
				1128	kNm
				1529	lbf in (pound-force-inch)
				1530	lbf ft
				1531	ozf in (ounce-force-inch)
				1532	ozf ft
				1533	pdl in (poundal-inch)
				1534	pdl ft
ForceUnit	UDINT	-	RON	Unit for force	
				1120	N
				1122	kN
				1094	lbf (pound-force)
				1093	ozf (ounce-force)
				1535	pdl (poundals)
UnitFactor	UDINT	-	RON	Factor for internal conversion in the high-resolution units.	

A.1.9 "DynamicLimits" tag (speed axis) (S7-1500, S7-1500T)

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 276)

Tag	Data type	Values	W	Description
DynamicLimits.	TO_Struct_DynamicLimits			
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.1.10 "DynamicDefaults" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.DynamicDefaults.<tag name>" contains the configuration of the dynamic defaults. These settings will be used when you specify a dynamic value less than 0.0 in a Motion Control instruction (exceptions: "MC_MoveJog.Velocity", "MC_MoveVelocity.Velocity"). Changes to the default dynamic values will be applied at the next positive edge at the "Execute" parameter of a Motion Control instruction.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description
DynamicDefaults.	TO_Struct_DynamicDefaults			
Velocity	LREAL	0.0 to 1.0E12	CAL	Default velocity
Acceleration	LREAL	0.0 to 1.0E12	CAL	Default acceleration
Deceleration	LREAL	0.0 to 1.0E12	CAL	Default deceleration
Jerk	LREAL	0.0 to 1.0E12	CAL	Default jerk
Emergency Deceleration	LREAL	0.0 to 1.0E12	DIR	Emergency stop deceleration

A.1.11 "Override" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Override.<tag name>" contains the configuration of 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 276)

Tag	Data type	Values	W	Description
Override.	TO_Struct_Override			
Velocity	LREAL	0.0 to 200.0%	DIR	Velocity or speed override Percentage correction of the velocity/speed

A.1.12 "StatusDrive" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusDrive.<tag name>" indicates the status of the drive.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description	
StatusDrive.	TO_Struct_StatusDrive				
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 drive error
				TRUE	Drive error
AdaptionState	DINT	0 to 4	RON	Status of automatic data transfer of drive parameters	
				0	"NOT_ADAPTED" Data not transferred
				1	"IN_ADAPTION" Data transfer in progress
				2	"ADAPTED" Data transfer complete
				3	"NOT_APPLICABLE" Data transfer not selected, not possible
				4	"ADAPTION_ERROR" Error during data transfer

A.1.13 "StatusTorqueData" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusTorqueData.<tag name>" indicates the status of the torque.

Tags

Legend (Page 276)

Tag	Data type	Value range	W	Description	
StatusTorqueData.	TO_Struct_StatusTorqueData				
CommandAdditiveTorqueActive	DINT	-	RON	Additive torque setpoint function	
				0	Disabled
				1	Enabled
CommandTorqueRangeActive	DINT	-	RON	Torque range above high and low limit of the torque function	
				0	Disabled
				1	Enabled
ActualTorque	LREAL	-1.0E12 to 1.0E12	RON	Actual torque of the axis in the technological unit of the technology object for torque	

A.1.14 "StatusMotionIn" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusMotionIn.<tag name>" indicates the motion status.

Tags

Legend (Page 276)

Tag	Data type	Value range	W	Description	
StatusMotionIn.	TO_Struct_StatusMotionIn				
FunctionState	DINT	0, 1	RON	0	No "MotionIn" function active
				1	"MotionInVelocity" function active

A.1.15 "StatusWord" tag (speed axis) (S7-1500, S7-1500T)

The "<TO>.StatusWord" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 0 "Enable") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 276)

Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information 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 tags unchanged
				1	Change to Restart tags 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 is active 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" job active
				1	"MC_MoveJog" job active
Bit 10	-	-	-	"VelocityCommand"	
				0	No "MC_MoveVelocity" job active
				1	"MC_MoveVelocity" job active
Bit 11	-	-	-	Reserved	
Bit 12	-	-	-	"ConstantVelocity"	
				0	The axis is accelerated or decelerated.
				1	The setpoint velocity is reached. A constant velocity setpoint is output.

Tag	Data type	Values	W	Description	
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 24	-	-	-	Reserved	
Bit 25	-	-	-	"AxisSimulation"	
				0	No simulation
				1	Simulation is active
Bit 26	-	-	-	"TorqueLimitingCommand"	
				0	No "MC_TorqueLimiting" job is active
				1	"MC_TorqueLimiting" job is active
Bit 27	-	-	-	"InLimitation"	
				0	The drive does not operate at the torque limit.
				1	The drive operates at least at the threshold value (default 90%) of the torque limit.
Bit 28... Bit 31	-	-	-	Reserved	

A.1.16 "StatusWord2" tag (speed axis) (S7-1500, S7-1500T)

The "<TO>.StatusWord2" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 0 "StopCommand") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tags

Legend (Page 276)

Tag	Data type	Value range	W	Description	
StatusWord2	DWORD	-	RON	Status information of the technology object	
Bit 0	BOOL	-	RON	"StopCommand"	
				0	No "MC_Stop" job is active.
				1	An "MC_Stop" job is running. The technology object is disabled.
Bit 1 to Bit 31	BOOL	-	RON	Reserved	

A.1.17 "ErrorWord" tag (speed axis) (S7-1500, S7-1500T)

The "<TO>.ErrorWord" tag indicates technology object errors (technology alarms).

Information on the evaluation of the individual bits (e.g. bit 3 "CommandNotAccepted") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 276)

Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" System error
Bit 1	-	-	-	"ConfigFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in user program at a Motion Control instruction or its use
Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
Bit 4	-	-	-	"DriveFault" Error in 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... Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14	-	-	-	Reserved
Bit 15	-	-	-	"AdaptionError" Error during data transfer
Bit 16 ... Bit 31	-	-	-	Reserved

A.1.18 "ErrorDetail" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.ErrorDetail.<tag name>" contains the alarm number and the effective local alarm reaction for the technology alarm that is currently pending on the technology object.

You can find a list of the technology alarms and alarm reactions in the "Technology alarms" appendix of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description	
ErrorDetail.	TO_Struct_ErrorDetail				
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	Track setpoints

A.1.19 "WarningWord" tag (speed axis) (S7-1500, S7-1500T)

The "<TO>.WarningWord" tag indicates pending warnings at the technology object.

Information on the evaluation of the individual bits (e.g. bit 13 "PeripheralWarning") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 276)

Tag		Data type	Values	W	Description
WarningWord		DWORD	-	RON	
	Bit 0	-	-	-	"SystemWarning" A system-internal error has occurred.
	Bit 1	-	-	-	"ConfigWarning" Configuration error One or several configuration parameters are adjusted internally.
	Bit 2	-	-	-	"UserWarning" Error in user program at a Motion Control instruction or its use
	Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
	Bit 4	-	-	-	"DriveWarning" Error in drive
	Bit 5	-	-	-	Reserved
	Bit 6	-	-	-	"DynamicWarning" Specified dynamic values are limited to permissible values.
	Bit 7	-	-	-	"CommunicationWarning" Communication error Missing or faulty communication.
	Bit 8... Bit 12	-	-	-	Reserved
	Bit 13	-	-	-	"PeripheralWarning" Error accessing a logical address
	Bit 14	-	-	-	Reserved
	Bit 15	-	-	-	"AdaptionWarning" Error in automatic data transfer
	Bit 16... Bit 31	-	-	-	Reserved

A.1.20 "ControlPanel" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.ControlPanel.<tag name>" contains no user-relevant data. This tag structure is internally used.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description
ControlPanel.	TO_Struct_ControlPanel			
Input.	TO_Struct_ControlPanelInput			
TimeOut	LREAL	100 to 60000	DIR	-
EsLifeSign	UDINT	-	DIR	-
Command[1..1].	ARRAY [1..1] OF TO_Struct_ControlPanelInputCmd			
ReqCounter	UDINT	-	DIR	-
Type	UDINT	-	DIR	-
Position	LREAL	-	DIR	-
Velocity	LREAL	-	DIR	-
Acceleration	LREAL	-	DIR	-
Deceleration	LREAL	-	DIR	-
Jerk	LREAL	-	DIR	-
Param	LREAL	-	DIR	-
Output.	TO_Struct_ControlPanelOutput			
RTLifeSign	UDINT	-	RON	-
Command[1..1].	ARRAY [1..1] OF TO_Struct_ ControlPanelOutputCmd			
AckCounter	UDINT	-	RON	-
Error	BOOL	-	RON	-
ErrorID	UDINT	-	RON	-
Done	BOOL	-	RON	-
Aborted	BOOL	-	RON	-

A.1.21 "InternalToTrace[1..4]" tag (speed axis) (S7-1500, S7-1500T)

The tag structure "<TO>.InternalToTrace[1..4]..<tag name>" contains no user-relevant data. This tag structure is internally used.

Tags

Legend (Page 276)

Tag	Data type	Values	W	Description
InternalToTrace[1..4].	ARRAY [1..4] OF TO_Struct_Internal			
Id	DINT	-	DIR	-
Value	LREAL	-	DIR	-

A.2 Tags of the positioning axis technology object (S7-1500, S7-1500T)

A.2.1 Legend (S7-1500, S7-1500T)

<table>
<tr><td>Tag</td><td colspan="2">Name of the tag</td></tr>
<tr><td>Data type</td><td colspan="2">Data type of the tag</td></tr>
<tr><td>Values</td><td colspan="2">Value range of the tag - minimum value to maximum value
(L - linear specification R - rotary specification)
If no specific value is shown, the value range limits of the relevant data type apply or the information under "Description".</td></tr>
<tr><td rowspan="5">W</td><td colspan="2">Effectiveness of changes in the technology data block</td></tr>
<tr><td>DIR</td><td>Direct:
Values are changed via direct assignment and take effect at the start of the next MC-Servo [OB91].</td></tr>
<tr><td>CAL</td><td>At call of Motion Control instruction:
Values are changed directly and take effect at the start of the next MC-Servo [OB91] after the call of the corresponding Motion Control instruction in the user program.</td></tr>
<tr><td>RES</td><td>Restart:
Changes to the start value in the 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.</td></tr>
<tr><td>RON</td><td>Read only:
The tag cannot and must not be changed during runtime of the user program.</td></tr>
<tr><td>Description</td><td colspan="2">Description of the tag</td></tr>
</table>

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) (S7-1500, S7-1500T)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description
Position	LREAL	-	RON	Position setpoint
Velocity	LREAL	-	RON	Velocity setpoint/speed setpoint
ActualPosition	LREAL	-	RON	Actual position
ActualVelocity	LREAL	-	RON	Actual velocity
ActualSpeed	LREAL	-	RON	With analog setpoint = 0.0: Actual speed of the motor
Acceleration	LREAL	-	RON	Setpoint acceleration
ActualAcceleration	LREAL	-	RON	Actual acceleration
OperativeSensor	UDINT	1 to 4	RON	Operative encoder
ModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles of the setpoint
ActualModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles of the actual value
VelocitySetpoint	LREAL	-1.0E12 to 1.0E12	RON	Output velocity setpoint/speed setpoint

A.2.3 "Simulation" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Simulation.<tag name>" contains the configuration of the simulation mode. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 293)

<table>
<tr><th colspan="2">Tag</th><th>Data type</th><th>Values</th><th>W</th><th colspan="2">Description</th></tr>
<tr><td colspan="2">Simulation.</td><td colspan="3">TO_Struct_AxisSimulation</td><td colspan="2"></td></tr>
<tr><td rowspan="3"></td><td rowspan="3">Mode</td><td rowspan="3">UDINT</td><td rowspan="3">0, 1</td><td rowspan="3">RES1)</td><td colspan="2">Simulation mode</td></tr>
<tr><td>0</td><td>No simulation, normal operation</td></tr>
<tr><td>1</td><td>Simulation mode</td></tr>
</table>

1) Technology version V2.0: RON

A.2.4 "VirtualAxis" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.VirtualAxis.<tag name>" contains the configuration of the simulation mode. In simulation mode, you can simulate axes without a real drive in the CPU.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
VirtualAxis.	TO_Struct_VirrtualAxis				
Mode	UDINT	0, 1	RON	Virtual axis	
				0	No virtual axis
				1	Axis is always and exclusively operated as virtual axis

A.2.5 "Actor" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Actor.<tag name>" contains the controller-side configuration of the drive.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
Actor.	TO_Struct_Actor				
Type	DINT	0, 1	RON	Drive connection	
				0	Analog output
				1	PROFIdrive telegram
InverseDirection	BOOL	-	RES	Inversion of the setpoint	
				FALSE	No
				TRUE	Yes
DataAdaption	DINT	0, 1	RES	Automatic transfer of the drive values reference speed, maximum speed and reference torque	
				0	No automatic transfer, manual configuration of values
				1	Automatic transfer of values configured in the drive to the configuration of the technology object
Efficiency	LREAL	0.0 to 1.0	RES	Efficiency of mechanics (gear and leadscrew)	

Tag	Data type	Values	W	Description
Interface.	TO_Struct_ActorInterface			
AddressIn	VREF	0 to 65535	RON	Input address for the PROFIdrive telegram
AddressOut	VREF	0 to 65535	RON	Output address for the PROFIdrive telegram or the analog setpoint
EnableDriveOutput	BOOL	-	RES	"Enable output" for analog drives FALSE: Disabled TRUE: Enabled
EnableDrive OutputAddress	VREF	0 to 65535	RON	Address for the "Enable output" for analog setpoint
DriveReadyInput	BOOL	-	RES	"Ready input" for analog drives The analog drive signals its readiness to receive speed setpoints. FALSE: Disabled TRUE: Enabled
DriveReady InputAddress	VREF	0 to 65535	RON	Address for the "Enable input" for analog setpoint
EnableTorqueData	BOOL	-	RES	Torque data FALSE: Disabled TRUE: Enabled
TorqueData AddressIn	VREF	0 to 65535	RON	Input address of the supplemental telegram
TorqueData AddressOut	VREF	0 to 65535	RON	Output address of the supplemental telegram
DriveParameter.	TO_Struct_ActorDriveParameter			
ReferenceSpeed	LREAL	0.0 to 1.0E12	RES	Reference value (100%) for the speed setpoint (N-set) of the drive The speed setpoint is transferred in the PROFIdrive telegram as a normalized 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%, provided the drive permits this.
MaxSpeed	LREAL	0.0 to 1.0E12	RES	Maximum value for the speed setpoint of the drive (N-set) (PROFIdrive: MaxSpeed ≤ 2 × ReferenceSpeed Analog setpoint: MaxSpeed ≤ 1.17 × ReferenceSpeed)
ReferenceTorque	LREAL	0.0 to 1.0E12	RES	Reference value (100%) for the drive torque

A.2.6 "TorqueLimiting" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.TorqueLimiting.<tag name>" contains the configuration of the torque limiting.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
TorqueLimiting.	TO_Struct_TorqueLimiting				
LimitBase	DINT	0, 1	RES	Torque limiting	
				0	Motor side
				1	Load side
PositionBased Monitorings	DINT	0, 1	RES	Positioning and following error monitoring	
				0	Monitoring deactivated
				1	Monitoring activated
LimitDefaults.	TO_Struct_ TorqueLimitingLimitDefaults				
Torque	LREAL	0.0 to 1.0E12	CAL	Limiting torque	
Force	LREAL	0.0 to 1.0E12	CAL	Limiting force	

A.2.7 "Clamping" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Clamping.<tag name>" contains the configuration of the fixed stop detection.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description
Clamping.	TO_Struct_Clamping			
FollowingError Deviation	LREAL	0.001 to 1.0E12	DIR	Value of the following error starting from which the fixed stop is detected.
PositionTolerance	LREAL	0.001 to 1.0E12	DIR	Position tolerance for the clamping monitoring

A.2.8 Sensor[1..4] tags (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Sensor[1..4].<tag name>" contains the controller-end configuration for the encoder, and the configuration for active and passive homing.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
Sensor[1..4].	ARRAY [1..4] OF TO_Struct_Sensor / TO_Struct_ExternalEncoder_ Sensor				
Existent	BOOL	-	RON	Displaying created encoders	
Type	DINT	0 to 2	RON	Encoder type	
				0	"INCREMENTAL" Incremental
				1	"ABSOLUTE" Absolute
				2	"CYCLIC_ABSOLUTE" Cyclic absolute
InverseDirection	BOOL	-	RES	Inversion of the actual value	
				FALSE	No
				TRUE	Yes
System	DINT	0, 1	RES	Encoder system	
				0	"LINEAR" Linear encoder
				1	"ROTATORY" Rotary encoder
MountingMode	DINT	0 to 2	RES	Mounting type of encoder	
				0	On motor shaft
				1	On load side
				2	External measuring system
DataAdaption	DINT	0, 1	RES	Automatic transfer of the drive values reference speed, maximum speed and reference torque in the device	
				0	No automatic transfer, manual configuration of values
				1	Automatic transfer of values configured in the drive to the configuration of the technology object
Interface.	TO_Struct_SensorInterface				
AddressIn	VREF	0 to 65535	RON	Input address for the PROFIdrive telegram	
AddressOut	VREF	0 to 65535	RON	Output address for the PROFIdrive telegram	
Number	UDINT	1 to 2	RON	Number of the encoder in the telegram	

Tag	Data type	Values	W	Description	
Parameter.	TO_Struct_SensorParameter				
Resolution	LREAL	-1.0E12 to 1.0E12	RES	Resolution of a linear encoder (offset between two encoder pulses)	
StepsPerRevolution	UDINT	1 to 8388608	RES	Increments per rotary encoder revolution	
FineResolutionXist1	UDINT	0 … 31	RES	Number of bits for fine resolution Gx_XIST1 (cyclic actual encoder value)	
FineResolutionXist2	UDINT	0 … 31	RES	Number of bits for fine resolution Gx_XIST2 (absolute value of encoder)	
Determinable Revolutions	UDINT	0 to 8388608	RES	Number of differentiable encoder revolutions for a multi-turn absolute encoder (For a single-turn absolute 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	
BehaviorGx_XIST1	DINT	-	RES	Evaluation of Gx_XIST1 bits	
				0	Based on the bits of the encoder resolution
				1	32-bit value of the encoder value
ActiveHoming.	TO_Struct_SensorActiveHoming				
Mode	DINT	0 to 2	RES	Homing mode	
				0	Use zero mark via PROFIdrive telegram
				1	Zero mark via PROFIdrive telegram and reference output cam
				2	Use homing mark via digital input
SideInput	BOOL	-	CAL	Side of the digital input for active homing	
				FALSE	Negative side
				TRUE	Positive side
Direction	DINT	0, 1	CAL	Homing direction/approach direction on the homing mark	
				0	Positive homing direction
				1	Negative homing direction
DigitalInputAddress	VREF	0 to 65535	RON	Address of digital input	
HomePositionOffset	LREAL	-1.0E12 to 1.0E12	CAL	Home position offset	
SwitchLevel	BOOL	-	RES	Signal level that is present at the digital input when homing mark is approached	
				FALSE	Low level
				TRUE	High level

Tag	Data type	Values	W	Description	
PassiveHoming.	TO_Struct_SensorPassiveHoming				
Mode	DINT	0 to 2	RES	Homing mode	
				0	Use zero mark via PROFIdrive telegram
				1	Zero mark via PROFIdrive telegram and reference output cam
				2	Use homing mark via digital input
SideInput	BOOL	-	CAL	Side of the digital input for passive homing	
				FALSE	Negative side
				TRUE	Positive side
Direction	DINT	0 to 2	CAL	Homing direction/approach direction on the homing mark	
				0	Positive homing direction
				1	Negative homing direction
				2	Current homing direction
DigitalInputAddress	VREF	0 to 65535	RON	Address of digital input	
SwitchLevel	BOOL	-	RES	Signal level that is present at the digital input when homing mark is approached	
				FALSE	Low level
				TRUE	High level

A.2.9 "CrossPlcSynchronousOperation" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.CrossPlcSynchronousOperation.<tag name>" contains the configuration of the cross-PLC synchronous operation.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
CrossPlc SynchronousOperation.	TO_Struct_ CrossPlcSynchronousOperation				
Interface[1..1].	ARRAY [1..1] of TO_Struct_ CrossPlcLeadingValueInterface				
EnableLeading ValueOutput	BOOL	-	RON	Provide cross-PLC leading value	
				FALSE	No
				TRUE	Yes
AddressOut	VREF	-	RON	Output address for the leading value telegram	
LocalLeading ValueDelayTime	LREAL	0.0 to 1.0E12	DIR	Delay time of leading value output on the local following axes	

A.2.10 "Extrapolation" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Extrapolation.<tag name>" contains the configuration of the actual value extrapolation.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description
Extrapolation.	TO_Struct_Extrapolation			
LeadingAxis DependentTime	LREAL	-	RON	Extrapolation time component (caused by leading axis) Results from the following times: • Time of actual value acquisition for the leading axis • Interpolator cycle clock • Time of position filter of actual value extrapolation (T1 + T2)
FollowingAxis DependentTime	LREAL	0.0 to 1.0E12	DIR	Extrapolation time component (caused by following axis) Results from the following times: • For a following axis with set velocity precontrol: – Communication cycle – Interpolator cycle clock – Speed control loop substitute time for the following axis – Output delay time of the setpoint at the following axis • For a following axis without velocity precontrol: – Communication cycle – Interpolator cycle clock – Position control loop equivalent time (1/Kv from "<TO>.PositionControl.Kv") – Output delay time of the setpoint at the following axis

Tag	Data type	Values	W	Description
Settings.	TO_Struct_ExtrapolationSettings			
SystemDefined Extrapolation	DINT	0, 1	RES	Leading axis dependent time 0: Not effective 1: Effective
Extrapolated VelocityMode	DINT	0, 1	RES	Effective velocity value for the synchronization function 0: "FilteredVelocity" Leading value velocity from filtered actual velocity 1: "VelocityByDifferentiation" The leading value velocity results from the differentiation of the extrapolated leading value position
PositionFilter.	TO_Struct_ExtrapolationPositionFilter			
T1	LREAL	0.0 to 1.0E12	DIR	Position filter time constant T1
T2	LREAL	0.0 to 1.0E12	DIR	Position filter time constant T2
VelocityFilter.	TO_Struct_ExtrapolationVelocityFilter			
T1	LREAL	0.0 to 1.0E12	DIR	Velocity filter time constant T1
T2	LREAL	0.0 to 1.0E12	DIR	Velocity filter time constant T2
VelocityTolerance.	TO_Struct_ExtrapolationVelocityTolerance			
Range	LREAL	0.0 to 1.0E12	DIR	Tolerance band width for velocity
Hysteresis.	TO_Struct_ExtrapolationHysteresis			
Value	LREAL	0.0 to 1.0E12	DIR	Hysteresis of the extrapolated actual position value

A.2.11 "LoadGear" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.LoadGear.<tag name>" contains the configuration of the load gear.

Tags

Legend (Page 293)

Tag	Data type	Value range	W	Description
LoadGear.	TO_Struct_LoadGear			
Numerator	UDINT	1 to 4294967295	RES	Load gear counter
Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.2.12 "Properties" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Properties.<tag name>" contains the configuration of the type of axis or motion.

Tags

Legend (Page 293)

Tag	Data type	Value range	W	Description	
Properties.	TO_Struct_Properties				
MotionType	DINT	0, 1	RON	Indication of axis type or motion type	
				0	Linear axis or motion
				1	Rotary axis or motion

A.2.13 "Units" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
Units.	TO_Struct_Units / TO_Struct_ExternalEncoder_Units				
LengthUnit	UDINT	-	RON	Unit for position	
				1010	m
				1013	mm
				1536	mm[1)]
				1011	km
				1014	µm
				1015	nm
				1019	in
				1018	ft
				1021	mi
				1004	rad
				1005	°
				1537	°[1)]

Tag	Data type	Values	W	Description	
VelocityUnit	UDINT	-	RON	Unit for velocity	
				1521	°/s
				1539	°/s[1)]
				1522	°/min
				1086	rad/s
				1523	rad/min
				1062	mm/s
				1538	mm/s[1)]
				1061	m/s
				1524	mm/min
				1525	m/min
				1526	mm/h
				1063	m/h
				1527	km/min
				1064	km/h
				1066	in/s
				1069	in/min
				1067	ft/s
				1070	ft/min
				1075	mi/h
TimeUnit	UDINT	-	RON	Unit for time	
				1054	s
TorqueUnit	UDINT	-	RON	Unit for torque	
				1126	Nm
				1128	kNm
				1529	lbf in (pound-force-inch)
				1530	lbf ft
				1531	ozf in (ounce-force-inch)
				1532	ozf ft
				1533	pdl in (poundal-inch)
				1534	pdl ft
ForceUnit	UDINT	-	RON	Unit for force	
				1120	N
				1122	kN
				1094	lbf (pound-force)
				1093	ozf (ounce-force)
				1535	pdl (poundals)
UnitFactor	UDINT	-	RON	Factor for internal conversion in the high-resolution units.	

1) Position values with higher resolution or six decimal places

A.2.14 "Mechanics" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Mechanics.<tag name>" contains the configuration of the mechanics.

Tags

Legend (Page 293)

Tag	Data type	Value range	W	Description
Mechanics.	TO_Struct_Mechanics			
LeadScrew	LREAL	0.0 to 1.0E12	RES	Leadscrew pitch

A.2.15 "Modulo" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Modulo.<tag name>" contains the configuration of the modulo function.

Tags

Legend (Page 293)

Tag	Data type	Values	W	Description	
Modulo.	TO_Struct_Modulo				
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.2.16 "DynamicLimits" tag (positioning axis) (S7-1500, S7-1500T)

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 are limited).

Tags

Legend (Page 293)

Tag		Data type	Values	W	Description
DynamicLimits.		TO_Struct_DynamicLimits			
	MaxVelocity	LREAL	0.0 to 1.0E12	RES	Maximum permissible velocity of the axis
	Velocity	LREAL	0.0 to 1.0E12	DIR	Current maximum 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.2.17 "DynamicDefaults" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.DynamicDefaults.<tag name>" contains the configuration of the dynamic defaults. These settings will be used when you specify a dynamic value less than 0.0 in a Motion Control instruction (exceptions: "MC_MoveJog.Velocity", "MC_MoveVelocity.Velocity"). Changes to the default dynamic values will be applied at the next positive edge at the "Execute" parameter of a Motion Control instruction.

Tags

Legend (Page 293)

Tag		Data type	Values	W	Description
DynamicDefaults.		TO_Struct_DynamicDefaults			
	Velocity	LREAL	0.0 to 1.0E12	CAL	Default velocity
	Acceleration	LREAL	0.0 to 1.0E12	CAL	Default acceleration
	Deceleration	LREAL	0.0 to 1.0E12	CAL	Default deceleration
	Jerk	LREAL	0.0 to 1.0E12	CAL	Default jerk
	Emergency Deceleration	LREAL	0.0 to 1.0E12	DIR	Emergency stop deceleration

A.2.18 "PositionLimits_SW" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.PositionLimits_SW.<tag name>" contains the configuration of position monitoring with software limit switches. Software limit switches are used to limit the operating range of a positioning axis.

Tags

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Tag	Data type	Values	W	Description	
PositionLimits_SW.	TO_Struct_PositionLimitsSW				
Active	BOOL	-	DIR	FALSE	Monitoring deactivated
				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")	

A.2.19 "PositionLimits_HW" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.PositionLimits_HW.<tag name>" contains the configuration of position monitoring with hardware limit switches. Hardware limit switches are used to limit the traversing range of a positioning axis.

Tags

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Tag	Data type	Values	W	Description	
PositionLimits_HW.	TO_Struct_PositionLimitsHW				
Active	BOOL	-	RES	FALSE	Monitoring deactivated
				TRUE	Monitoring enabled
				With "Active", both (negative and positive) hardware limit switches are activated or deactivated.	
MinSwitchLevel	BOOL	-	RES	Level selection for activation of the negative hardware limit switch	
				FALSE	Low level (Low active)
				TRUE	High level (high-enabled)
MinSwitchAddress	VREF	0 to 65535	RON	Address for the negative hardware limit switch	
MaxSwitchLevel	BOOL	-	RES	Level selection for activation of the positive hardware limit switch	
				FALSE	Low level (Low active)
				TRUE	High level (high-enabled)
MaxSwitchAddress	VREF	0 to 65535	RON	Address for the positive hardware limit switch	

A.2.20 "Homing" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Homing.<tag name>" contains the configuration for homing the TO.

Tags

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Tag	Data type	Values	W	Description
Homing.	TO_Struct_Homing / TO_Struct_ExternalEncoder_Homing			
AutoReversal	BOOL	-	RES	Reversal at the hardware limit switches FALSE: No TRUE: Yes
ApproachDirection	BOOL	-	CAL	Direction of approach to the homing position switch FALSE: Positive direction TRUE: Negative direction
ApproachVelocity	LREAL	Linear: 0.0 to 10000.0 mm/s Rotary: 0.0 ... 360000.0 °/s	CAL	Approach velocity Velocity during active homing at which the reference output cam and home position are approached.
ReferencingVelocity	LREAL	Linear: 0.0 to 1000.0 mm/s Rotary: 0.0 ... 36000.0 °/s	CAL	Homing velocity Velocity during active homing at which the home position is approached.
HomePosition	LREAL	-1.0E12 to 1.0E12	CAL	Home position

A.2.21 "Override" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.Override.<tag name>" contains the configuration of 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

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Tag	Data type	Values	W	Description
Override.	TO_Struct_Override			
Velocity	LREAL	0.0 to 200.0%	DIR	Velocity or speed override Percentage correction of the velocity/speed

A.2.22 "PositionControl" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.PositionControl.<tag name>" contains the settings of position control.

Tags

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Tag	Data type	Values	W	Description
PositionControl.	TO_Struct_PositionControl			
Kv	LREAL	0.0 to 2147480.0	DIR	Proportional gain of the closed loop position control ("Kv" > 0.0)
Kpc	LREAL	0.0 to 150.0%	DIR	Velocity precontrol of the position control Recommended setting: • 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 activated DSC is only possible with one of the following PROFIdrive telegrams: • Standard telegram 5 or 6 • SIEMENS telegram 105 or 106

Tag	Data type	Values	W	Description
SmoothingTime ByChangeDifference	LREAL	0.0 to 1.0E12 s	DIR	Smoothing time for the manipulated variable for switching operations, for example: • Encoder switchover • Change in P-gain ("Kv") • Switchover to emergency stop ramp
InitialOperativeSensor	UDINT	1 to 4	RES	Active sensor after initialization of the axis (sensor number 1 to 4) This encoder is used after startup of the CPU and after a restart of the technology object. At an operating mode transition from STOP → RUN of the CPU (without restart of the technology object), the encoder that was also active before the STOP is still being used.
ControlDifference Quantization.	TO_Struct_ PositionDifferenceQuantification			
Mode	DINT	-	RES	Type of quantification Configuration of a quantization when a drive with stepper motor interface is connected 0 — No quantification 1 — Quantization corresponding to encoder resolution 2 — Quantization to a direct value (configuration is performed using the parameter view (data structure))
Value	LREAL	0.001 to 1.0E12	RES	Value of quantification Configuration of a value for quantization to a direct value (<TO>.PositionControl.ControlDifferenceQuantization. Mode = 2) (configuration is performed using the parameter view (data structure))

A.2.23 "DynamicAxisModel" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.DynamicAxisModel.<tag name>" contains the settings of the balancing filter.

Tags

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Tag	Data type	Values	W	Description
DynamicAxisModel.	TO_Struct_DynamicAxisModel			Time constants for braking ramp generation with alarm response "Brake with emergency stop ramp"
VelocityTimeConstant	LREAL	0.0 to 1.0E12	DIR	Speed control loop substitute time [s]
AdditionalPosition-TimeConstant	LREAL	0.0 to 1.0E12	DIR	Additive position control loop substitute time [s]

A.2.24 "FollowingError" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.FollowingError.<tag name>" contains the configuration of the dynamic 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

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Tag	Data type	Values	W	Description
FollowingError.	TO_Struct_FollowingError			
EnableMonitoring	BOOL	-	RES	FALSE: Following error monitoring deactivated TRUE: Following error monitoring enabled
MinValue	LREAL	Linear: 0.0 to 1.0E12 Rotary: 0.001 to 1.0E12	DIR	Permissible following error at velocities below the value of "MinVelocity"
MaxValue	LREAL	Linear: 0.0 to 1.0E12 Rotary: 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

A.2.25 "PositioningMonitoring" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.PositioningMonitoring.<tag name>" contains the configuration of 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 range not reached" is displayed.

If the minimum dwell time is not met, then technology alarm 541 "Positioning monitoring" with supplemental value 2: "Exit target range again" is displayed.

Tags

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Tag	Data type	Values	W	Description
PositioningMonitoring.	TO_Struct_PositionMonitoring			
ToleranceTime	LREAL	0.0 to 1.0E12	DIR	Tolerance time Maximum permitted duration from reaching of velocity setpoint zero until entrance into the positioning window
MinDwellTime	LREAL	0.0 to 1.0E12	DIR	Minimum dwell time in positioning window
Window	LREAL	0.0 to 1.0E12	DIR	Positioning window

A.2.26 "StandstillSignal" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StandstillSignal.<tag name>" contains the configuration of 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

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Tag	Data type	Values	W	Description
StandstillSignal.	TO_Struct_StandstillSignal			Configuration for the standstill signal
VelocityThreshold	LREAL	0.0 to 1.0E12	DIR	Velocity threshold If velocity is below this threshold, the minimum dwell time begins.
MinDwellTime	LREAL	0.0 to 1.0E12	DIR	Minimum dwell time

A.2.27 "StatusPositioning" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusPositioning.<tag name>" indicates the status of a positioning motion.

Tags

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Tag		Data type	Values	W	Description
StatusPositioning.		TO_Struct_StatusPositioning			
	Distance	LREAL	-1.0E12 to 1.0E12	RON	Distance to the target position
	TargetPosition	LREAL	-1.0E12 to 1.0E12	RON	Target position
	TargetPosition ModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles to target position with positioning motions
	FollowingError	LREAL	-1.0E12 to 1.0E12	RON	Current following error
	SetpointExecutionTime	LREAL	-1.0E12 to 1.0E12	RON	Setpoint execution time of the axis (Results from T_{Ipo}, T_{vtc} or 1/kv, T_{Send} and T_{O} of the axis)

A.2.28 "StatusDrive" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusDrive.<tag name>" indicates the status of the drive.

Tags

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Tag	Data type	Values	W	Description	
StatusDrive.	TO_Struct_StatusDrive				
Disabled	BOOL	-	RON	FALSE	Drive not switched off
				TRUE	Drive switched off
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 drive error
				TRUE	Drive error
AdaptionState	DINT	0 to 4	RON	Status of automatic data transfer of drive parameters	
				0	"NOT_ADAPTED" Data not transferred
				1	"IN_ADAPTION" Data transfer in progress
				2	"ADAPTED" Data transfer complete
				3	"NOT_APPLICABLE" Data transfer not selected, not possible
				4	"ADAPTION_ERROR" Error during data transfer

A.2.29 "StatusServo" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusServo.<tag name>" indicates the status for the balancing filter.

Tags

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Tag	Data type	Values	W	Description
StatusServo.	TO_Struct_StatusServo			
BalancedPosition	LREAL	-	RON	Position after the balancing filter
ControlDifference	LREAL	-	RON	Control error

A.2.30 "StatusProvidedLeadingValue" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusProvidedLeadingValue.<tag name>" contains the provided leading value with leading value delay of the cross-PLC synchronous operation.

Tags

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Tag	Data type	Values	W	Description
StatusProvidedLead-ingValue.	TO_Struct_StatusProvidedLeading Value			Provided leading value
DelayedLeadingValue	TO_Struct_ProvidedLeadingValue			Leading value with leading value delay
Position	LREAL	-1.0E12 to 1.0E12	RON	Position
Velocity	LREAL	-1.0E12 to 1.0E12	RON	Velocity
Acceleration	LREAL	-1.0E12 to 1.0E12	RON	Acceleration

A.2.31 StatusSensor[1..4] Tags (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusSensor[1..4].<tag name>" indicates the status of the measuring system.

Tags

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Tag	Data type	Values	W	Description	
StatusSensor[1..4].	Array [1..4] OF TO_Struct_StatusSensor				
State	DINT	0 to 2	RON	Status of the actual encoder value	
				0	"NOT_VALID" Invalid
				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 position offset for value of an absolute value encoder. The value will be retentively stored in the CPU.	
Control	BOOL	-	RON	FALSE	Encoder is not active
				TRUE	Encoder is active
Position	LREAL	-	RON	Encoder position	
Velocity	LREAL	-	RON	Encoder velocity	
AdaptionState	DINT	0 to 4	RON	Status of automatic data transfer of encoder parameters	
				0	"NOT_ADAPTED" Data not transferred
				1	"IN_ADAPTION" Data transfer in progress
				2	"ADAPTED" Data transfer complete
				3	"NOT_APPLICABLE" Data transfer not selected, not possible
				4	"ADAPTION_ERROR" Error during data transfer
ModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles	

A.2.32 "StatusExtrapolation" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusExtrapolation.<tag name>" indicates the status of the actual value extrapolation.

Tags

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Tag	Data type	Values	W	Description
StatusExtrapolation.	TO_Struct_StatusExtrapolation			
FilteredPosition	LREAL	-1.0E12 to 1.0E12	RON	Position after position filter
FilteredVelocity	LREAL	-1.0E12 to 1.0E12	RON	Velocity after velocity filter and tolerance band
ExtrapolatedPosition	LREAL	-1.0E12 to 1.0E12	RON	Extrapolated position
ExtrapolatedVelocity	LREAL	-1.0E12 to 1.0E12	RON	Extrapolated velocity

A.2.33 "StatusKinematicsMotion" tag (positioning axis) (S7-1500, S7-1500T)

The "<TO>.StatusKinematicsMotion" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 2 "MaxDecelerationExceeded") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

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Tag	Data type	Values	W	Description	
StatusKinematicsMotion	DWORD	-	RON	Status information of the technology object	
Bit 0	-	-	-	"MaxVelocityExceeded"	
				0	The kinematics technology object calculated a lower velocity setpoint than the maximum velocity on the axis.
				1	The kinematics technology object calculated a higher velocity setpoint than the maximum velocity on the axis.
Bit 1	-	-	-	"MaxAccelerationExceeded"	
				0	The kinematics technology object calculated a lower setpoint acceleration calculated than the maximum acceleration of the axis.
				1	The kinematics technology object calculated a higher setpoint acceleration than the maximum acceleration of the axis.
Bit 2	-	-	-	"MaxDecelerationExceeded"	
				0	The kinematics technology object calculated a lower setpoint deceleration than the maximum deceleration of the axis.
				1	The kinematics technology object calculated a lower setpoint deceleration than the maximum deceleration of the axis.

A.2.34 "StatusTorqueData" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusTorqueData.<tag name>" indicates the status of the torque data.

Tags

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Tag	Data type	Value range	W	Description	
StatusTorqueData.	TO_Struct_StatusTorqueData				
CommandAdditiveTorqueActive	DINT	0, 1	RON	Additive setpoint torque	
				0	Inactive
				1	Active
CommandTorqueRangeActive	DINT	0, 1	RON	Torque limits B +, B-	
				0	Inactive
				1	Active
ActualTorque	LREAL	-1.0E12 to 1.0E12	RON	Actual torque of the axis	

A.2.35 "StatusMotionIn" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusMotionIn.<tag name>" indicates the status of the "MotionIn" function.

Tags

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Tag	Data type	Value range	W	Description	
StatusMotionIn.	TO_Struct_StatusMotionIn				
FunctionState	DINT	0 to 2	RON	0	No "MotionIn" function active
				1	"MC_MotionInVelocity" active
				2	"MC_MotionInPosition" active

A.2.36 "StatusWord" tag (positioning axis) (S7-1500, S7-1500T)

The "<TO>.StatusWord" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 5 "HomingDone") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

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Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information of the technology object	
Bit 0	-	-	-	"Enable" Enable status	
				0	The technology object is disabled.
				1	The technology object has been enabled.
Bit 1	-	-	-	"Error"	
				0	No error is present.
				1	An error is present.
Bit 2	-	-	-	"RestartActive"	
				0	No restart is active.
				1	A restart is active. The technology object is being reinitialized.
Bit 3	-	-	-	"OnlineStartValuesChanged"	
				0	The restart tags are unchanged.
				1	The restart tags have been changed. For the changes to be applied, the technology object must be reinitialized.
Bit 4	-	-	-	"ControlPanelActive"	
				0	The axis control panel is deactivated.
				1	The axis control panel is active.
Bit 5	-	-	-	"HomingDone" Homing status	
				0	The technology object is not homed.
				1	The technology object is homed.
Bit 6	-	-	-	"Done"	
				0	A motion job is in progress or the axis control panel is activated.
				1	No motion job is in progress and the axis control panel is deactivated.
Bit 7	-	-	-	"Standstill" Standstill signal	
				0	The axis is in motion.
				1	The axis is at a standstill.

Tag	Data type	Values	W	Description	
Bit 8	-	-	-	"PositioningCommand"	
				0	No positioning job is active.
				1	A positioning job is active ("MC_MoveRelative","MC_MoveAbsolute").
Bit 9	-	-	-	"JogCommand"	
				0	No "MC_MoveJog" job is active.
				1	An "MC_MoveJog" job is running
Bit 10	-	-	-	"VelocityCommand"	
				0	No "MC_MoveVelocity" job is active.
				1	An "MC_MoveVelocity" job is running
Bit 11	-	-	-	"HomingCommand"	
				0	No "MC_Home" job is in progress.
				1	An "MC_Home" job is being processed.
Bit 12	-	-	-	"ConstantVelocity"	
				0	The axis is accelerated or decelerated.
				1	The setpoint velocity is reached. A constant velocity setpoint is output.
Bit 13	-	-	-	"Accelerating"	
				0	No acceleration operation is active.
				1	An acceleration operation is active.
Bit 14	-	-	-	"Decelerating"	
				0	No deceleration process is active.
				1	A deceleration operation is active.
Bit 15	-	-	-	"SWLimitMinActive"	
				0	No negative software limit switch was approached.
				1	A negative software limit switch was reached or exceeded.
Bit 16	-	-	-	"SWLimitMaxActive"	
				0	No positive software limit switch was approached.
				1	A positive software limit switch was reached or exceeded.
Bit 17	-	-	-	"HWLimitMinActive"	
				0	No negative hardware limit switch was approached.
				1	A negative hardware limit switch was reached or exceeded.
Bit 18	-	-	-	"HWLimitMaxActive"	
				0	No positive hardware limit switch was approached.
				1	A positive hardware limit switch was reached or exceeded.

Tag		Data type	Values	W	Description	
	Bit 19 … Bit 22	-	-	-	Reserved	
	Bit 23	-	-	-	"SuperimposedMotionCommand"	
					0	No overlaid movement is active.
					1	No overlaid movement is running.
	Bit 24	-	-	-	Reserved	
	Bit 25	-	-	-	"AxisSimulation"	
					0	The simulation is not running.
					1	The simulation is active.
	Bit 26	-	-	-	"TorqueLimitingCommand"	
					0	No "MC_TorqueLimiting" job is active.
					1	An "MC_TorqueLimiting" job is running
	Bit 27	-	-	-	"InLimitation"	
					0	The drive does not operate at the torque limit.
					1	The drive operates at least at the threshold value (default 90%) of the torque limit.
	Bit 28	-	-	-	"NonPositionControlled"	
					0	The axis is in position-controlled mode.
					1	The axis is not in position-controlled mode.
	Bit 29	-	-	-	"KinematicsMotionCommand"	
					0	The axis is not used for a kinematics job.
					1	The axis is used for a kinematics job.
	Bit 30	-	-	-	"InClamping"	
					0	The axis is not clamped at a fixed stop.
					1	The axis is clamped at a fixed stop.
	Bit 31	-	-	-	"MotionInCommand"	
					0	No "MotionIn" job is active.
					1	A "MotionIn" job is running.

A.2.37 "StatusWord2" tag (positioning axis) (S7-1500, S7-1500T)

The "<TO>.StatusWord2" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 0 "StopCommand") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tags

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Tag	Data type	Value range	W	Description	
StatusWord2	DWORD	-	RON	Status information of the technology object	
Bit 0	BOOL	-	RON	"StopCommand"	
				0	No "MC_Stop" job is active.
				1	An "MC_Stop" job is running. The technology object is disabled.
Bit 1 … Bit 31	BOOL	-	RON	Reserved	

A.2.38 "ErrorWord" tag (positioning axis) (S7-1500, S7-1500T)

The "<TO>.ErrorWord" tag indicates technology object errors (technology alarms).

Information on the evaluation of the individual bits (e.g. bit 3 "CommandNotAccepted") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

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Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" A system-internal error has occurred.
Bit 1	-	-	-	"ConfigFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in user program at a Motion Control instruction or its use
Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
Bit 4	-	-	-	"DriveFault" Error in drive
Bit 5	-	-	-	"SensorFault" Error in encoder system
Bit 6	-	-	-	"DynamicError" Specified dynamic values are limited to permissible values.
Bit 7	-	-	-	"CommunicationFault" Communication error Missing or faulty communication.
Bit 8	-	-	-	"SWLimit" Software limit switch reached or overtraveled.
Bit 9	-	-	-	"HWLimit" Hardware limit switch reached or overtraveled.
Bit 10	-	-	-	"HomingError" Error during homing operation The homing cannot be completed.
Bit 11	-	-	-	"FollowingErrorFault" Following error limits exceeded

Tag		Data type	Values	W	Description
	Bit 12	-	-	-	"PositioningFault" Positioning error
	Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
	Bit 14	-	-	-	Reserved
	Bit 15	-	-	-	"AdaptionError" Error in automatic data transfer
	Bit 16 ... Bit 31	-	-	-	Reserved

A.2.39 "ErrorDetail" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.ErrorDetail.<tag name>" contains the alarm number and the effective local alarm reaction for the technology alarm that is currently pending on the technology object.

You can find a list of the technology alarms and alarm reactions in the "Technology alarms" appendix of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tags

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Tag		Data type	Values	W	Description	
ErrorDetail.		TO_Struct_ErrorDetail				
	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	Track setpoints

A.2.40 "WarningWord" tag (positioning axis) (S7-1500, S7-1500T)

The "<TO>.WarningWord" tag indicates pending warnings at the technology object.

Information on the evaluation of the individual bits (e.g. bit 13 "PeripheralWarning") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

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Tag	Data type	Values	W	Description
WarningWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemWarning" A system-internal error has occurred.
Bit 1	-	-	-	"ConfigWarning" Configuration error One or several configuration parameters are adjusted internally.
Bit 2	-	-	-	"UserWarning" Error in user program at a Motion Control instruction or its use
Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
Bit 4	-	-	-	"DriveWarning" Error in drive
Bit 5	-	-	-	"SensorWarning" Error in encoder system
Bit 6	-	-	-	"DynamicWarning" Specified dynamic values are limited to permissible values.
Bit 7	-	-	-	"CommunicationWarning" Communication error Missing or faulty communication.
Bit 8	-	-	-	"SWLimitMin"
Bit 9	-	-	-	"SWLimitMax"
Bit 10	-	-	-	"HomingWarning" Error during homing operation The homing cannot be completed.
Bit 11	-	-	-	"FollowingErrorWarning" Warning limit of following error monitoring reached/exceeded

Tag	Data type	Values	W	Description
Bit 12	-	-	-	"PositioningWarning" Positioning error
Bit 13	-	-	-	"PeripheralWarning" Error accessing a logical address
Bit 14	-	-	-	Reserved
Bit 15	-	-	-	"AdaptionWarning" Error in automatic data transfer
Bit 16... Bit 31	-	-	-	Reserved

A.2.41 "ControlPanel" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.ControlPanel.<tag name>" contains no user-relevant data. This tag structure is internally used.

A.2.42 "InternalToTrace" tag (positioning axis) (S7-1500, S7-1500T)

The tag structure "<TO>.InternalToTrace.<tag name>" contains no user-relevant data. This tag structure is internally used.

A.3 Tags of the technology object external encoder (S7-1500, S7-1500T)

A.3.1 Legend (S7-1500, S7-1500T)

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	Direct: Values are changed via direct assignment and take effect at the start of the next MC-Servo [OB91].
	CAL	At call of Motion Control instruction: Values are changed directly and take effect at the start of the next MC-Servo [OB91] after the call of the corresponding Motion Control instruction in the user program.
	RES	Restart: Changes to the start value in the 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 during runtime of the user program.
Description	Description of the tag	

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) (S7-1500, S7-1500T)

The following tags indicate the setpoint and actual values of the technology object.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
ActualPosition	LREAL	-	RON	Actual position
ActualVelocity	LREAL	-	RON	Actual velocity
ActualAcceleration	LREAL	-	RON	Actual acceleration
ActualModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles of the actual value

A.3.3 "Sensor[1..4]" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Sensor[1..4].<tag name>" contains the controller-end configuration for the encoder, and the configuration for active and passive homing.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description	
Sensor[1..4].	ARRAY [1..4] OF TO_Struct_Sensor / TO_Struct_ExternalEncoder_Sensor				
Type	DINT	0 to 2	RON	Encoder type	
				0	"INCREMENTAL" Incremental
				1	"ABSOLUTE" Absolute
				2	"CYCLIC_ABSOLUTE" Cyclic absolute
InverseDirection	BOOL	-	RES	Inversion of the actual value	
				FALSE	No
				TRUE	Yes
System	DINT	0, 1	RES	Encoder system	
				0	"LINEAR" Linear encoder
				1	"ROTATORY" Rotary encoder
MountingMode	DINT	0 to 2	RES	Mounting type of encoder	
				0	On motor shaft
				1	On load side
				2	External measuring system
DataAdaption	DINT	0, 1	RES	Automatic transfer of the drive values reference speed, maximum speed and reference torque in the device	
				0	No automatic transfer, manual configuration of values
				1	Automatic transfer of values configured in the drive to the configuration of the technology object
Interface.					
AddressIn	VREF	0 to 65535	RON	Input address for the PROFIdrive telegram	
AddressOut	VREF	0 to 65535	RON	Output address for the PROFIdrive telegram	
Number	UDINT	1 to 2	RON	Number of the encoder in the telegram	

Tag	Data type	Values	W	Description	
Parameter.					
Resolution	LREAL	-1.0E12 to 1.0E12	RES	Resolution of a linear encoder (offset between two encoder pulses)	
StepsPerRevolution	UDINT	1 to 8388608	RES	Increments per rotary encoder revolution	
FineResolutionXist1	UDINT	0 … 31	RES	Number of bits for fine resolution Gx_XIST1 (cyclic actual encoder value)	
FineResolutionXist2	UDINT	0 … 31	RES	Number of bits for fine resolution Gx_XIST2 (absolute value of encoder)	
Determinable Revolutions	UDINT	0 to 8388608	RES	Number of differentiable encoder revolutions for a multi-turn absolute encoder (For a single-turn absolute 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	
BehaviorGx_XIST1	DINT	0, 1	RES	Evaluation of Gx_XIST1 bits	
				0	Based on the bits of the encoder resolution
				1	32-bit value of the encoder value
PassiveHoming.	TO_Struct_SensorPassiveHoming				
Mode	DINT	0 to 2	RES	Homing mode	
				0	Use zero mark via PROFIdrive telegram
				1	Zero mark via PROFIdrive telegram and reference output cam
				2	Use homing mark via digital input
SideInput	BOOL	-	CAL	Side of the digital input for passive homing	
				FALSE	Negative side
				TRUE	Positive side
Direction	DINT	0 to 2	CAL	Homing direction/approach direction on the homing mark	
				0	Positive homing direction
				1	Negative homing direction
				2	Current homing direction
DigitalInputAddress	VREF	0 to 65535	RON	Address of the digital input	
SwitchLevel	BOOL	-	RON	Signal level that is present at the digital input when homing mark is approached	
				FALSE	Low level
				TRUE	High level

A.3.4 "CrossPlcSynchronousOperation" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.CrossPlcSynchronousOperation.<tag name>" contains the configuration of the cross-PLC synchronous operation.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
CrossPlcSynchronousOperation.	TO_Struct_ CrossPlcSynchronousOperation			
Interface[1..1].	ARRAY [1..1] of TO_Struct_ CrossPlcLeadingValueInterface			
EnableLeading ValueOutput	BOOL	-	RON	Provide cross-PLC leading value FALSE: No TRUE: Yes
AddressOut	VREF	-	RON	Output address for the leading value telegram
LocalLeading ValueDelayTime	LREAL	0.0 to 1.0E12	DIR	Delay time of leading value output on the local following axes

A.3.5 "Extrapolation" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Extrapolation.<tag name>" contains the configuration of the actual value extrapolation.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
Extrapolation.	TO_Struct_Extrapolation			
LeadingAxis DependentTime	LREAL	-	RON	Extrapolation time component (caused by leading axis) Results from the following times: • Time of actual value acquisition for the leading axis • Interpolator cycle clock • Time of position filter of actual value extrapolation (T1 + T2)
FollowingAxis DependentTime	LREAL	0.001 to 1.0E12	DIR	Extrapolation time component (caused by following axis) Results from the following times: • For a following axis with set velocity precontrol: – Communication cycle – Interpolator cycle clock – Speed control loop substitute time for the following axis – Output delay time of the setpoint at the following axis • For a following axis without velocity precontrol: – Communication cycle – Interpolator cycle clock – Position control loop equivalent time (1/Kv from "<TO>.PositionControl.Kv") – Output delay time of the setpoint at the following axis
Settings.	TO_Struct_ExtrapolationSettings			
SystemDefined Extrapolation	DINT	0, 1	RES	Leading axis dependent time 0: Not effective 1: Effective
Extrapolated VelocityMode	DINT	0, 1	RES	Effective velocity value for the synchronization function 0: "FilteredVelocity" Leading value velocity from filtered actual velocity 1: "VelocityByDifferentiation" The leading value velocity results from the differentiation of the extrapolated leading value position

Tag	Data type	Values	W	Description
PositionFilter.	TO_Struct_ ExtrapolationPositionFilter			
T1	LREAL	0.0 to 1.0E12	DIR	Position filter time constant T1
T2	LREAL	0.0 to 1.0E12	DIR	Position filter time constant T2
VelocityFilter.	TO_Struct_ ExtrapolationVelocityFilter			
T1	LREAL	0.0 to 1.0E12	DIR	Velocity filter time constant T1
T2	LREAL	0.0 to 1.0E12	DIR	Velocity filter time constant T2
VelocityTolerance.	TO_Struct_ ExtrapolationVelocityTolerance			
Range	LREAL	0.0 to 1.0E12	DIR	Tolerance band width for velocity
Hysteresis.	TO_Struct_ExtrapolationHysteresis			
Value	LREAL	0.0 to 1.0E12	DIR	Hysteresis of the extrapolated actual position value

A.3.6 "LoadGear" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.LoadGear.<tag name>" contains the configuration of the load gear.

Tags

Legend (Page 329)

Tag	Data type	Value range	W	Description
LoadGear.	TO_Struct_LoadGear			
Numerator	UDINT	1 to 4294967295	RES	Load gear counter
Denominator	UDINT	1 to 4294967295	RES	Load gear denominator

A.3.7 "Properties" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Properties.<tag name>" contains the configuration of the type of axis or motion.

Tags

Legend (Page 329)

Tag	Data type	Value range	W	Description	
Properties.	TO_Struct_Properties				
MotionType	DINT	0, 1	RON	Display of axis type or motion type	
				0	Linear axis or motion
				1	Rotary axis or motion

A.3.8 "Units" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description	
Units.	TO_Struct_Units / TO_Struct_ExternalEncoder_Units				
LengthUnit	UDINT	-	RON	Unit for position	
				1010	m
				1013	mm
				1536	mm[1)]
				1011	km
				1014	µm
				1015	nm
				1019	in
				1018	ft
				1021	mi
				1004	rad
				1005	°
				1537	°[1)]

Tag		Data type	Values	W	Description	
	VelocityUnit	UDINT	-	RON	Unit for velocity	
					1521	°/s
					1539	°/s[1)]
					1522	°/min
					1086	rad/s
					1523	rad/min
					1062	mm/s
					1538	mm/s[1)]
					1061	m/s
					1524	mm/min
					1525	m/min
					1526	mm/h
					1063	m/h
					1527	km/min
					1064	km/h
					1066	in/s
					1069	in/min
					1067	ft/s
					1070	ft/min
					1075	mi/h
	TimeUnit	UDINT	-	RON	Unit for time	
					1054	s
	UnitFactor	UDINT	-	RON	Factor for internal conversion in the high-resolution units.	

1) Position values with higher resolution or six decimal places

A.3.9 "Mechanics" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Mechanics.<tag name>" contains the configuration of the mechanics.

Tags

Legend (Page 329)

Tag		Data type	Value range	W	Description
Mechanics.		TO_Struct_Mechanics			
	LeadScrew	LREAL	0.0 to 1.0E12	RES	Leadscrew pitch

A.3.10 "Modulo" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Modulo.<tag name>" contains the configuration of the modulo function.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description	
Modulo.	TO_Struct_Modulo				
Enable	BOOL	-	RES	FALSE	Modulo conversion disabled
				TRUE	Modulo conversion enabled
Length	LREAL	0.001 to 1.0E12	RES	Modulo length When modulo conversion is enabled, a check is made for modulo length > 0.0	
StartValue	LREAL	-1.0E12 to 1.0E12	RES	Modulo start value	

A.3.11 "Homing" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.Homing.<tag name>" contains the configuration for homing the TO.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
Homing.	TO_Struct_Homing / TO_Struct_ ExternalEncoder_Homing			
HomePosition	LREAL	-1.0E12 to 1.0E12	CAL	Home position

A.3.12 "StatusProvidedLeadingValue" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusProvidedLeadingValue.<tag name>" contains the provided leading value with leading value delay of the cross-PLC synchronous operation.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
StatusProvidedLeadingValue.	TO_Struct_ StatusProvidedLeadingValue			Provided leading value
DelayedLeadingValue	TO_Struct_ ProvidedLeadingValue			Leading value with leading value delay
Position	LREAL	-1.0E12 to 1.0E12	RON	Position
Velocity	LREAL	-1.0E12 to 1.0E12	RON	Velocity
Acceleration	LREAL	-1.0E12 to 1.0E12	RON	Acceleration

A.3.13 "StatusSensor[1..4]" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusSensor[1..4].<tag name>" indicates the status of the measuring system.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description	
StatusSensor[1..4].	Array [1..4] OF TO_Struct_StatusSensor				
State	DINT	0 to 2	RON	Status of the actual encoder value	
				0	"NOT_VALID" Invalid
				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 position offset for value of an absolute value encoder. The value will be retentively stored in the CPU.	
Control	BOOL	-	RON	FALSE	Encoder is not active
				TRUE	Encoder is active
Position	LREAL	-	RON	Encoder position	
Velocity	LREAL	-	RON	Encoder velocity	
AdaptionState	DINT	-	RON	Status of automatic data transfer of encoder parameters	
				0	"NOT_ADAPTED" Data not transferred
				1	"IN_ADAPTION" Data transfer in progress
				2	"ADAPTED" Data transfer complete
				3	"NOT_APPLICABLE" Data transfer not selected, not possible
				4	"ADAPTION_ERROR" Error during data transfer
ModuloCycle	DINT	-2147483648 to 2147483647	RON	Number of modulo cycles	

A.3.14 "StatusExtrapolation" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.StatusExtrapolation.<tag name>" indicates the status of the actual value extrapolation.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
StatusExtrapolation.	TO_Struct_StatusExtrapolation			
FilteredPosition	LREAL	-1.0E12 to 1.0E12	RON	Position after position filter
FilteredVelocity	LREAL	-1.0E12 to 1.0E12	RON	Velocity after velocity filter and tolerance band
ExtrapolatedPosition	LREAL	-1.0E12 to 1.0E12	RON	Extrapolated position
ExtrapolatedVelocity	LREAL	-1.0E12 to 1.0E12	RON	Extrapolated velocity

A.3.15 "StatusWord" tag (external encoder) (S7-1500, S7-1500T)

The "<TO>.StatusWord" tag contains the status information of the technology object.

Information on the evaluation of the individual bits (e.g. bit 5 "HomingDone") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 329)

Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information 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.

Tag	Data type	Values	W	Description	
Bit 3	-	-	-	"OnlineStartValuesChanged"	
				0	Restart tags unchanged
				1	Change to Restart tags 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 is active or axis control panel ena-bled
				1	No motion job in process and axis control pan-el disabled
Bit 7 … Bit 10	-	-	-	Reserved	
Bit 11	-	-	-	"HomingCommand"	
				0	No "MC_Home" job in progress
				1	"MC_Home" job in progress
Bit 12... Bit 31	-	-	-	Reserved	

A.3.16 "ErrorWord" tag (external encoder) (S7-1500, S7-1500T)

The "<TO>.ErrorWord" tag indicates technology object errors (technology alarms).

Information on the evaluation of the individual bits (e.g. bit 3 "CommandNotAccepted") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 329)

Tag	Data type	Values	W	Description
ErrorWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemFault" A system-internal error has occurred.
Bit 1	-	-	-	"ConfigFault" Configuration error One or more configuration parameters are inconsistent or invalid.
Bit 2	-	-	-	"UserFault" Error in user program at a Motion Control instruction or its use
Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	"SensorFault" Error in encoder system
Bit 6	-	-	-	Reserved
Bit 7	-	-	-	"CommunicationFault" Communication error Missing or faulty communication.
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	"HomingError" Error during homing operation 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.3.17 "ErrorDetail" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.ErrorDetail.<tag name>" contains the alarm number and the effective local alarm reaction for the technology alarm that is currently pending on the technology object.

You can find a list of the technology alarms and alarm reactions in the "Technology alarms" appendix of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tags

Legend (Page 329)

<table>
<tr><th colspan="2">Tag</th><th>Data type</th><th>Values</th><th>W</th><th colspan="2">Description</th></tr>
<tr><td colspan="2">ErrorDetail.</td><td colspan="3">TO_Struct_ErrorDetail</td><td colspan="2"></td></tr>
<tr><td rowspan="4"></td><td>Number</td><td>UDINT</td><td>-</td><td>RON</td><td colspan="2">Alarm number</td></tr>
<tr><td rowspan="3">Reaction</td><td rowspan="3">DINT</td><td rowspan="3">0, 4</td><td rowspan="3">RON</td><td colspan="2">Effective alarm reaction</td></tr>
<tr><td>0</td><td>No reaction</td></tr>
<tr><td>4</td><td>Remove enable</td></tr>
</table>

A.3.18 "WarningWord" tag (external encoder) (S7-1500, S7-1500T)

The "<TO>.WarningWord" tag indicates pending warnings at the technology object.

Information on the evaluation of the individual bits (e.g. bit 13 "PeripheralWarning") can be found in the "Evaluating StatusWord, ErrorWord and WarningWord" section of the "S7-1500/S7-1500T Motion Control overview" (https://support.industry.siemens.com/cs/ww/en/view/109766459) documentation.

Tag

Legend (Page 329)

Tag	Data type	Values	W	Description
WarningWord	DWORD	-	RON	
Bit 0	-	-	-	"SystemWarning" A system-internal error has occurred.
Bit 1	-	-	-	"ConfigWarning" Configuration error One or several configuration parameters are adjusted internally.
Bit 2	-	-	-	"UserWarning" Error in user program at a Motion Control instruction or its use
Bit 3	-	-	-	"CommandNotAccepted" Job cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
Bit 4	-	-	-	Reserved
Bit 5	-	-	-	"SensorWarning" Error in encoder system
Bit 6	-	-	-	Reserved
Bit 7	-	-	-	"CommunicationWarning" Communication error Missing or faulty communication.
Bit 8	-	-	-	Reserved
Bit 9	-	-	-	Reserved
Bit 10	-	-	-	"HomingWarning" Error during homing operation The homing cannot be completed.
Bit 11	-	-	-	Reserved
Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralWarning" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.3.19 "InternalToTrace[1..4]" tag (external encoder) (S7-1500, S7-1500T)

The tag structure "<TO>.InternalToTrace[1..4].<tag name>" contains no user-relevant data. This tag structure is internally used.

Tags

Legend (Page 329)

Tag	Data type	Values	W	Description
InternalToTrace[1..4].	ARRAY [1..4] OF TO_Struct_Internal			
Id	DINT	-	DIR	-
Value	LREAL	-	RON	-

A.4 "MC_Power" function diagrams (S7-1500, S7-1500T)

A.4.1 Drive connection via PROFIdrive (S7-1500, S7-1500T)

A.4.1.1 PROFIdrive State Machine (S7-1500, S7-1500T)

An axis controls the PROFIdrive state machine in the drive through the control word in the PROFIdrive telegram. The PROFIdrive state machine shows the state of the drive.

The following table shows the states of the PROFIdrive state machine:

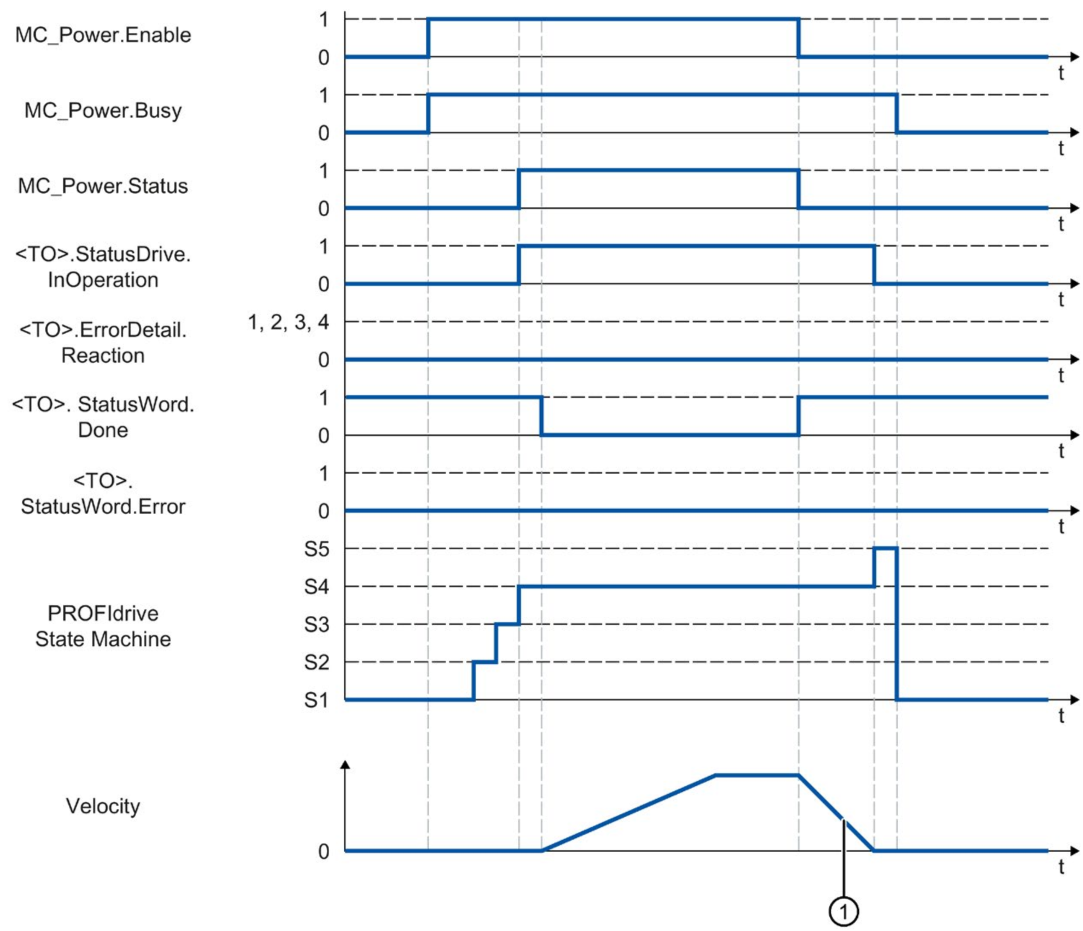
Status	Description
S1	Switching on inhibited (drive off, brake closed if necessary)
S2	Ready for power-up
S3	Switched on (drive switched on, release brake if necessary)
S4	Operation (drive released, brakes released if necessary)
S5	Switching off (braking with drive-defined ramp)

Additional information

For more information about the PROFIdrive state machine, refer to Siemens Industry Online Support in the FAQ entry 109770665 (https://support.industry.siemens.com/cs/ww/en/view/109770665).

A.4.1.2 "StopMode" = 0, 2 (S7-1500, S7-1500T)

Function chart: Enabling a technology object and disabling with "StopMode" = 0, 2



① • "StopMode" = 0

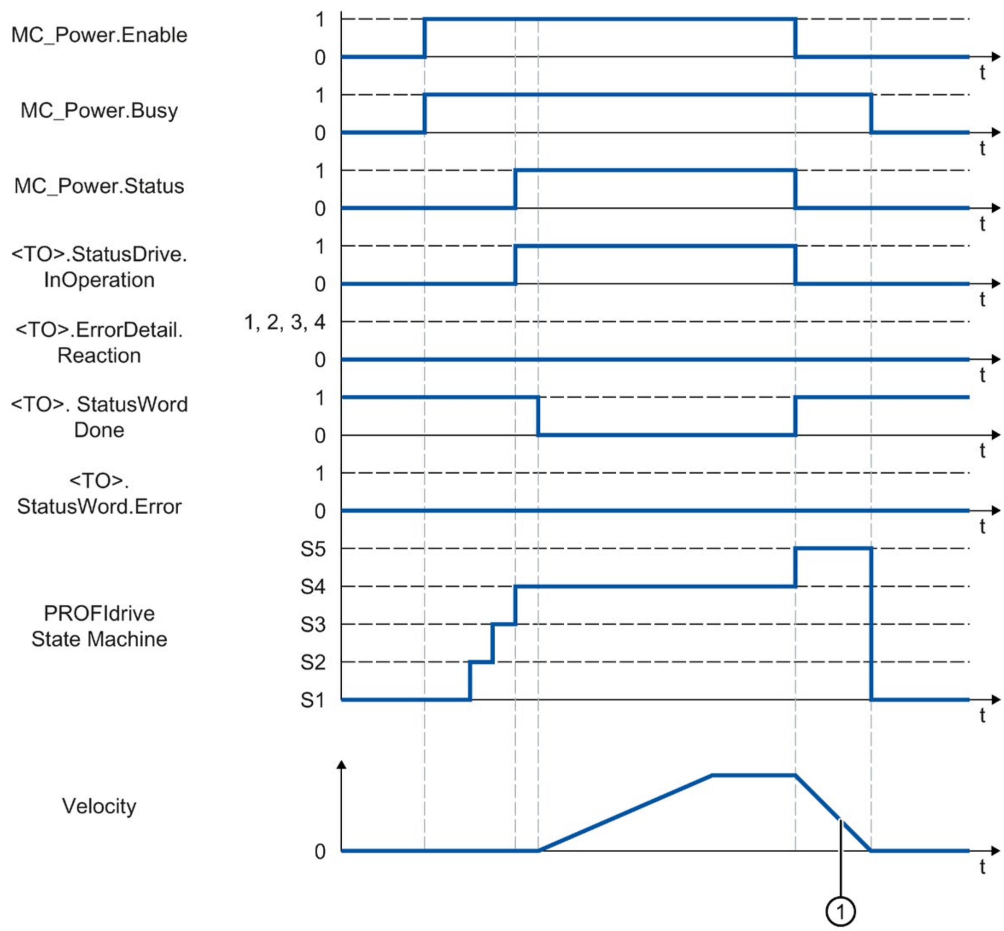
The axis is braked with the configured emergency stop deceleration.

• "StopMode" = 2

The axis decelerates with the configured maximum deceleration.

A.4.1.3 "StopMode" = 1 (S7-1500, S7-1500T)

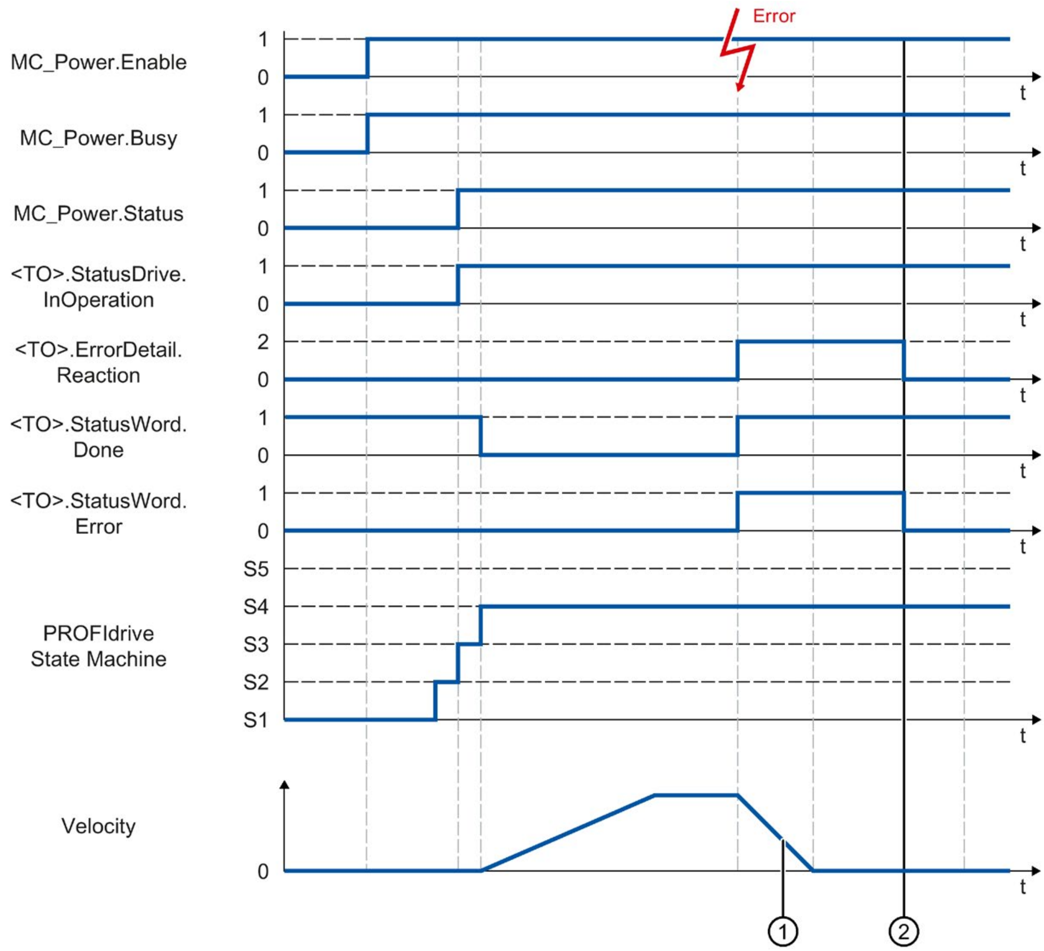
Function chart: Enabling a technology object and disabling with "StopMode" = 1



① The deceleration ramp depends on the configuration in the drive.

A.4.1.4 Alarm reactions with braking ramp via the technology object (S7-1500, S7-1500T)

Function chart: Enabling a technology object and occurrence of a technology alarm with braking ramp via the technology object



① The axis is braked based on the alarm reaction:

- Stop with current dynamic values (<TO>.ErrorDetail.Reaction = 1)

  The axis is braked with the deceleration in the Motion Control instruction.
- Stop with maximum dynamic values (<TO>.ErrorDetail.Reaction = 2)

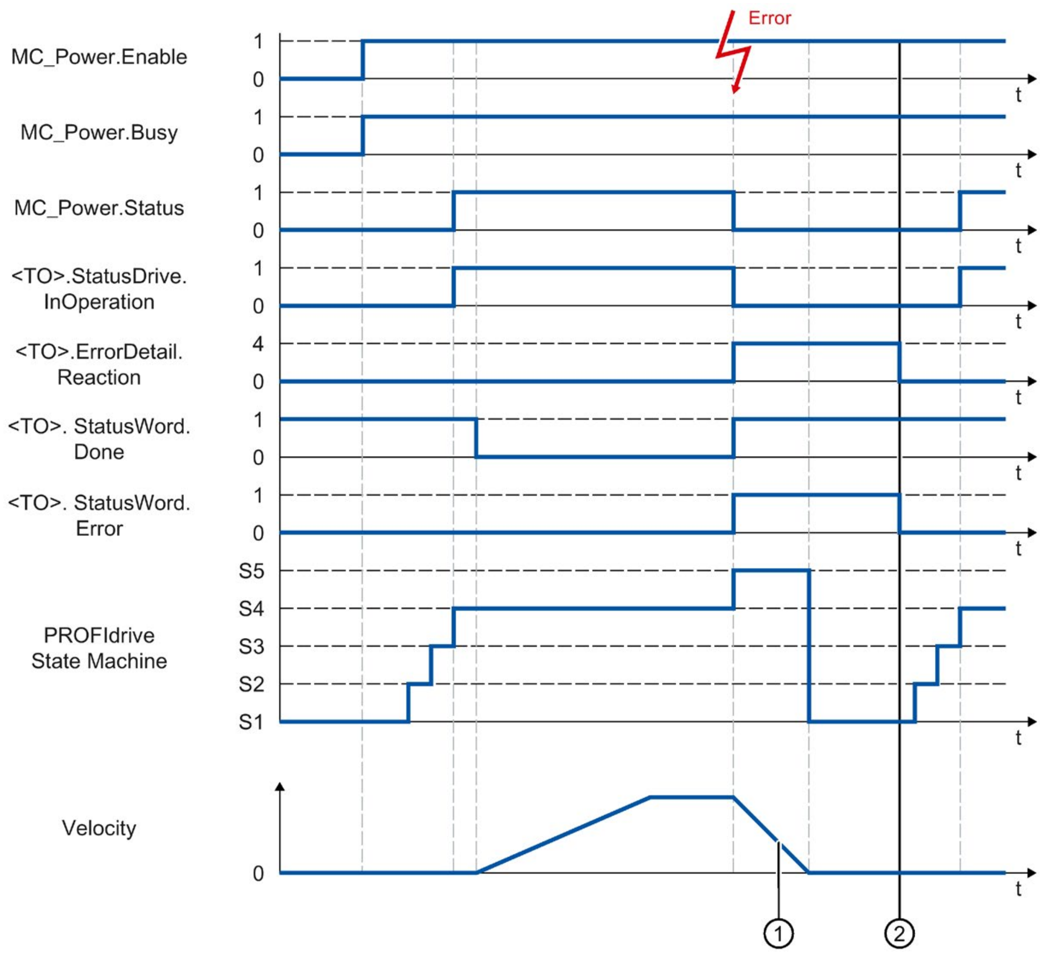
  The axis decelerates with the configured maximum deceleration.
- Stop with emergency stop ramp (<TO>.ErrorDetail.Reaction = 3)

  The axis is braked with the configured emergency stop deceleration.

② The technology alarm is acknowledged.

A.4.1.5 Alarm response "Remove enable" (S7-1500, S7-1500T)

Function chart: Enabling a technology object and occurrence of a technology alarm with alarm reaction "Remove enable"



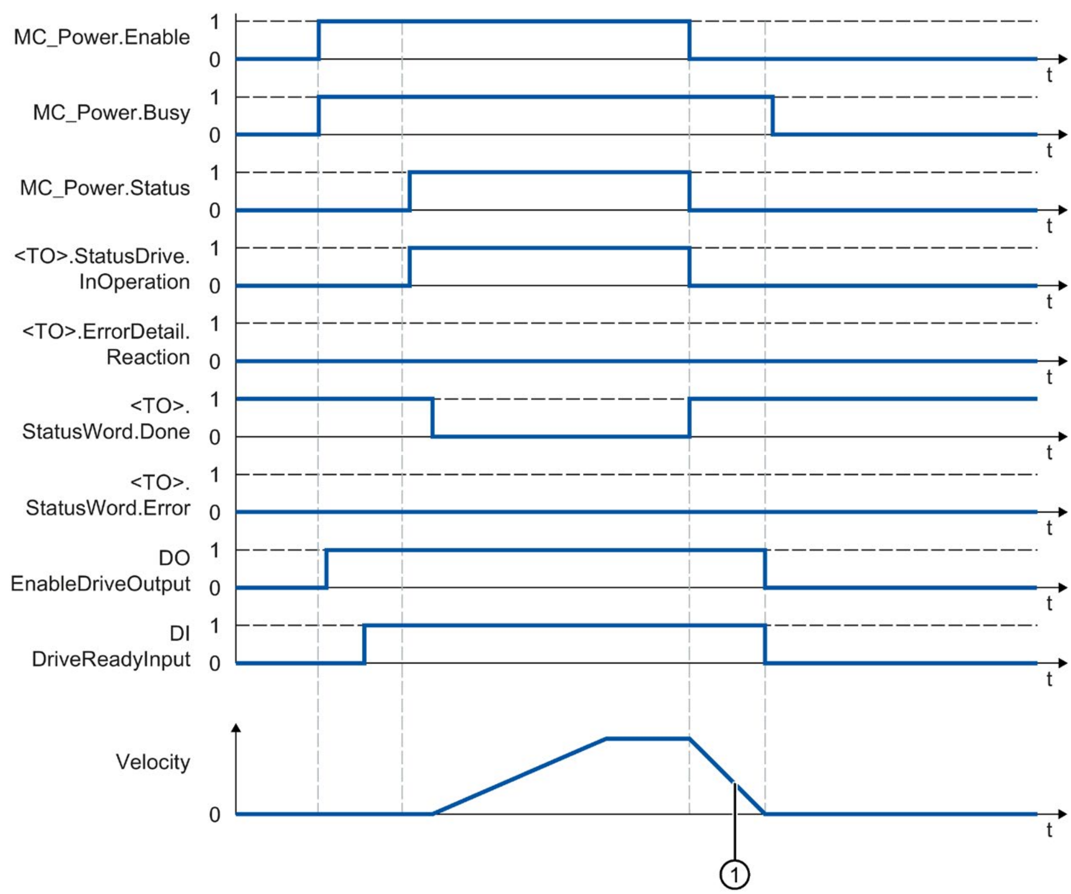
① The deceleration ramp depends on the configuration in the drive.

② The technology alarm is acknowledged at time ②.

A.4.2 Analog drive connection (S7-1500, S7-1500T)

A.4.2.1 "StopMode" = 0, 2 (S7-1500, S7-1500T)

Function chart: Enabling a technology object and disabling with "StopMode" = 0, 2



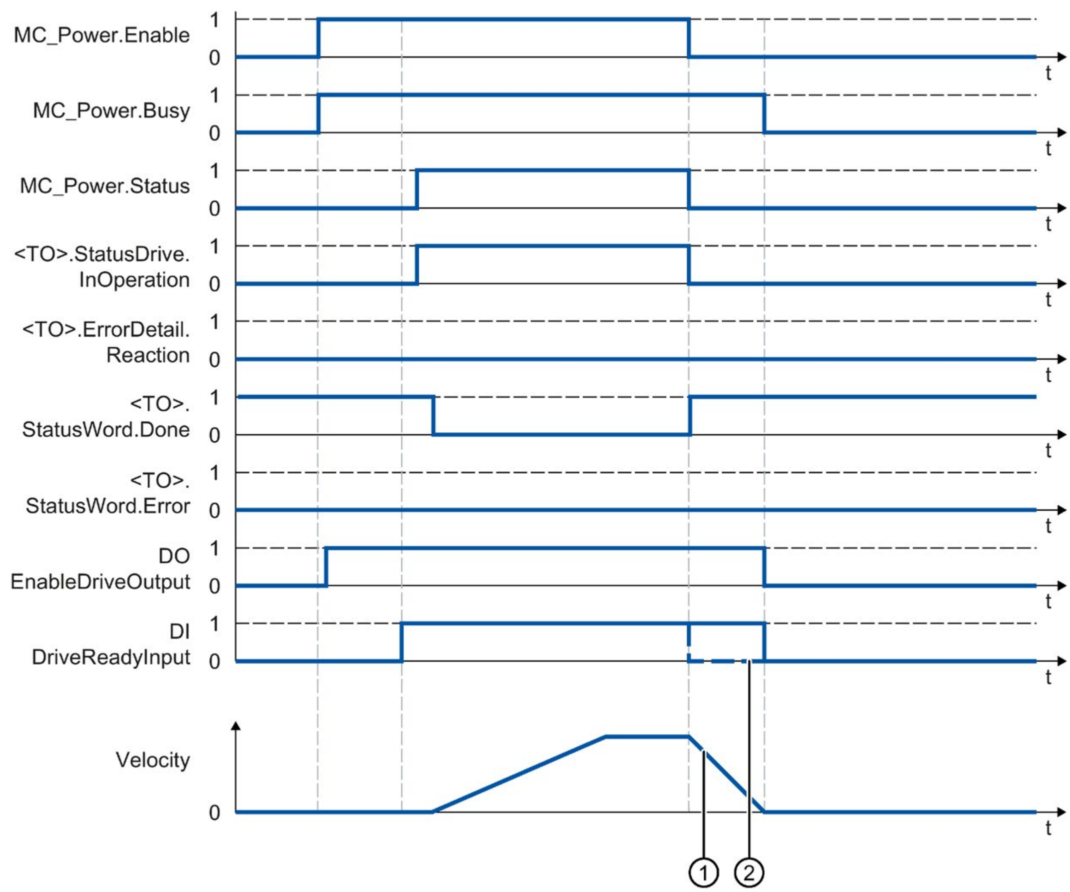
①
- "StopMode" = 0

  The axis is braked with the configured emergency stop deceleration.
- "StopMode" = 2

  The axis decelerates with the configured maximum deceleration.

A.4.2.2 "StopMode" = 1 (S7-1500, S7-1500T)

Function chart: Enabling a technology object and disabling with "StopMode" = 1

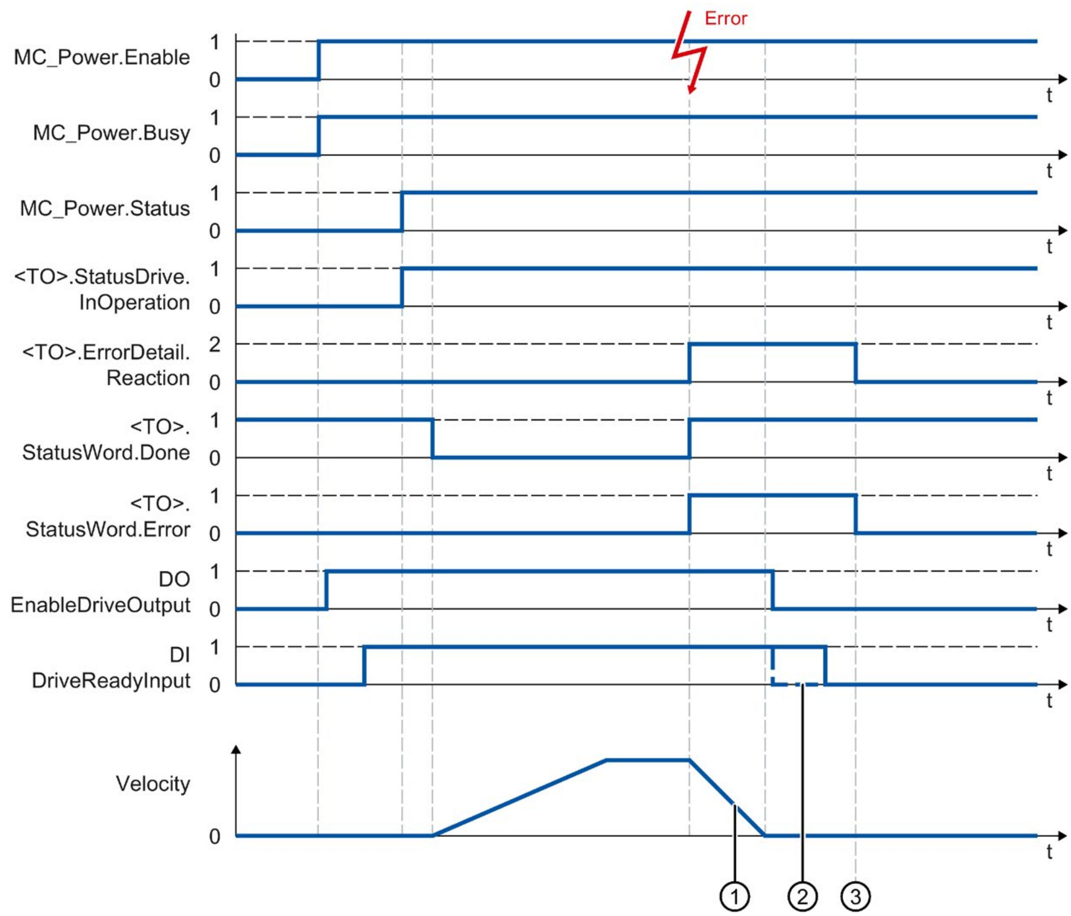


① The deceleration ramp depends on the configuration in the drive.

② The behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

A.4.2.3 Alarm reactions with braking ramp via the technology object (S7-1500, S7-1500T)

Function chart: Enabling a technology object and occurrence of a technology alarm with braking ramp via the technology object



① The axis is braked based on the alarm reaction:

- Stop with current dynamic values (<TO>.ErrorDetail.Reaction = 1)

  The axis is braked with the deceleration in the Motion Control instruction.
- Stop with maximum dynamic values (<TO>.ErrorDetail.Reaction = 2)

  The axis decelerates with the configured maximum deceleration.
- Stop with emergency stop ramp (<TO>.ErrorDetail.Reaction = 3)

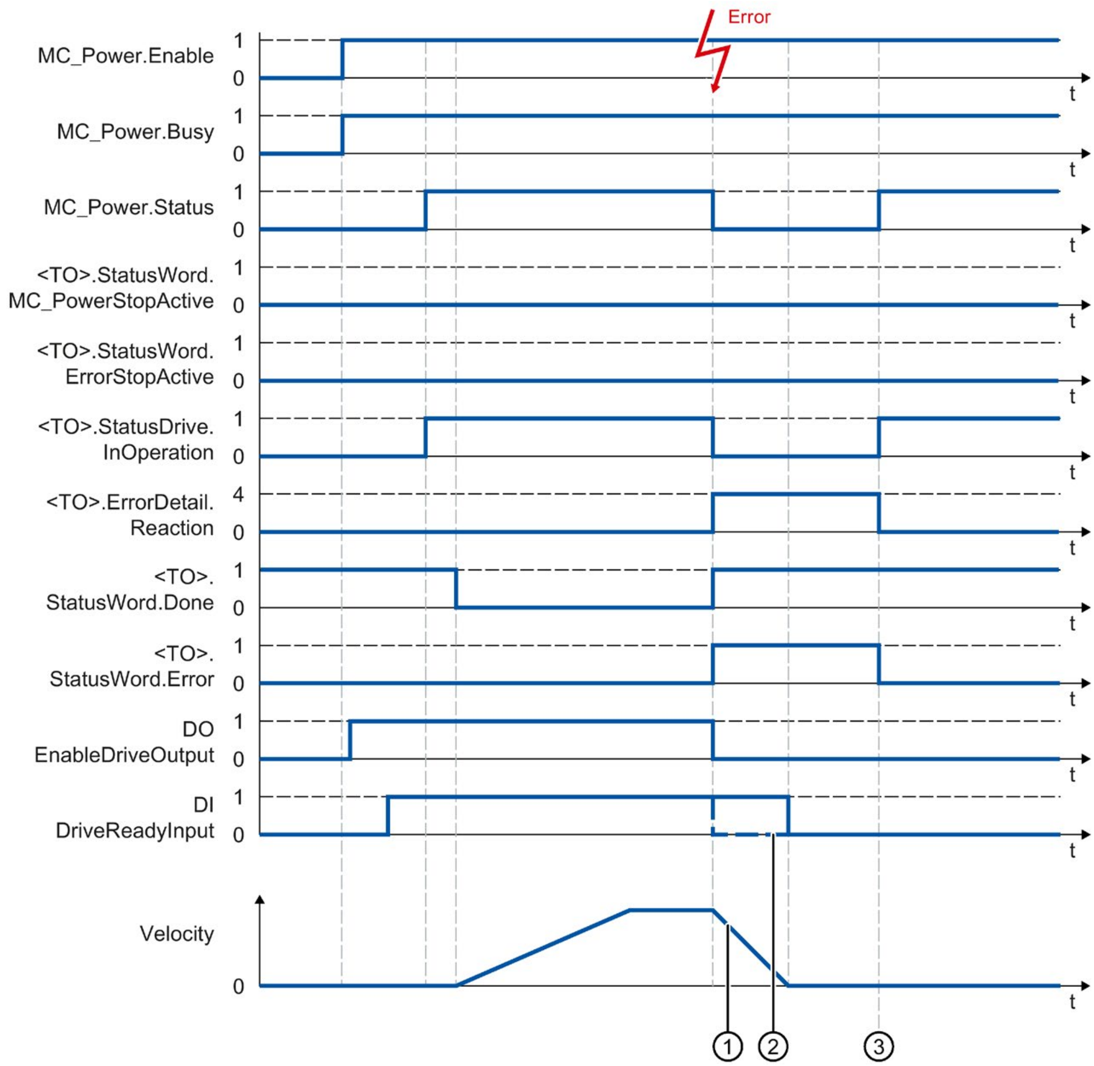
  The axis is braked with the configured emergency stop deceleration.

② The behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

③ The technology alarm is acknowledged at time ③.

A.4.2.4 Alarm response "Remove enable" (S7-1500, S7-1500T)

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 behavior of the ready signal of the drive "DI DriveReadyInput" is manufacturer-specific.

③ The technology alarm is acknowledged at time ③.

Glossary (S7-1500, S7-1500T)

Absolute synchronous operation

Function corresponds to the Motion Control instruction MC_GearInPos or MC_CamIn.

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 measuring 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

Gain factor of the position controller

Master value

Input value 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

Processing cycle clock

The processing of a technology object in the servo cycle clock.

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.

Relative gearing

Function corresponds to the Motion Control instruction MC_GearIn.

Restart

The technology object is reinitialized with the current configuration parameters.

Safe Stop 1 (SS1)

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

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 loads or to brake drives quickly and safely at high speeds

Safe Stop 2 (SS2)

The Safe Stop 2 (SS2) safety function brings a drive to standstill quickly and safely via an internal rapid stop ramp. After standstill is reached, the standstill position is monitored on the drive side. The drive can deliver full torque to maintain the standstill.

SS2, for example, is used for processing machines and machine tools.

Safe Torque Off (STO)

The Safe Torque Off (STO) safety function is the most commonly used and most basic drive-internal safety function. STO ensures that no more torque generating energy acts on a drive. This prevents unintended startup of the drive. 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 on its own due to the load torque or due to friction. Other areas of use are where "coasting" of the drive has no relevance for safety.

Software limit switch

A programmable position which limits the traversing range of an axis.

Synchronization

The phase of the following axis to reach synchronous movement.

Synchronous operation

Defined synchronous movement after synchronization of a following axis to a leading axis.

Technology alarm

If an error occurs at a technology object (e.g. approaching a hardware limit switch), a technology alarm is triggered and indicated.

The impact of a technology alarm on the technology object is specified by the alarm reaction (e.g. remove enable). The alarm reaction is specified by the system.

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 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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