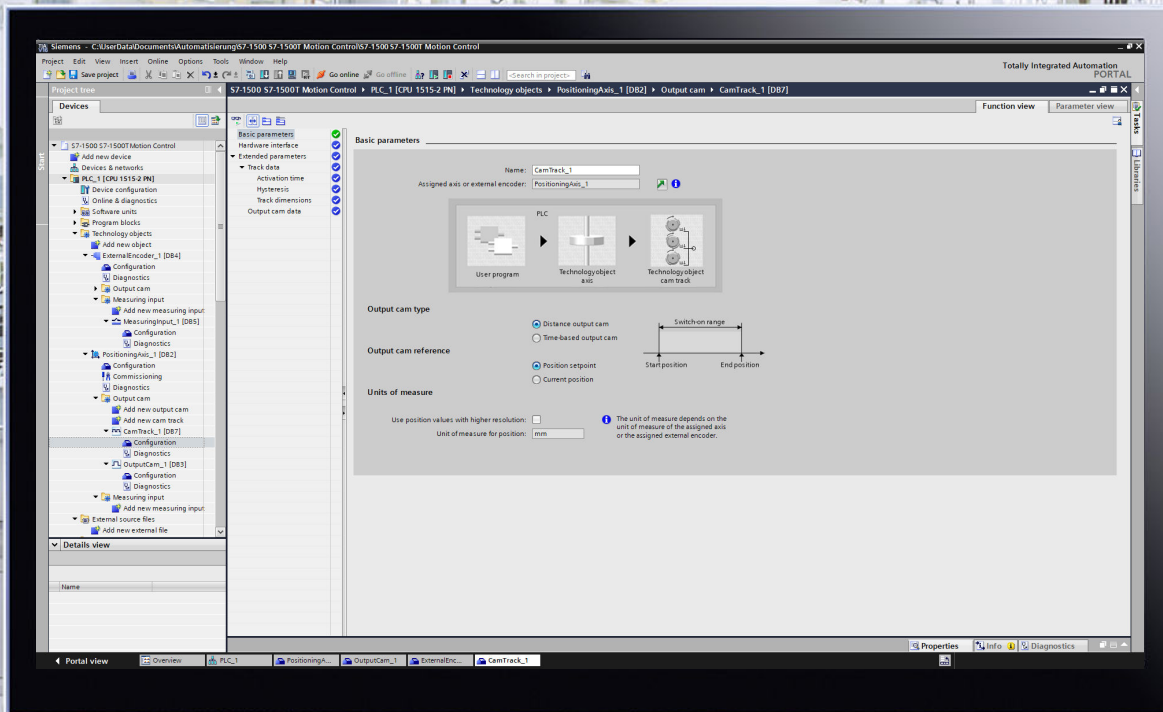


SIEMENS



Function manual

SIMATIC

S7-1500

S7-1500/S7-1500T Measuring input and output cam functions V5.0 in TIA Portal V16

Edition

12/2019

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SIMATIC

S7-1500 S7-1500/S7-1500T Measuring input and cam functions V5.0 in TIA Portal V16

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TIA Portal V16




12/2019

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Legal information

Warning notice system

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

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


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

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

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Preface (S7-1500, S7-1500T)

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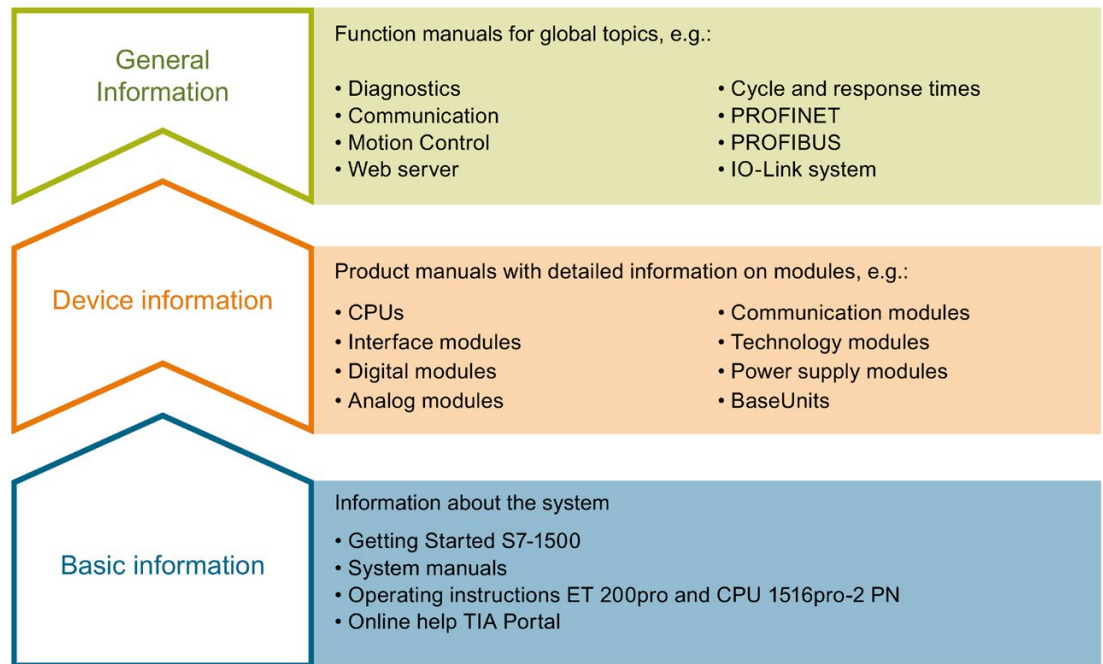
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Function manuals Documentation Guide (S7-1500, S7-1500T)

1

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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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)

2.1 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 measuring input, output cam and cam track technology objects via the Motion Control instructions in your user program.

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	Measuring input (Page 11)	Output cam (Page 26)	Cam track (Page 41)
"MC_Reset" Acknowledge alarms, restart technology objects	X	X	X	X	X
"MC_MeasuringInput" Start measuring once	X	X	X	-	-
"MC_MeasuringInputCyclic" Start cyclic measuring	X	X	X	-	-
"MC_AbortMeasuringInput" Cancel active measuring job	X	X	X	-	-
"MC_OutputCam" Activate/deactivate output cam	X	X	-	X	-
"MC_CamTrack" Activate/deactivate cam track	X	X	-	-	X

Basics (S7-1500, S7-1500T)

3.1

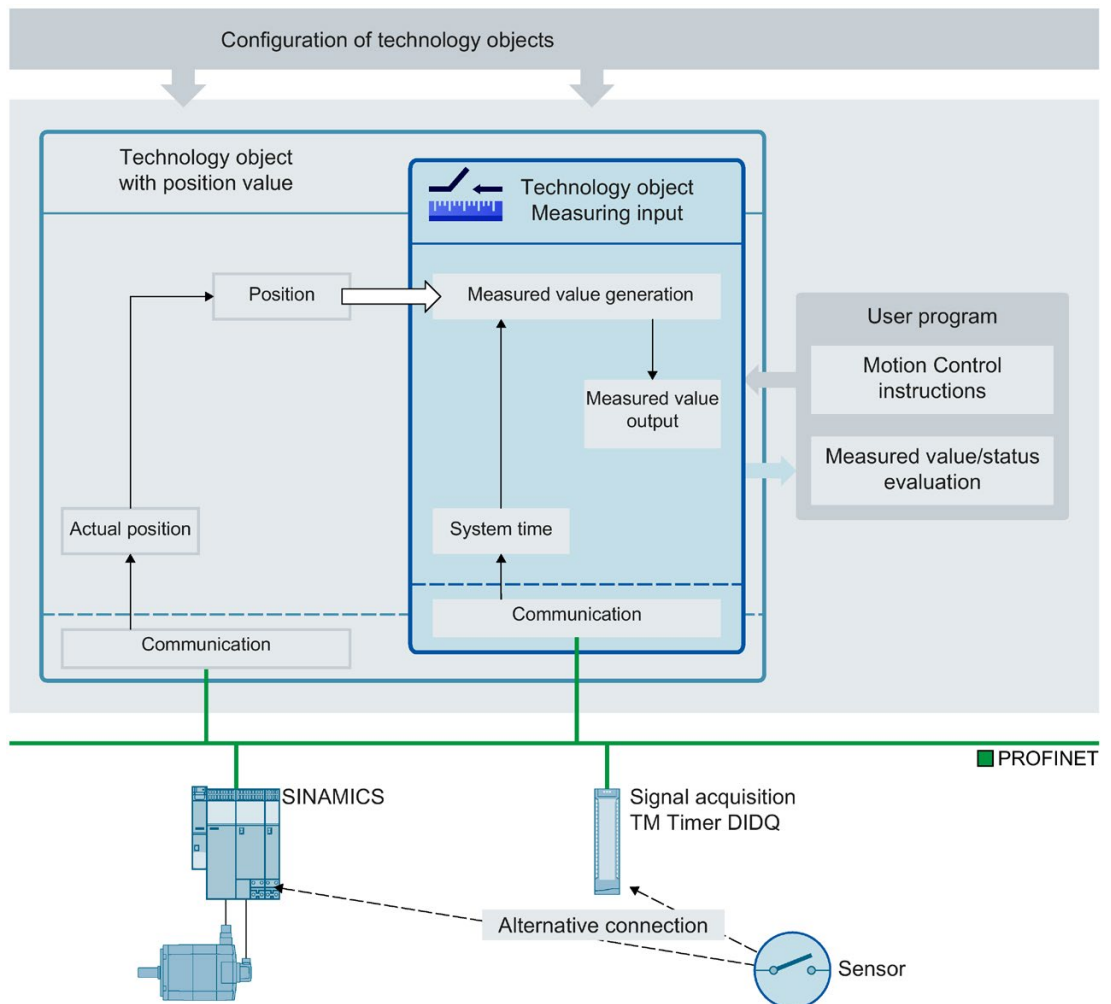
Measuring input technology object (S7-1500, S7-1500T)



The measuring input technology object acquires the actual position of an axis or external encoder at a signal change at the measuring input.

You can find an overview of the functions of the measuring input technology object in the "Functions (Page 10)" section.

The following figure shows the basic principle of operation of the measuring input technology object:



Measurement types

The following types of measurement can be performed:

- One-time measurement (Page 14)

Up to two measured values are acquired with edge accuracy with one measuring job. A one-time measuring job is started with "MC_MeasuringInput".

- Cyclic measuring (Page 16)

With cyclic measuring, up to two measured values are acquired with edge accuracy in each position control cycle.

A cyclic measuring job is started with "MC_MeasuringInputCyclic". The measurements are continued cyclically until they are ended per command.

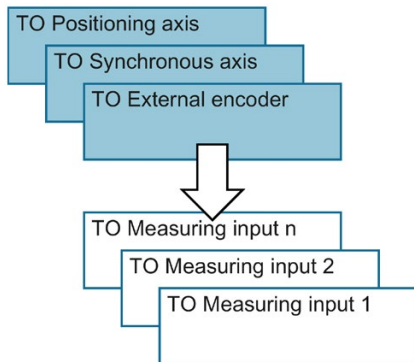
The edges to be detected are selected when starting the measurement using Motion Control instruction "MC_MeasuringInput" or "MC_MeasuringInputCyclic".

Assignment

The measuring input technology object must always be assigned to another technology object whose position will be evaluated by the measuring input.

The measuring input technology object can be assigned to the following technology objects:

- Synchronous axis
- Positioning axis
- External encoder



Exactly one axis or one external encoder can be assigned to a measuring input technology object.

An axis or external encoder can be assigned multiple measuring input technology objects.

Measured value determination

The position can be detected using support from the hardware in one of the following ways:

- **Measurement using Timer DI**

With measured value acquisition via time value, the time points of the signal changes are recorded precisely. The time stamps are then transferred to the controller and the associated actual positions are determined in the technology object.

Measurement using Timer DI requires isochronous mode.

- **Measurement using SINAMICS (central probe)**

With central measuring inputs, the time points of the signal changes are recorded precisely. The time stamps are then transferred to the controller via telegram 39x and the associated actual positions are determined in the technology object.

Measurements via a central measuring input are only possible for SINAMICS drives, see "Compatibility list". The maximum usable cycle time on the bus is limited, see "Time-related boundary conditions (Page 21)".

You can find more information on the telegrams in the "PROFIdrive telegrams" section of the documentation "S7-1500/S7-1500T Axis functions (<https://support.industry.siemens.com/cs/ww/en/view/109766462>)".

- **Measurement using PROFIdrive telegram (drive or external encoder)**

With measurement using PROFIdrive telegram, the measurement input is connected to the drive device and measurement takes place directly in the drive. The position value is determined on a signal change at the measurement input. The drive or encoder module communicates the determined position value to the technology object via the PROFIdrive telegram.

With measurement using PROFIdrive telegram, only one measurement input at a time can be active on an actual value or encoder in the PROFIdrive telegram. A maximum of two measuring inputs can be configured on an actual value or encoder in the PROFIdrive telegram via PROFIdrive; see section "Automatic transfer of drive and encoder parameters in the device" of the "S7-1500/S7-1500T Axis functions" (<https://support.industry.siemens.com/cs/ww/en/view/109766462>) documentation.

Measuring job

A measuring job is started using the Motion Control instruction "MC_MeasuringInput" (one-time measuring) or "MC_MeasuringInputCyclic" (cyclic measuring). Cyclic measuring is only available at selected measurement inputs. You can find an overview in the section Configuration - Hardware interface (Page 58). One-time measuring is always possible.

The resulting measured value is indicated at the respective output of the Motion Control instruction "MC_MeasuringInput" or "MC_MeasuringInputCyclic".

Use with SIMATIC S7-PLCSIM

The measuring input technology object cannot be used with SIMATIC S7-PLCSIM. The measuring input technology object and the measuring input jobs used in the user program can be loaded into SIMATIC S7-PLCSIM, but have no function. Measured values are not shown.

Correction time

The time of the measurement can be corrected by setting a correction time (<TO>.Parameter.CorrectionTime) for the measuring input technology object.

Corrections may be required for the following examples:

- Times for mechanical displacement of the measuring input
- Times for the generation of the measured signal before the input at the measurement module
- Filter times at measurement input

The correction time is included in the calculation for all measuring input types of the measuring input technology object.

Also note the time delay when measuring on a virtual axis, see section "Brief description of actual values" of the "S7-1500/S7-1500T Axis functions"

(<https://support.industry.siemens.com/cs/ww/en/view/109766462>) documentation.

3.1.1 Measuring (S7-1500, S7-1500T)

3.1.1.1 One-time measurement (S7-1500, S7-1500T)

With one-time measurement, up to two edges can be detected with one measuring job. The associated actual positions are signaled back in the function block and in the technology data block and can be further processed in the user program.

Measuring job

A measuring job is started using the Motion Control instruction "MC_MeasuringInput". The "<TO>.Status" tag in the technology data block changes to "WAITING_FOR_TRIGGER". The technology object activates the measurement when the selected edge is detected.

- The measurement occurs at the measurement input in the form of up to two system times. Based on the times, the associated position is determined and output, taking into consideration a correction time, if present.
- With direct position detection, the detected position value is supplied directly from the drive or encoder module to the technology object via the PROFIdrive telegram.

The measurement is then finished. An additional measurement must be restarted using Motion Control instruction "MC_MeasuringInput".

Configured "Mode" parameter in Motion Control instruction "MC_MeasuringInput"	Output of Motion Control instruction "MC_MeasuringInput"	
	"MeasuredValue1"	"MeasuredValue2"
Measure positive edge only	Actual position at the time of the edge	–
Measure negative edge only		
Measure the next two edges	Actual position at the time of the first edge	Actual position at the time of the second edge
Measure the next two edges starting with the positive edge	Actual position at the time of the positive edge	Actual position at the time of the negative edge
Measure the next two edges starting with the negative edge	Actual position at the time of the negative edge	Actual position at the time of the positive edge

The last detected values are set in the technology data block. If a new job is initiated with the function block, the outputs of the function block are initialized. The technology data block is not initialized. After detecting the first valid measuring cycle, the values in the technology data block and function block are consistent with one another.

The finished measuring job is indicated in the function block in "MC_MeasuringInput.DONE" = TRUE or in the technology data block in "<TO>.Status" = "TRIGGER_OCCURRED".

Temporal requirements for measuring jobs via "MC_MeasuringInput"

The hardware-related restrictions to measuring via the PROFIdrive telegram (drive or encoder) or measuring via SINAMICS (central probe) result in time requirements for the period until the measuring event can be recorded.

When measuring once via "MC_MeasuringInput" with "Mode" = 3 (measurement at both edges, beginning with the rising edge) or "Mode" = 4 (measurement at both edges, beginning with the falling edge), a minimum interval of several servo cycles is therefore required between the first edge to be measured and the previous edge, so that the first edge to be measured can be recorded.

You can find information on the temporal boundary conditions in the section Time-related boundary conditions (Page 21).

See also

Time-related boundary conditions (Page 21)

MC_MeasuringInput: Start measuring once V5 (Page 76)

3.1.1.2 Cyclic measuring (S7-1500, S7-1500T)

With cyclic measuring, up to two measuring events can be acquired by the system in each position control cycle of the technology object and the associated measuring positions can be displayed. The measurements are continued cyclically until they are ended per command.

The determined measured values are displayed and can be read by the user program.

Cyclic measuring requires the measured value to be determined using hardware support of the type "Measurement using Timer DI".

Measuring edges at which a measured value could not be determined are indicated in a lost edge counter in the technology data block as well as in function block "MC_MeasuringInputCyclic".

Measuring job

A cyclic measuring job is started with Motion Control instruction "MC_MeasuringInputCyclic" and the measuring job is issued to the corresponding measuring hardware. Depending on the functionality of the hardware, up to two measuring events and thus measuring times can be recorded with edge reference per position control cycle and then forwarded to the technology object. The technology object determines the measuring positions for the measuring times taking into consideration any specified correction times.

The technology data block tag "<TO>.Status" changes from "INACTIVE" to "WAITING_FOR_TRIGGER" and remains in this status as long as additional events are awaited.

The mode set in the Motion Control instruction specifies the edges for which the measured values are to be acquired. At most, the following edges can be detected in each position control cycle:

- Two positive edges when detecting positive edges
- Two negative edges when detecting negative edges
- One positive edge and one negative edge when detecting positive and negative edges

Measured values and counters

With a positive edge at the input "MC_MeasuringInputCyclic.Execute", outputs "MeasuredValue1Counter" and "MeasuredValue2Counter" are reset to "0". As a result, new events can be tracked immediately and new measured value entries can be detected.

All measuring event occurrences of the measuring job are incremented by "1" in the corresponding event counters "<TO>.MeasuredValues.MeasuredValue1Counter" and "<TO>.MeasuredValues.MeasuredValue2Counter" of the technology data block.

The acquired measured values are continuously captured in the technology data block irrespective of individual jobs and the values are only reset to "0" at power-up or restart of the technology object.

After a completed measurement, the measured values are output in the function block. The counters of the function block are set to "0" at a new measuring job. The measured value output in the technology data block always indicates the last acquired measured value.

Lost edge counter (LEC)

If more than two edges to be detected occur within one position control cycle, a measured value cannot be evaluated for the other edges to be detected. The number of lost edges is recorded in the LEC.

The lost edges that are recorded in the LEC depend on the mode set in the Motion Control instruction. For example, if only positive edges are to be measured, the LEC records only the non-measured positive edges.

A maximum of seven lost edges can be counted and displayed in the LEC.

The number of lost edges is indicated in the function block and in the technology data block in:

- "LostEdgeCounter1"

Lost cleared edges from the position control cycle in which "MeasuredValue1" was acquired.

⇒ The displayed value in "LostEdgeCounter1" is updated when counter "MeasuredValueCounter1" is incremented.

- "LostEdgeCounter2"

Lost cleared edges from the position control cycle in which "MeasuredValue2" was acquired.

⇒ The displayed value in "LostEdgeCounter2" is updated when counter "MeasuredValueCounter2" is incremented.

Display of measurement results when using cyclic measuring

Edges selected in the command	Display per position control cycle			
	"MeasuredValue1"	"MeasuredValue2"	"LostEdgeCounter1"	"LostEdgeCounter2"
Detect positive edges only "MC_MeasuringInputCyclic.-Mode" = 0	Actual position at the time of the first positive edge	Actual position at the time of the second positive edge	Number of positive or negative edges in excess of two in the position control cycle of acquisition of "MeasuredValue1" and "MeasuredValue2".	
Detect negative edges only "MC_MeasuringInputCyclic.-Mode" = 1	Actual position at the time of the first negative edge	Actual position at the time of the second negative edge	The following applies here: <ul style="list-style-type: none"> • If a "MeasuredValue1" and a "MeasuredValue2" are acquired, the number of acquired and lost edges indicated in "LostEdgeCounter1" and "LostEdgeCounter2" are the same. • If only one "MeasuredValue1" is acquired, the "LostEdgeCounter1" is reset to "0". The value in "LostEdgeCounter2" remains changed. 	
Detect positive and negative edges "MC_MeasuringInputCyclic.-Mode" = 2	Actual position at the time of the first positive edge in the position control cycle	Actual position at the time of the first negative edge in the position control cycle	Number of edges in excess of two in the position control cycle of acquisition of "MeasuredValue1" and "MeasuredValue2". <p>The following applies here:</p> <ul style="list-style-type: none"> • If a "MeasuredValue1" and a "MeasuredValue2" are acquired, the number of acquired and lost edges indicated in "LostEdgeCounter1" and "LostEdgeCounter2" are the same. • If only one "MeasuredValue1" is acquired, the "LostEdgeCounter1" is reset to "0". The value in "LostEdgeCounter2" remains changed. • If only one "MeasuredValue2" is acquired, the "LostEdgeCounter2" is reset to "0". The value in "LostEdgeCounter1" remains changed. 	

Examples

The following figures show examples of divergence of "MeasuredValue1Counter" and "MeasuredValue2Counter" as a result of lost edges.

Example: Measurement at positive edges (Mode = 0)

Processing cycle clock TO Measuring input	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10
Measuring input											
MeasuredValue1Counter	...	6	7	7	8	9	9	10	11	12	13
LostEdgeCounter1	...	0	0	0	0	0	0	1	0	1	0
MeasuredValue2Counter	...	6	7	7	7	7	7	8	8	9	9
LostEdgeCounter2	...	0	0	0	0	0	0	1	1	1	1

Example: Measurement at negative edges (Mode = 1)

Processing cycle clock TO Measuring input	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10
Measuring input											
MeasuredValue1Counter	...	6	7	8	9	10	10	11	11	12	13
LostEdgeCounter1	...	0	0	0	1	0	0	1	1	1	0
MeasuredValue2Counter	...	6	7	7	8	8	8	9	9	10	10
LostEdgeCounter2	...	0	0	0	1	1	1	1	1	1	1

Example: Measurement at positive and negative edges (Mode = 2)

Processing cycle clock TO Measuring input	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10
Measuring input											
MeasuredValue1Counter	...	6	7	7	8	9	9	10	11	12	13
LostEdgeCounter1	...	0	2	2	0	0	0	3	0	4	0
MeasuredValue2Counter	...	6	7	8	8	9	10	11	12	13	14
LostEdgeCounter2	...	0	2	0	0	0	0	3	0	4	0

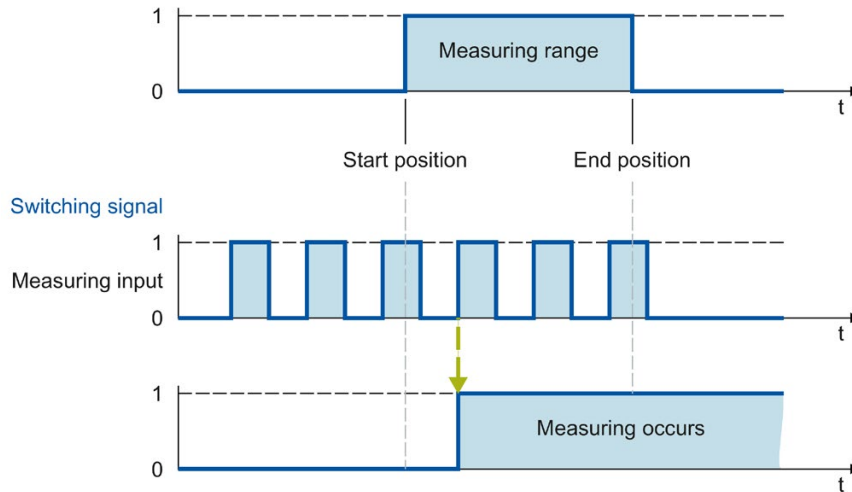
See also

MC_MeasuringInputCyclic: Start cyclic measuring V5 (Page 80)

3.1.2 Measuring with measuring range (S7-1500, S7-1500T)

A measuring job can be activated directly or restricted to a defined measuring range.

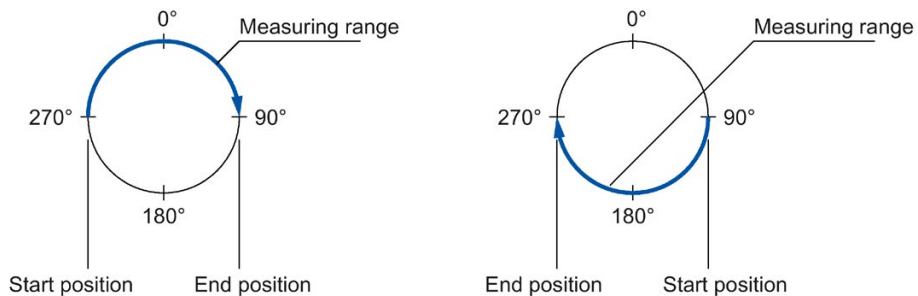
The following graphic shows an example of measuring with measuring range in "Mode" = 0 (measurement of next positive edge):



Only measured values within the measuring range are displayed for the technology object.

- If no measuring edge within the measuring range is detected during a one-time measurement, the measuring job is canceled and an alarm is triggered.
- Cyclic measuring remains active even if no measuring edge within the measuring range was detected.

For axes without modulo function, it is immaterial in which order the start and end positions are specified. If the start position is greater than the end position, the two values are interchanged in the application. If the start position for an axis with modulo function is greater than the end position, the measuring range is extended from the start position past the modulo transition of the axis to the end position.



The measuring range positions are specified in the Motion Control instruction "MC_MeasuringInput" or "MC_MeasuringInputCyclic".

Activation time for the measuring range

The measuring function must be active at the measurement input when the start of the measuring range is reached. To compensate for the communication time for activation in the Timer DI or drive, for example, the activation of the measurement in the technology object begins earlier than the measuring range start by the amount of the activation time.

The activation time for measuring with measuring range is divided up as follows:

- The activation time allocation defined and active on the system side is indicated in the "<TO>.Parameter.MeasuringRangeActivationTime" tag.
- An additional activation time can also be set by the user with the "<TO>.Parameter.MeasuringRangeAdditionalActivationTime" tag.

3.1.3 Time-related boundary conditions (S7-1500, S7-1500T)

Depending on the hardware configuration and selection of edges to be detected, different system-inherent requirements apply to the time allowed after calling the Motion Control instruction "MC_MeasuringInput" or "MC_MeasuringInputCyclic" until a measurement occurs and the results are displayed.

The following times must be distinguished here:

- Time until the measuring event can be captured
- Time until the measurement result is displayed or the measurement is finished.

The times calculated taking into account the current settings are indicated in configuration window "Extended parameters" of a measuring input.

Measurement using Timer DI/measurement using SINAMICS (central probe)

- Time from output of an "MC_MeasuringInput" job until measuring event detection becomes effective:
 - "MeasuringRangeActivationTime": $2 \times T_{\text{servo}}$
- Time after measuring event until measured value is available in the controller:
 - One-time measurement: $2 \times T_{\text{servo}} + T_{\text{Send}}$
 - Cyclic measuring: $T_{\text{servo}} + T_{\text{Send}}$
- Activation time for a measurement with measuring range:
 - "MeasuringRangeActivationTime" + "MeasuringRangeAdditionalActivationTime"

Note

Maximum bus clock cycle

With the use of SINAMICS measuring inputs, the maximum bus clock cycle T_{Send} can be up to 8 ms.

Measurement using PROFIdrive telegram (drive or external encoder)

- "MeasuringRangeActivationTime":
 - T_{Send} and T_{servo} equal to: $3 \times T_{\text{servo}}$
 - T_{Send} and T_{servo} not equal to: $2 \times T_{\text{servo}}$
- Time from output of an "MC_MeasuringInput" job until measuring event detection becomes effective:
 - Measuring a positive/negative edge or two edges:
"MeasuringRangeActivationTime" + $2 \times T_{\text{servo}}$
 - Measuring two dedicated edges:
"MeasuringRangeActivationTime" + $3 \times T_{\text{servo}}$
- Time after measuring event until measured value is available in the controller:
 - Measuring an edge: $7 \times T_{\text{servo}}$
 - Measuring two edges: $13 \times T_{\text{servo}}$
- Activation time for a measurement with measuring range:
 - Measuring a positive/negative edge or two edges:
"MeasuringRangeActivationTime" + "MeasuringRangeAdditionalActivationTime" + $2 \times T_{\text{servo}}$
 - Measuring two dedicated edges:
"MeasuringRangeActivationTime" + "MeasuringRangeAdditionalActivationTime" + $3 \times T_{\text{servo}}$

Definition of tags

- T_{servo} = Call interval of the technology object in the servo cycle clock [ms]
- T_{Send} = Send clock [ms]
- "MeasuringRangeActivationTime" = See section Measuring with measuring range (Page 20)

To prevent asynchronous processing from overwriting a measured value that was just determined, a new one-time measuring job cannot be started until the active measurement has concluded. The sum of the activation time and the time until display or conclusion must be taken into account for this.

In the case of cyclic measuring, evaluation or temporary storage of the measurement results in the synchronous MC-PreInterpolator [OB68] is recommended from the user perspective.

3.1.4 Tags: Measuring input technology object (S7-1500, S7-1500T)

The following technology object tags are relevant for measuring:

Status indicator	
Tag	Description
<TO>.Status	Status of the measuring input function
	0 Measurement is not active ("INACTIVE")
	1 The measuring input is waiting for a measuring event ("WAITING_FOR_TRIGGER")
	2 The measuring input has acquired one or more measured values ("TRIGGER_OCCURRED").
	3 Error during the measurement ("MEASURING_ERROR")
<TO>.InputState	Status of measuring input

Parameters	
Tag	Description
<TO>.Parameter.MeasuringInputType	Measuring input type
<TO>.Parameter.PROFdriveProbeNumber	Number of the measuring input to be used for a measurement via PROFdrive telegram
<TO>.Parameter.MeasuringRangeActivationTime	System-defined activation time allocation [ms]
<TO>.Parameter.MeasuringRangeAdditionalActivationTime	Additional user-defined activation time allocation [ms]
<TO>.Parameter.CorrectionTime	User-defined correction time for the measurement result [ms]

Interface	
Tag	Description
<TO>.Interface.Address	I/O address for the digital measuring input

3.1 Measuring input technology object (S7-1500, S7-1500T)

Units	
Tag	Description
<TO>.Units.LengthUnit	Unit of the length data
<TO>.Units.TimeUnit	Unit of the time data

MeasuredValues	
Tag	Description
<TO>.MeasuredValues.MeasuredValue1	First measured value
<TO>.MeasuredValues.MeasuredValue2	Second measured value (when measuring two or more edges in one position control cycle)
<TO>.MeasuredValues.MeasuredValue1Counter	Count value for the first measured value
<TO>.MeasuredValues.MeasuredValue2Counter	Count value for the second measured value
<TO>.MeasuredValues.LostEdgeCounter1	Lost edges in the cycle clock of the first measured value acquisition (zero in the case of one-time measurement)
<TO>.MeasuredValues.LostEdgeCounter2	Lost edges in the cycle clock of the second measured value acquisition (zero in the case of one-time measurement)

StatusWord	
Tag	Description
<TO>.StatusWord.X0 (Control)	The technology object is in operation.
<TO>.StatusWord.X1 (Error)	An error occurred at the technology object.
<TO>.StatusWord.X2 (RestartActive)	The technology object is being reinitialized. The tags of the technology data block are not updated with active restart.
<TO>.StatusWord.X3 (OnlineStartValuesChanged)	Data relevant for the restart has been changed. The changes are applied only after a restart of the technology object.
<TO>.StatusWord.X5 (CommunicationOk)	The measuring input is synchronized with the measuring module and can be used.

ErrorWord	
Tag	Description
<TO>.ErrorWord.X0 (SystemFault)	A system-internal error has occurred.
<TO>.ErrorWord.X1 (ConfigFault)	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data were incorrectly modified during runtime of the user program.
<TO>.ErrorWord.X2 (UserFault)	Error in user program at a Motion Control instruction or its use
<TO>.ErrorWord.X3 (CommandNotAccepted)	Command cannot be executed A Motion Control instruction cannot be executed because necessary requirements have not been met.
<TO>.ErrorWord.X13 (PeripheralError)	Error accessing a logical address

ErrorDetail		
Tag	Description	
<TO>.ErrorDetail.Number	Alarm number	
<TO>.ErrorDetail.Reaction	Effective alarm reaction	
	0	No reaction
	6	End measuring input processing

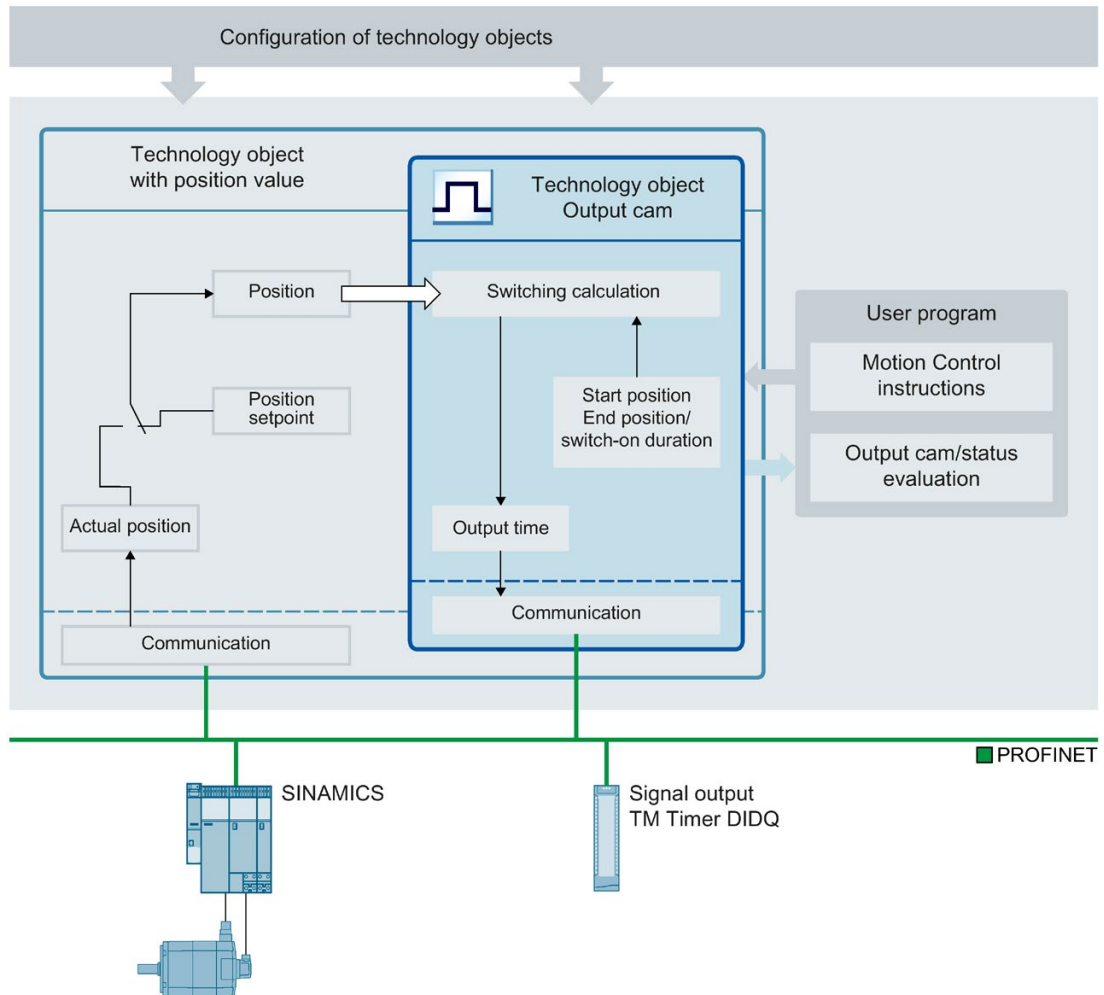
3.2 Output cam technology object (S7-1500, S7-1500T)



The output cam technology object generates switching signals depending on the position of an axis or external encoder. The switching states can be evaluated in the user program and fed to digital outputs.

You can find an overview of the functions of the output cam technology object in the "Functions (Page 10)" section.

The following figure shows the basic operating principle of the output cam technology object:



Output cam types

The following output cam types can be used:

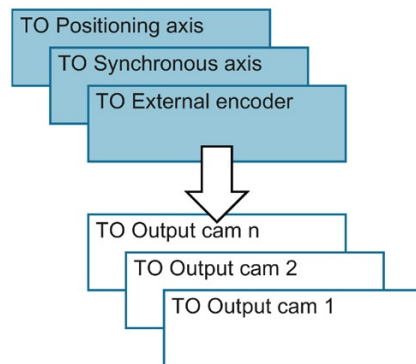
- Distance output cam (Page 29)
Distance output cams switch on between the start position and end position. Outside this range, the distance output cam is switched off.
- Time-based output cam (Page 31)
Time-based output cams switch on for a defined time period when the start position is reached.

Assignment

The output cam technology object must always be assigned to another technology object whose position will be evaluated.

The output cam technology object can be assigned to the following technology objects:

- Synchronous axis
- Positioning axis
- External encoder



Exactly one axis or one external encoder can be assigned to an output cam.

Multiple output cams can be assigned to one axis or external encoder.

Output cam calculation and output cam output

The output cam technology object calculates the exact switching time, thereby ensuring exact adherence to the switching positions. The switching time is calculated two position control cycles before the output.

The following output options are available for the digital output cam output:

- Timer-DQ

Digital output with high degree of accuracy and reproducibility in the microsecond range on time-based IO modules basis. In the case of signal output via time value, the times of the signal changes are determined by the technology object. The time stamps are then transferred to the hardware of the digital output and the edges are output with high precision.

Output via Timer DQ requires isochronous mode.

- Digital output module

Digital output with switching accuracy depending on the output cycle of the I/O used

When output is deactivated, the output cam status is not output at the hardware output. The output cam status can be used internally in the user program by evaluating the relevant "<TO>.CamOutput" tag.

Inverted output

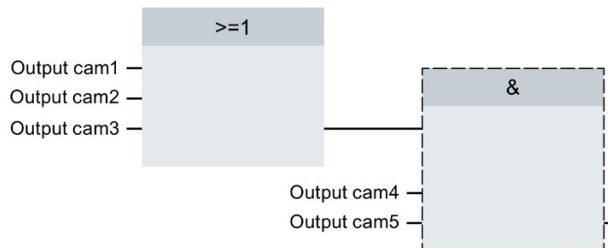
In the case of inverted output, the range in which the output cam output is switched on and the range in which it is switched off are swapped.

The inverted output is set in Motion Control instruction "MC_OutputCam" and is active when the instruction is enabled.

The inverted output can be used for both distance output cams and time-based output cams.

Output of multiple output cams to one output

The output of multiple output cams to one output is performed with either an AND or OR logic operation of the output cam signals to the output.



Display of the switching state

The switching state of the output cam is displayed in the associated technology data block in "<TO>.CamOutput".

Position reference

The switching points of the output cams can be referenced to the following positions, depending on the interconnected technology object.

- Actual position of a synchronous axis/positioning axis
- Position setpoint of a synchronous axis/positioning axis
- Position of an external encoder

Homing the interconnected technology object

A change to the position of an axis or external encoder using Motion Control instruction "MC_Home" is regarded as a sudden position change.

- Distance output cams are either skipped or correspondingly output.
- Time-based output cams are skipped. A time-based output cam is switched on only when the start position is overtraveled and remains switched on for the switch-on duration.
- Switched time-based output cams are not canceled by a homing operation.

Trace recording of output cam with reference to setpoint position

The CPU calculates the output time of the output cam in such a way that the output cam is switched when the position setpoint has been transferred from the PLC to the drive.

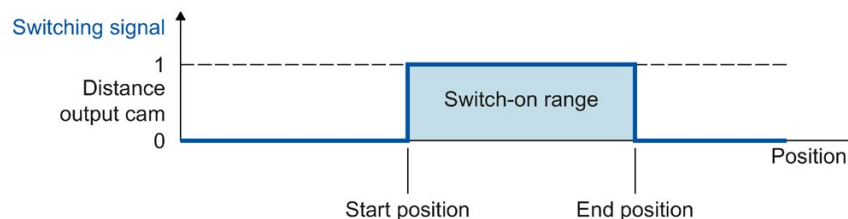
The communication time is not considered in the trace.

3.2.1 Distance output cam (S7-1500, S7-1500T)**Switch-on range**

The switch-on range of distance output cams is basically defined by the start position and end position.

Start position smaller than end position

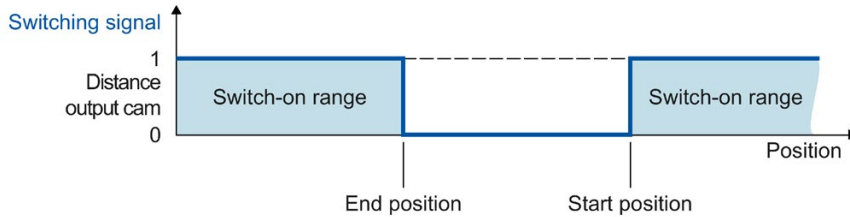
When the start position is less than the end position, the switch-on range begins with the start position and ends with the end position.



Start position greater than end position

When the start position is greater than the end position, there are two switch-on ranges as follows:

- Switch-on range beginning with the start position and ending with the positive range end (e.g. positive software limit switch, end of modulo range)
- Switch-on range beginning with the negative range end (e.g. negative software limit switch, start of modulo range) and ending with the end position



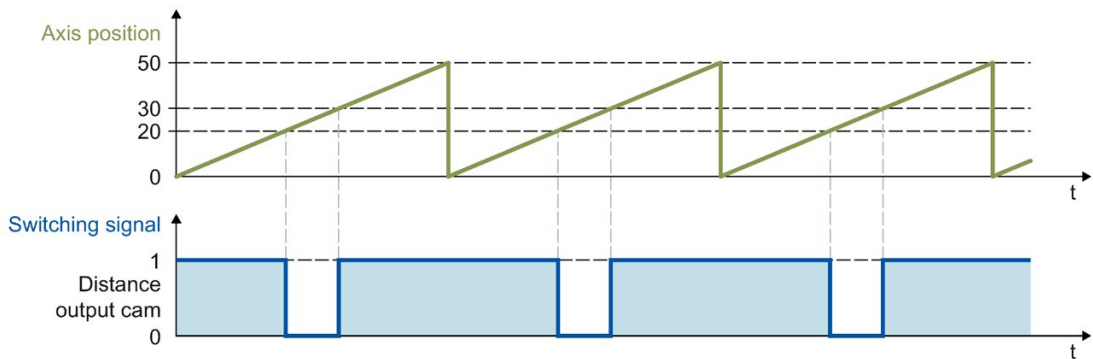
Mapping to an axis with modulo function

With active modulo function of the interconnected technology object, the start and end positions of the output cam are automatically mapped to values within the modulo range.

Example

- Modulo range = 0° to 50°
- Output cam start position = 80°
- Output cam end position = 220°

⇒ The specified start and end position of the output cam are outside the modulo range. The values are therefore mapped onto the modulo range. The start position is at 30° ($80^\circ \text{ mod } 50^\circ = 30^\circ$) and the end position is at 20° ($220^\circ \text{ mod } 50^\circ = 20^\circ$). The output cam remains switched on over two consecutive modulo lengths and switches off at 20° in every second modulo length.



Switching characteristics

After activation, a distance output cam switches on in the following cases:

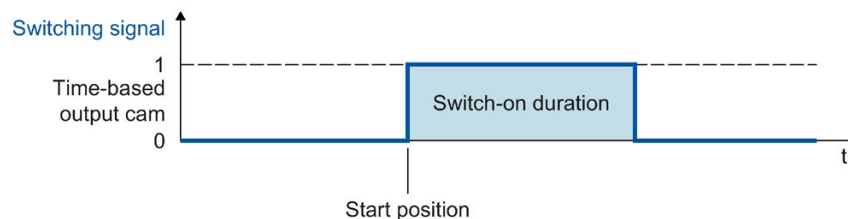
- The position of the interconnected technology object reaches the start or end position in the activation direction configured in Motion Control instruction "MC_OutputCam".
- The position of the interconnected technology object is moved into the switch-on range of the output cam (e.g. during homing) in the activation direction configured in Motion Control instruction "MC_OutputCam". If both activation directions are enabled in Motion Control instruction "MC_OutputCam", the output cam switches on even when the interconnected technology object is at a standstill.
- The output cam is switched on permanently using Motion Control instruction "MC_OutputCam" with "Mode" = 3.

An active distance output cam switches off in the following cases:

- The position is outside the switch-on range of the output cam.
- The position value is moved outside the switch-on range of the output cam.
- Motion Control instruction "MC_OutputCam" is set to "Enable" = FALSE.
- The motion direction of the interconnected technology object is reversed and no longer agrees with the enabled activation direction.

3.2.2 Time-based output cam (S7-1500, S7-1500T)

A time-based output cam switches on at the start position and remains set for the on-load factor.



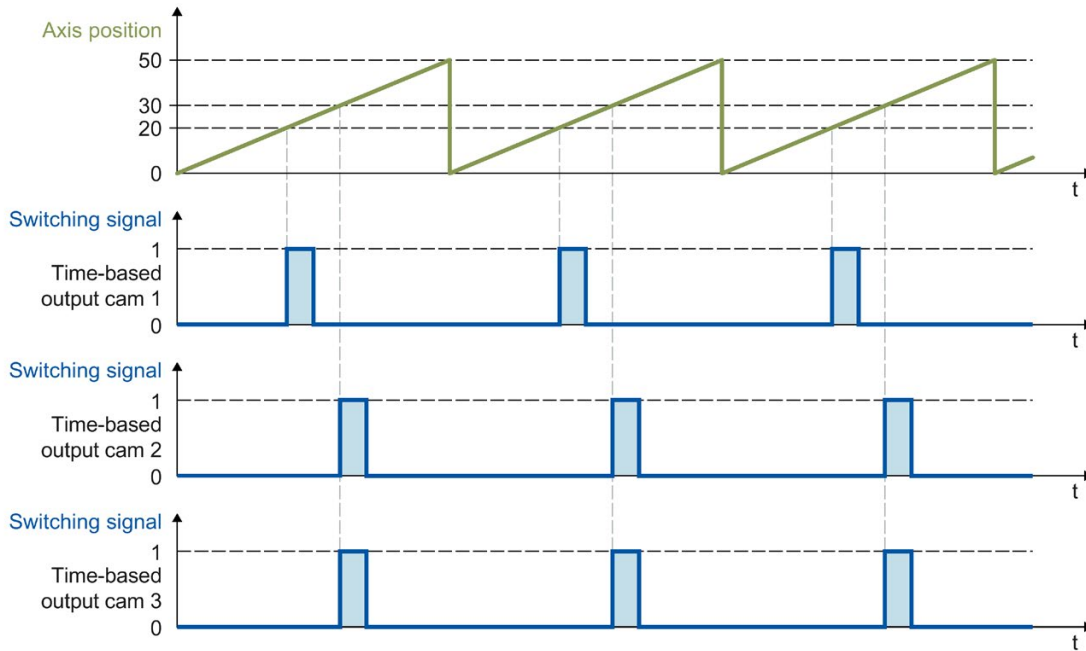
Mapping to an axis with modulo function

In the case of active modulo function of the interconnected technology object, the start position of the output cam is automatically mapped to the value within the modulo range.

Example

- Modulo range = 0° to 50°
- Output cam start positions:
 - Output cam 1 = 20°
 - Output cam 2 = 30°
 - Output cam 3 = 80°

⇒ The time-based output cam 1 switches on at 20°, the time-based output cam 2 switches on at 30°. The specified start position of time-based output cam 3 is outside the modulo range. The value for the start position is therefore mapped onto the modulo range so that the time-based output cam 3 switches on at 30°. All three output cams remain active the set on-load factor in each case.



Switching characteristics

A time-based output cam switches on in the following cases:

- The start position has been reached and the motion direction of the interconnected technology object corresponds to the effective direction enabled by the instruction.

Note

- If the start position is reached again while an output cam is switched on, the on-load factor is not re-triggered.
 - If due to the Motion Control instruction "MC_Home", the position value of the interconnected technology object is placed directly on or behind the start position of the output cam during the motion, the output cam does not switch on.
-

A time-based output cam switches off in the following cases:

- The configured on-load factor has expired.
- Motion Control instruction "MC_OutputCam" is set to "Enable" = FALSE.

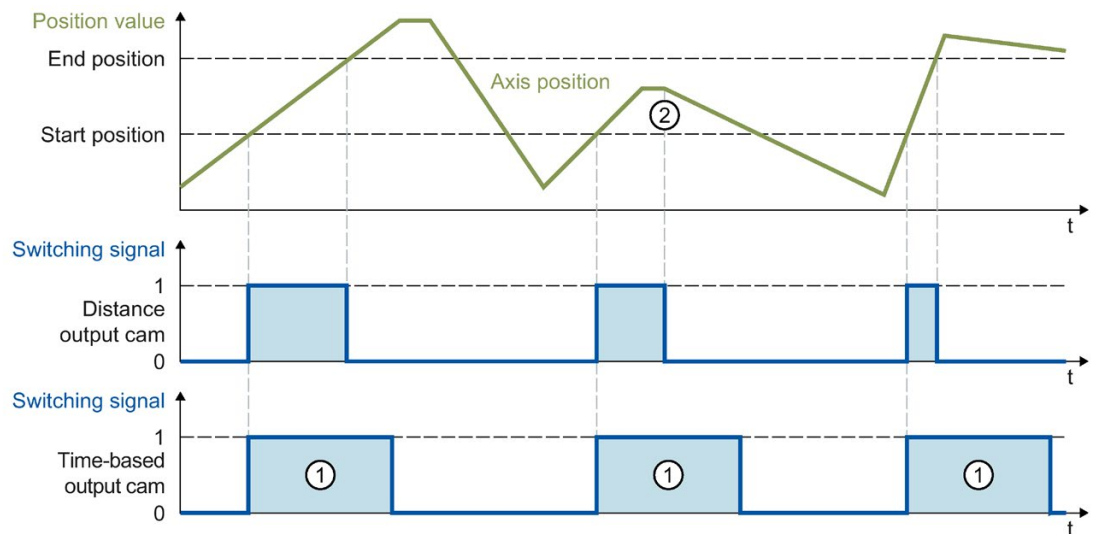
3.2.3 Activation direction of cam (S7-1500, S7-1500T)

An output cam can be switched depending on the motion direction of the interconnected technology object. An output of the output cam in positive or negative motion direction or independent of direction is possible.

The effective direction is set in "MC_OutputCam.Direction".

The following examples show the behavior of the output cam as a function of the effective direction setting.

Example of "positive" effective direction ("Direction" = 1)



Distance output cam

The output cam switches on when the switch-on range is reached in the **positive** direction. At a direction reversal ②, the output cam switches off.

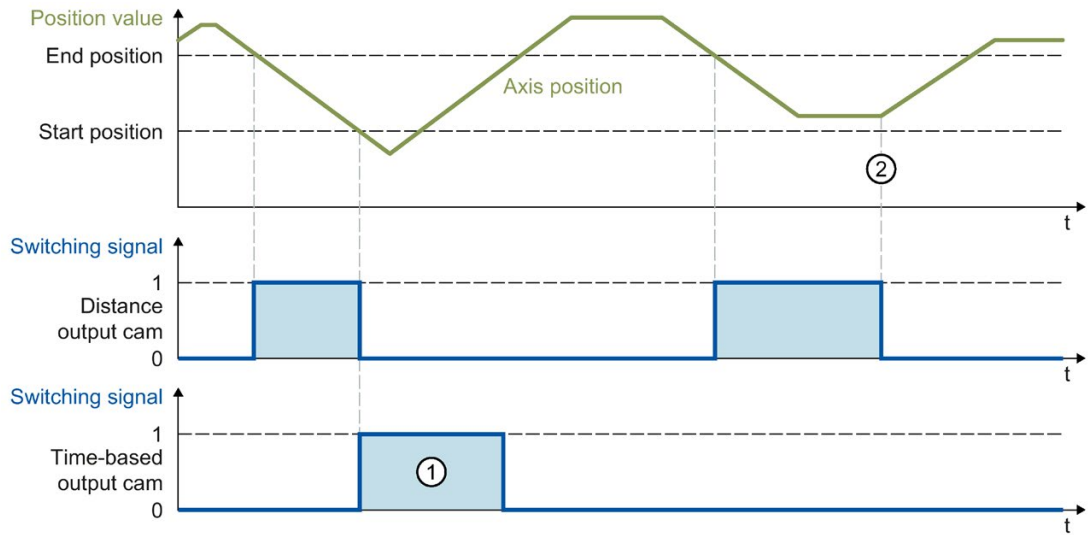
If the position value is moved into the switch-on range of the output cam, the cam switches on when there is positive motion direction of the interconnected technology object. The output cam remains switched off when the interconnected technology object is at a standstill.

Time-based output cam

The output cam switches on when the start position is reached in the **positive** direction. At a direction reversal, the output cam remains switched on for the specified on-load factor ①.

If during the homing motion, the position value of the interconnected technology object is directly on or behind the start position of the output cam, the output cam does not switch on.

Example of "negative" effective direction ("Direction" = 2)



Distance output cam

The output cam switches on when the switch-on range is reached in the **negative** direction. At a direction reversal ②, the output cam switches off.

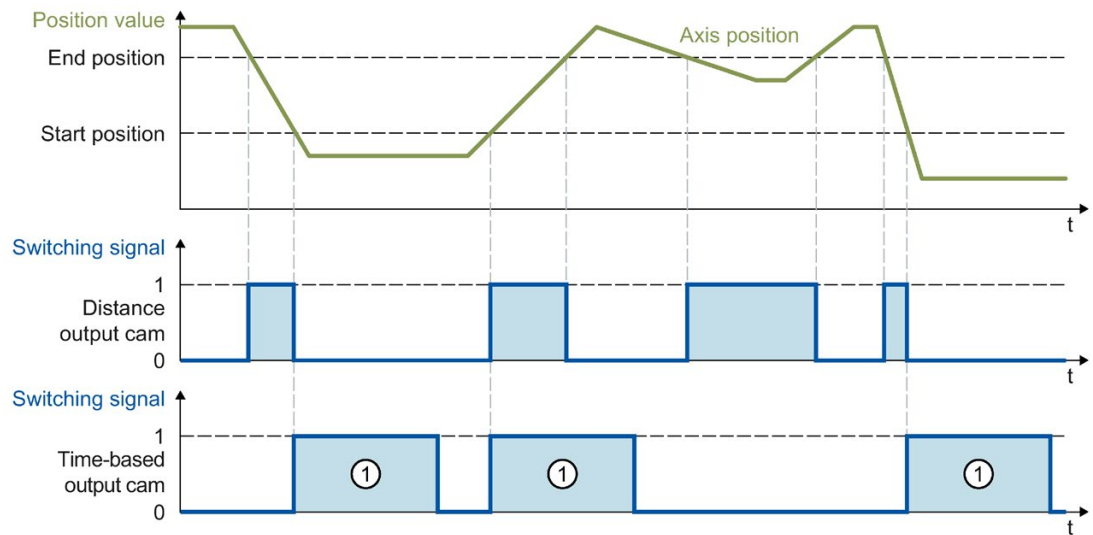
If the position value is moved into the switch-on range of the output cam, the output cam switches on when there is negative motion direction of the interconnected technology object. The output cam remains switched off when the interconnected technology object is at a standstill.

Time-based output cam

The output cam switches on when the start position is reached in the **negative** direction. At a direction reversal, the output cam remains switched on for the specified on-load factor ①.

If during the homing motion, the position value of the interconnected technology object is directly on or behind the start position of the output cam, the output cam does not switch on.

Example of "both directions" effective direction ("Direction" = 3)



Distance output cam

The output cam switches on when the position of the interconnected technology object is within the switch-on range.

If the position value of the interconnected technology object is moved into the switch-on range of the output cam, the cam switches on even when the interconnected technology object is at a standstill.

Time-based output cam

The output cam switches on when the start position is reached. At a direction reversal, the output cam remains switched on for the specified on-load factor ①.

If during the homing motion, the position value of the interconnected technology object is directly on or behind the start position of the output cam, the output cam does not switch on.

3.2.4 Hysteresis (S7-1500, S7-1500T)

Possible variations in the actual position/position setpoint can result in unwanted switch-on and switch-off of cams.

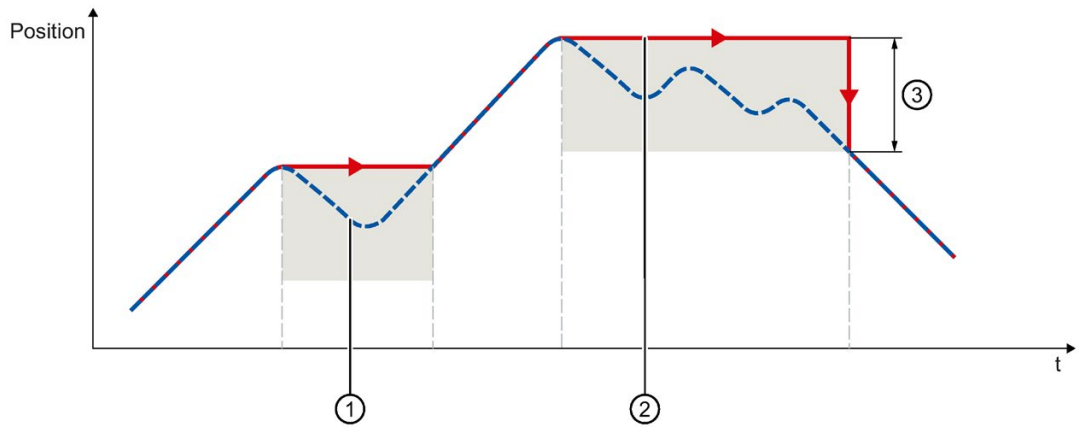
Minimal changes of the actual value of an axis in standstill can result in the switching on or off of an actual value output cam with preset positive or negative effective direction. Even minimal changes of the setpoints of a switched-off axis in follow-up mode can result in switch-on or switch-off of an actual value output cam with specified positive or negative effective direction. Such unwanted switching states can be prevented by configuring a hysteresis (> 0.0). The configuration of a hysteresis value (> 0.0) is recommended in particular with reference to the actual position.

The hysteresis is a position tolerance within which the position values may vary without changing the switching state of the output cam. Changes of direction detected within the hysteresis are ignored.

The hysteresis is set for the technology object in "<TO>.Parameter.Hysteresis".

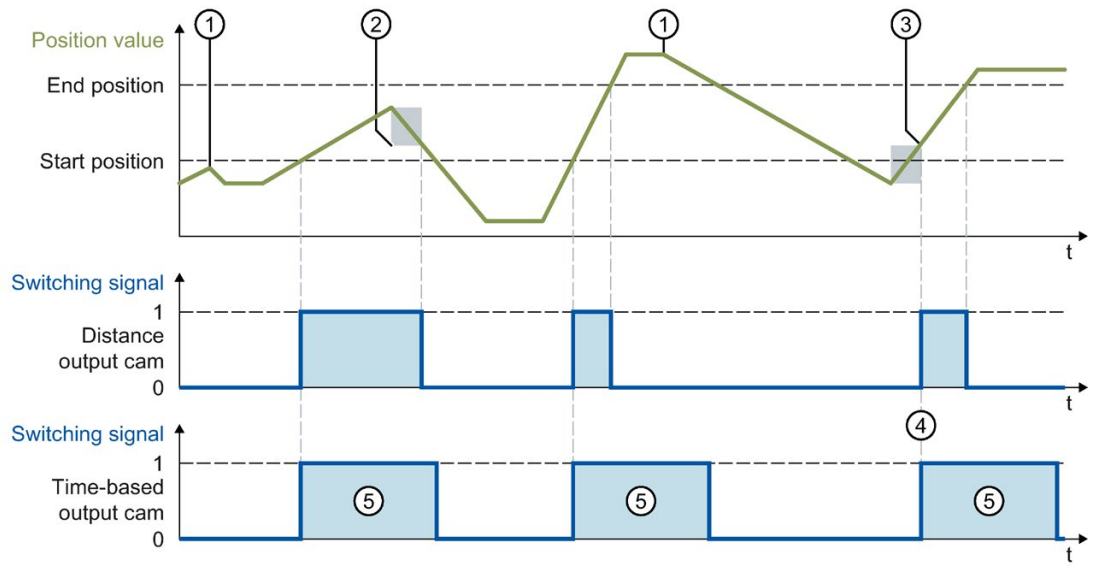
Behavior

- The hysteresis is activated at a direction reversal.
- The following applies within the hysteresis:
 - The switching state of distance output cams is not changed.
 - The motion direction is not determined again.
 - If the start position of a time-based output cam is within the hysteresis, the time-based output cam is switched on when leaving the hysteresis with the corresponding effective direction.
 - The on-load factor of time-based output cams remains unchanged.
- After the hysteresis range is exited, distance output cams are set according to the output cam settings.



- ① Actual position
- ② Effective position
- ③ Hysteresis range

The following examples show the effects of the hysteresis on the switching behavior of output cams with positive activation direction.



- ① Direction reversal without hysteresis effect
- ② Hysteresis in effect
- ③ The switch-on position of the distance output cam is influenced according to the direction reversal and hysteresis.
- ④ The start position of the time-based output cam is located within the hysteresis. The time-based output cam is switched on when leaving the hysteresis with the corresponding effective direction.
- ⑤ Switch-on duration

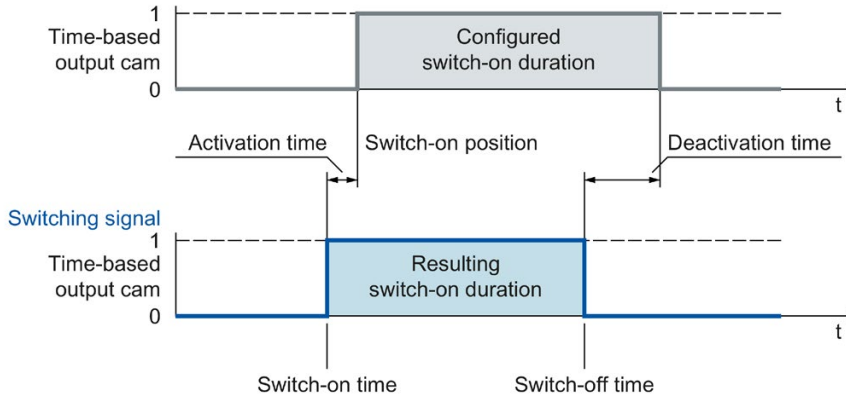
Hysteresis range

The maximum size of the hysteresis range in the system is as follows: for an axis with modulo function, one quarter of the modulo range; for an axis without modulo function, one quarter of the operating range.

3.2.5 Compensation of actuator switching times (S7-1500, S7-1500T)

Switching times of the output and the connected actuator (e.g. valve) can be compensated for using the activation time or deactivation time of the output cam technology object.

The activation time is specified as the lead time for the switch-on edge, and the deactivation time as the lead time for the switch-off edge.



The activation time is set in the technology object via the "<TO>.Parameter.OnCompensation" tag.

The deactivation time is set at the technology object via the "<TO>.Parameter.OffCompensation" tag.

Note

- The following must be met for the times:
 On-load factor > deactivation time - activation time
 (The switch-on duration for distance output cams is determined by the switching positions and the current velocity.)
- If the output cam has been switched taking the lead times into consideration, this action has taken place from the system perspective and will not be restarted in response to any subsequent variation in the actual velocity.
- System-dependent runtimes are automatically taken into consideration when output by TM Timer DIDQ is used.
 When the output with a digital output module is used, system-dependent runtimes are not taken into consideration and must be set as correction times in the activation time or deactivation time.

3.2.6 Tags: Output cam technology object (S7-1500, S7-1500T)

The following technology object tags are relevant:

Status indicator	
Tag	Description
<TO>.CamOutput	The output cam is switched.

Parameters		
Tag	Description	
<TO>.Parameter.OutputCamType	Output cam type	
	0	Distance output cam
	1	Time-based output cam
<TO>.Parameter.PositionType	Position reference	
	0	Position setpoint
	1	Actual position
<TO>.ParameterOnCompensation	Activation time (lead time for the switch-on edge)	
<TO>.Parameter.OffCompensation	Deactivation time (lead time for the switch-off edge)	
<TO>.Parameter.Hysteresis	Hysteresis value	

Interface		
Tag	Description	
<TO>.Interface.EnableOutput	Activation of the output cam output	
	FALSE	No output
	TRUE	Output
<TO>.Interface.Address	I/O address of the output cam	
<TO>.Interface.LogicOperation	Logical operation of the output cam signals at the output	
	0	OR logic operation
	1	AND logic operation

Units	
Tag	Description
<TO>.Units.LengthUnit	Unit of the length data
<TO>.Units.TimeUnit	Unit of the time data

3.2 Output cam technology object (S7-1500, S7-1500T)

StatusWord	
Tag	Description
<TO>.StatusWord.X0 (Control)	The technology object is in operation.
<TO>.StatusWord.X1 (Error)	An error occurred at the technology object.
<TO>.StatusWord.X2 (RestartActive)	The technology object is being reinitialized. The tags of the technology data block are not updated with active restart.
<TO>.StatusWord.X3 (OnlineStartValuesChanged)	Data relevant for the restart has been changed. The changes are applied only after a restart of the technology object.
<TO>.StatusWord.X4 (OutputInverted)	The output cam output is inverted.
<TO>.StatusWord.X5 (CommunicationOk)	The output cam is synchronized with the output module and available for use.

ErrorWord	
Tag	Description
<TO>.ErrorWord.X0 (SystemFault)	A system-internal error has occurred.
<TO>.ErrorWord.X1 (ConfigFault)	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data was incorrectly modified during runtime of the user program.
<TO>.ErrorWord.X2 (UserFault)	Error in user program at a Motion Control instruction or its use
<TO>.ErrorWord.X3 (CommandNotAccepted)	Command cannot be executed A Motion Control instruction cannot be executed because the necessary conditions are not met.
<TO>.ErrorWord.X13 (PeripheralError)	Error accessing a logical address

ErrorDetail	
Tag	Description
<TO>.ErrorDetail.Number	Alarm number 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.
<TO>.ErrorDetail.Reaction	Effective alarm reaction
	0 No reaction
	6 Output cam processing is complete.
	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.

3.3

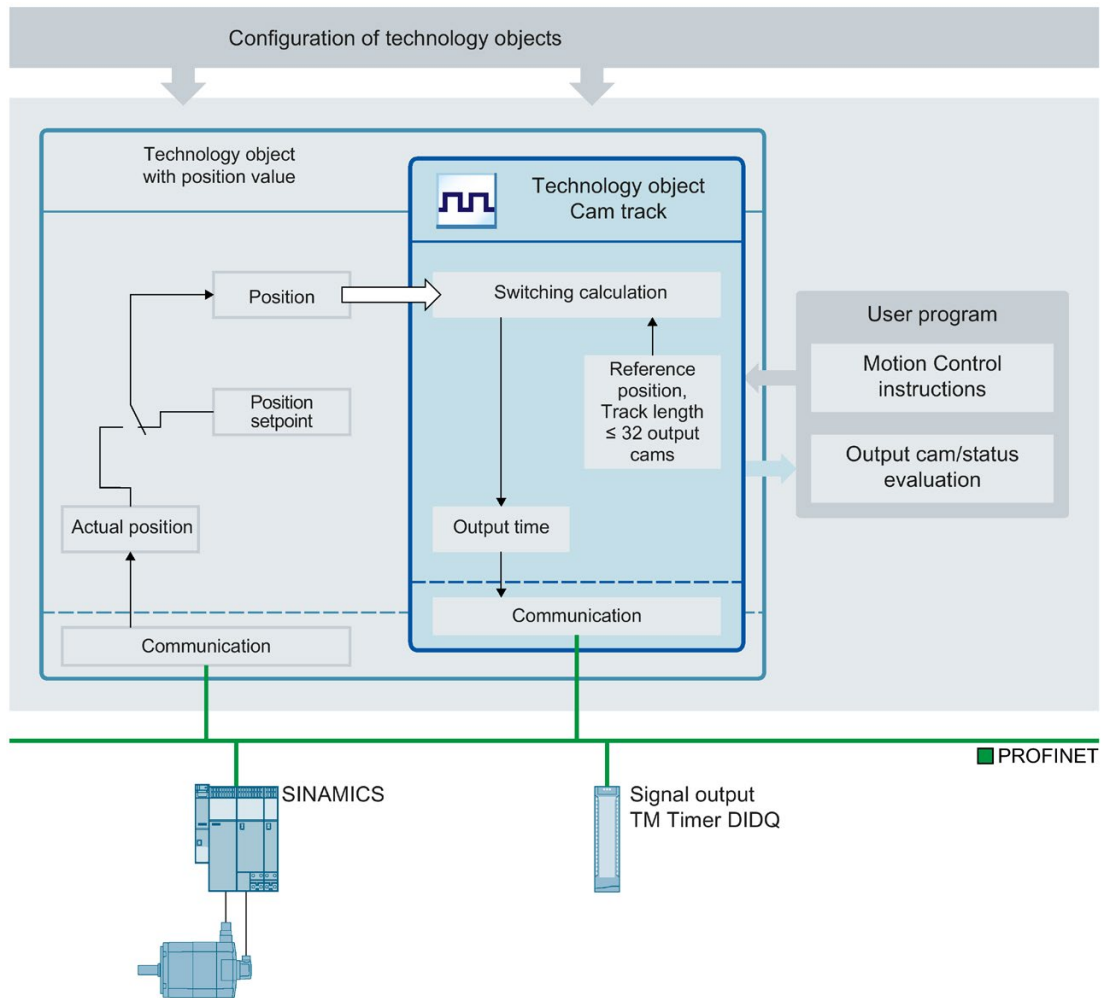
Cam track technology object (S7-1500, S7-1500T)



The cam track technology object generates a switching signal sequence dependent on the position of an axis or external encoder. A cam track can consist of up to 32 individual output cams and be output to one output. The switching states can be evaluated in the user program or fed to digital outputs.

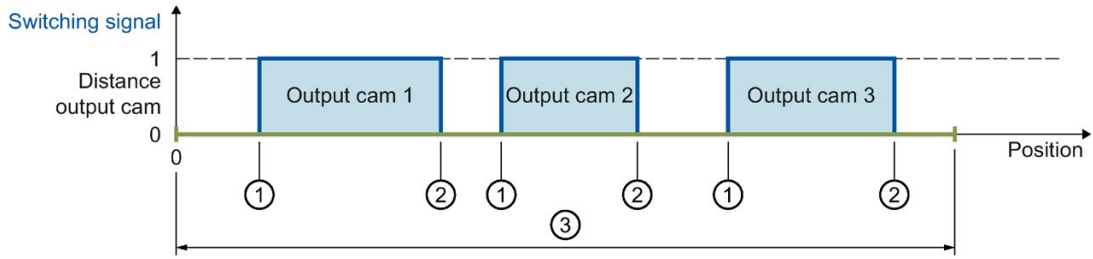
You can find an overview of the functions of the cam track technology object in the "Functions (Page 10)" section.

The following figure shows the basic principle of operation of the cam track technology object:



Definition of cam track

A cam track consists of up to 32 individual output cams that are specified within an adjustable track length.



- ① Start position
- ② End position
- ③ Cam track length

The output cam positions are defined relative to the cam track. The start of the cam track is always 0.0. The output cam positions on the cam track are thus always positive.

When the cam track is processed, the output cams with start position within the track length are taken into consideration.

The output cams of the cam track can be set as distance output cams or time-based output cams, whereby only one of the two output cam types can be used in a cam track.

If the end of a cam track is crossed, connected output cams behave as follows within the cam track:

- Time-based output cams remain switched on for the set on-load factor.
- Distance output cams whose end position lies outside the cam track are switched off when the cam track is left.

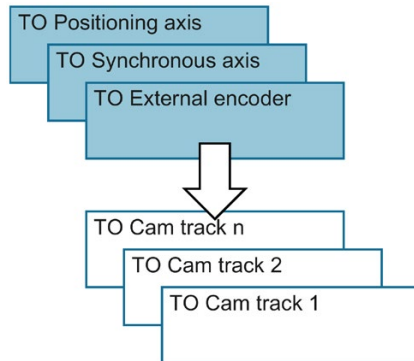
Cams whose start and end positions lie outside the cam track length are ignored. They become active only if the cam track length is increased so that at least the respective start position of an output cam is within the new track length.

Assignment

The cam track technology object must always be assigned to another technology object whose position is evaluated.

The cam track technology object can be assigned to the following technology objects:

- Synchronous axis
- Positioning axis
- External encoder



Exactly one axis or one external encoder can be assigned to a cam track.

Multiple cam tracks can be assigned to one axis or external encoder.

Position reference

The switching points of the output cams of a cam track can be referenced to the following positions, depending on the interconnected technology object.

- Actual position of a synchronous axis/positioning axis
- Position setpoint of a synchronous axis/positioning axis
- Position of an external encoder

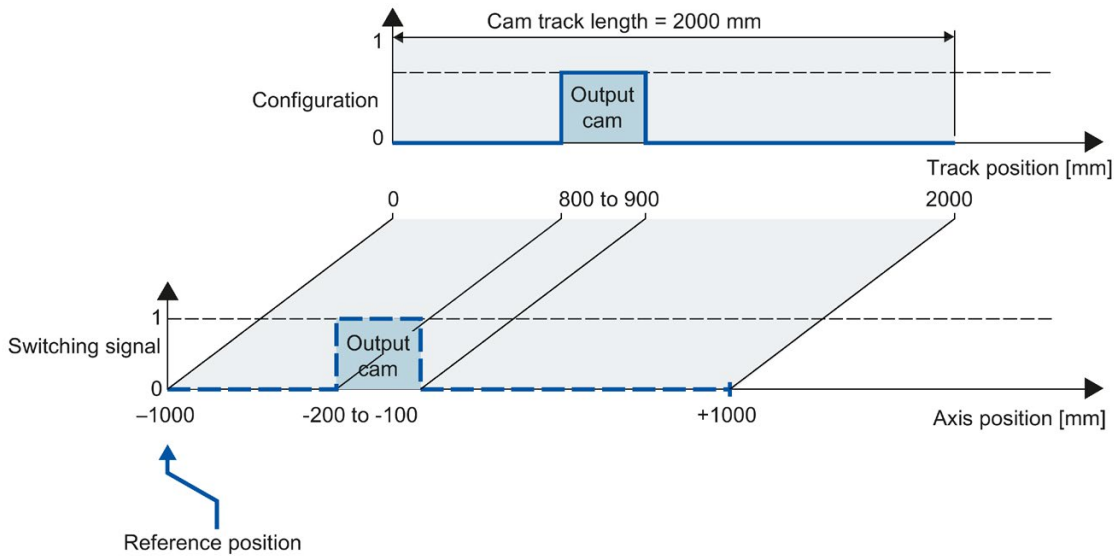
Mapping of the cam track to the position of the technology object

The start of the cam track is placed at the specified reference position of the interconnected technology object. Thus, the switching positions result from the cam track positions mapped onto the interconnected technology object starting from the reference position. The cam track is continued in both directions of the interconnected technology object.

The setting for the reference position can be either positive or negative.

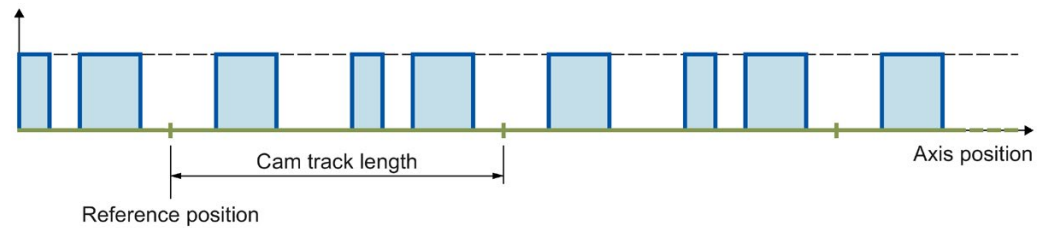
Example

- Axis range = -1000 mm to +1000 mm
- Desired switching points of the output cam with reference to axis position:
 - Start position = -200 mm
 - End position = -100 mm
- Cam track length = 2000 mm
- Definition of output cam on the track:
 - Start position = 800 mm
 - End position = 900 mm



Processing of a cam track

The processing of a cam track occurs cyclically.



The cam track is mapped onto the position of the interconnected technology object starting from the reference position and is continued cyclically in both directions.

Output of a cam track

The following output options are available for the digital cam track output:

- Timer-DQ

Digital output with high degree of accuracy and reproducibility in the microsecond range on time-based IO modules basis. In the case of signal output via time value, the times of the signal changes are determined by the technology object. The time stamps are then transferred to the hardware of the digital output and the edges are output with high precision.

Output via Timer DQ requires isochronous mode.

- Digital output module

Digital output with switching accuracy depending on the output cycle of the I/O used

A maximum of two edges (via Timer DQ, positive and negative) or one edge (via digital output module, positive or negative) can be output per position control cycle. If multiple switch-on edges or switch-off edges are transmitted in one position control cycle clock, the last written values in each case are valid.

Masking of individual output cams of a cam track

In order for output cams to be processed, they must be configured as valid in the technology data block with "`<TO>.Parameter.Cam[1..32].Existent`" = TRUE. In addition, output cams of a cam track configured as valid can be defined as valid in the user program using bit masking ("`<TO>.Parameter.CamMasking`"). In the default setting, all valid output cams are enabled ("`<TO>.Parameter.CamMasking`" = 0xFFFFFFFF). The cam track itself is activated/deactivated using the Motion Control instruction "MC_CamTrack".

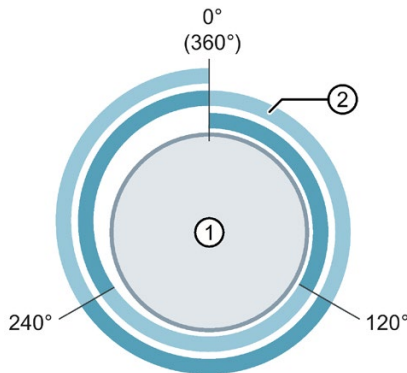
3.3.1 Modulo function (S7-1500, S7-1500T)

Track length and mapping to an axis or encoder with modulo function

When a cam track is mapped onto an axis with modulo function, a reference position specified outside the modulo range is mapped within the modulo range.

The track length can be less than or greater than the modulo length of the axis. In order for the cam track to be mapped without offset in the modulo range and to prevent unwanted overrides, an integer ratio of modulo length to track length, and vice versa, is required.

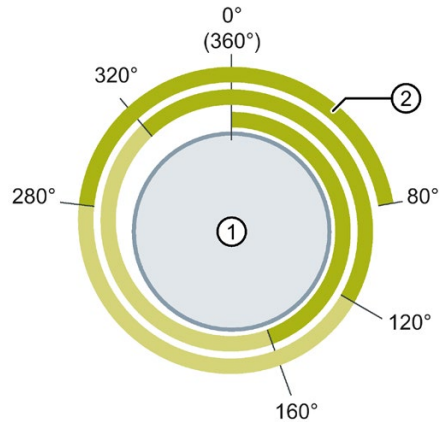
Example Mapping without offset



- ① Axis with modulo length 360°
 - ② Cam track with track length 120°
- ⇒ Ratio = $360^\circ / 120^\circ = 3$

The cam track is output 3 times on a modulo length.

Example Mapping with offset



- ① Axis with modulo length 360°
 - ② Cam track with track length 160°
- ⇒ Ratio = $360^\circ / 160^\circ = 2.25$

The cam track is output 2.25 times on the first modulo length and continued correspondingly in the other modulo lengths.

During cyclic processing of the cam track, the continued reference position of the current cam track is displayed in the "<TO>.MatchPosition" tag. The continued reference position is independent of direction and always the position of the left boundary of the cam track. The unique detection and output of the position is only possible when the assigned technology object is in motion. The distance to the current reference position of the current cam track (<TO>.MatchPosition) is displayed in the "<TO>.TrackPosition" tag.

When the cam track is enabled by a "MC_CamTrack" job, the position of the cam track (<TO_CamTrack>.MatchPosition) is set as if the current position had been reached by a motion in the positive direction starting from the reference position (<TO_CamTrack>.ReferencePosition).

Homing of an axis or an encoder without modulo function

A change to the position of an axis or external encoder using Motion Control instruction "MC_Home" is regarded as a sudden position change. An enabled cam track is referenced to the changed position and processed further from there.

- Homing also has an effect on the current position of the cam track (<TO>.TrackPosition). The position is formed again as quickly as possible due to the offset.
- Distance output cams are either skipped or correspondingly output.
- Time-based output cams are skipped. A time-based output cam is switched on only when the start position is overtraveled and remains switched on for the switch-on duration.
- Switched time-based output cams are not canceled by a homing operation.

Recommendation:

Disable the cam track before or during homing.

Homing of an axis or an encoder with modulo function

- Homing also has an effect on the current position of the cam track (<TO>.TrackPosition). The homing of the assigned technology object influences the position of the subsequently active cam track on a direction-dependent basis. This is dependent on the position difference, the difference between the new position minus the original position. If the position difference is negative, you add the modulo length (<TO_Axis/TO_Encoder>.Modulo.Length).

If this position difference is less than or equal to half the modulo length, the new position of the cam track (<TO_CamTrack>.MatchPosition) is set as if the new position had been reached by a motion in the positive direction starting from the original position.

If this position difference is greater than half the modulo length, the new position of the cam track (<TO_CamTrack>.MatchPosition) is set as if the new position had been reached by a motion in the negative direction starting from the original position.

- Distance output cams are either skipped or correspondingly output.
- Time-based output cams are skipped. A time-based output cam is switched on only when the start position is overtraveled and remains switched on for the switch-on duration.
- Switched time-based output cams are not canceled by a homing operation.

Recommendation:

Disable the cam track before or during homing.

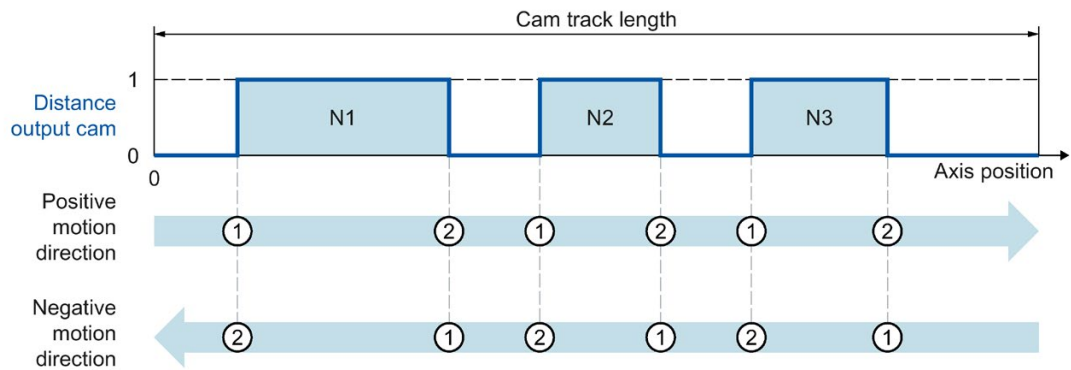
3.3.2 Effective direction (S7-1500, S7-1500T)

The cam track is always active for both directions of the position of the interconnected technology object.

Output of a cam track with distance output cams

Distance output cams are switched when the switch-on range is overtraveled.

The following graphic shows the execution of a cam track with distance output cam depending on the motion direction of the axis.

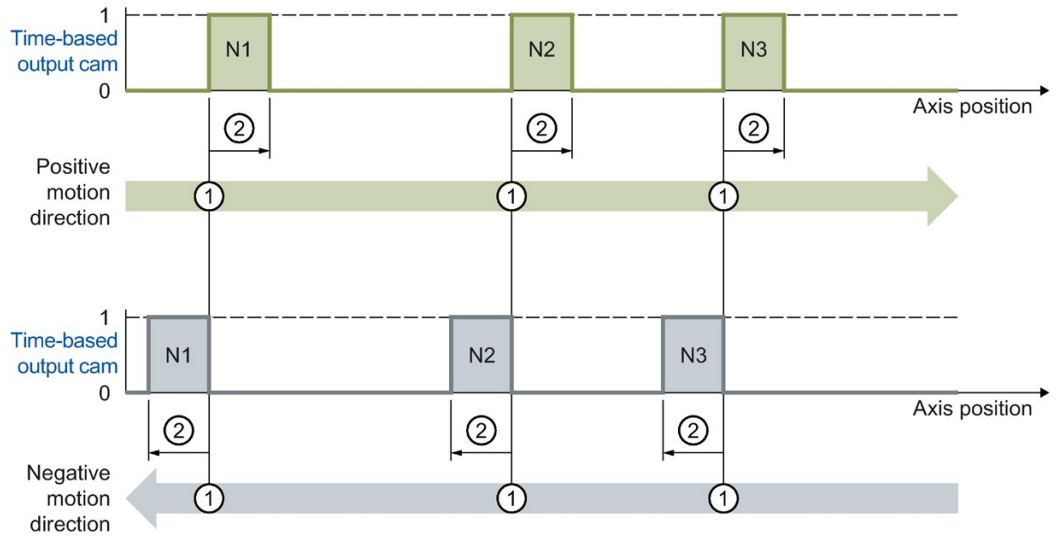


With positive motion direction, the output cams of the cam track are output in the order Output Cam N1, Output Cam N2, Output Cam N3. In the case of negative motion direction, the output cams of the cam track are output in the order Output Cam N3, Output Cam N2, Output Cam N1. The distance output cams switch on at ① and switch off at ②.

Output of a cam track with time-based output cams

The time-based output cams are switched when the start position is crossed.

The following graphic shows the execution of a cam track with time-based output cam depending on the motion direction of the axis.



With positive motion direction, the output cams of the cam track are output in the order Output Cam N1, Output Cam N2, Output Cam N3. In the case of negative motion direction, the output cams of the cam track are output in the order Output Cam N3, Output Cam N2, Output Cam N1. The time-based output cams switch on at ① and remain switched on for the set switch-on duration ②.

3.3.3 Changing the cam track data during operation (S7-1500, S7-1500T)

The data of a cam track and the parameters of the associated Motion Control instruction "MC_CamTrack" can be changed while track processing is enabled. The active Motion Control instruction "MC_CamTrack" is not aborted. The modified parameters, however, only take effect at the next call of the Motion Control instruction "MC_CamTrack".

The following parameters can be changed during operation and are in effect after another call of Motion Control instruction "MC_CamTrack".

- Cam track data in technology data block
 - Reference position (<TO>.Parameter.ReferencePosition)
 - Track length (<TO>.Parameter.CamTrackLength)
 - Bit masking of individual output cams (<TO>.Parameter.CamMasking)
 - Activation time (<TO>.Parameter.OnCompensation)
 - Deactivation time (<TO>.Parameter.OffCompensation)
 - Hysteresis value (<TO>.Parameter.Hysteresis)
 - Output cam data (<TO>.Parameter.Cam[1..32])
- Parameters in the function block
 - Enable (MC_CamTrack.Enable)
 - Mode (MC_CamTrack.Mode)
 - Inverted output (MC_CamTrack.InvertOutput)

Note the different activation behavior (Page 51) when changing the cam track data.

3.3.4 Activation behavior (S7-1500, S7-1500T)

A cam track is activated by the call of Motion Control instruction "MC_CamTrack" with "Enable" = TRUE. A distinction must be made here between:

- First-time activation of the cam track
- Call after a change of the cam track data during active cam track processing

The difference relates to how the cam track data is applied. Depending on the set mode ("MC_CamTrack.Mode"), the configuration (cam track data, data in the function block) is applied at different times.

- **First-time switch-on of a cam track**

Calling the Motion Control instruction "MC_CamTrack" with "Enable" = TRUE activates the cam track immediately ("`<TO>.Status`" changes to 1) and configured cam track data takes effect immediately. This behavior is the same when "MC_CamTrack.Mode" = 0 and "MC_CamTrack.Mode" = 1.

- **Change of cam track data of an already activated cam track ("`<TO>.Status`" = 1)**

- With the call of Motion Control instruction "MC_CamTrack" with "Enable" = TRUE and "Mode" = 0, the modified cam track data takes effect immediately.

Previously activated distance output cams are aborted if their track signals are not still set due to the changed cam track data. Previously activated time-based output cams are always aborted.

- With the call of Motion Control instruction "MC_CamTrack" with "Enable" = TRUE and "Mode" = 1, the cam track continues to be output with the prior configuration up to the cam track end. Modified cam track data takes effect at the end of the current track cycle.

If you change a cam track with "MC_CamTrack.Mode" = 1 during runtime of the user program, keep in mind the lead time of the cam track as reserve for the first output cam. Define the first output cam position in the cam track only after the following position:

Position of first output cam > velocity of axis x lead time of the cam track
 (`<TO>.Parameter.OnCompensation`)

Also keep in mind the internal system time for output cam calculation, even if you set the lead time 0.0.

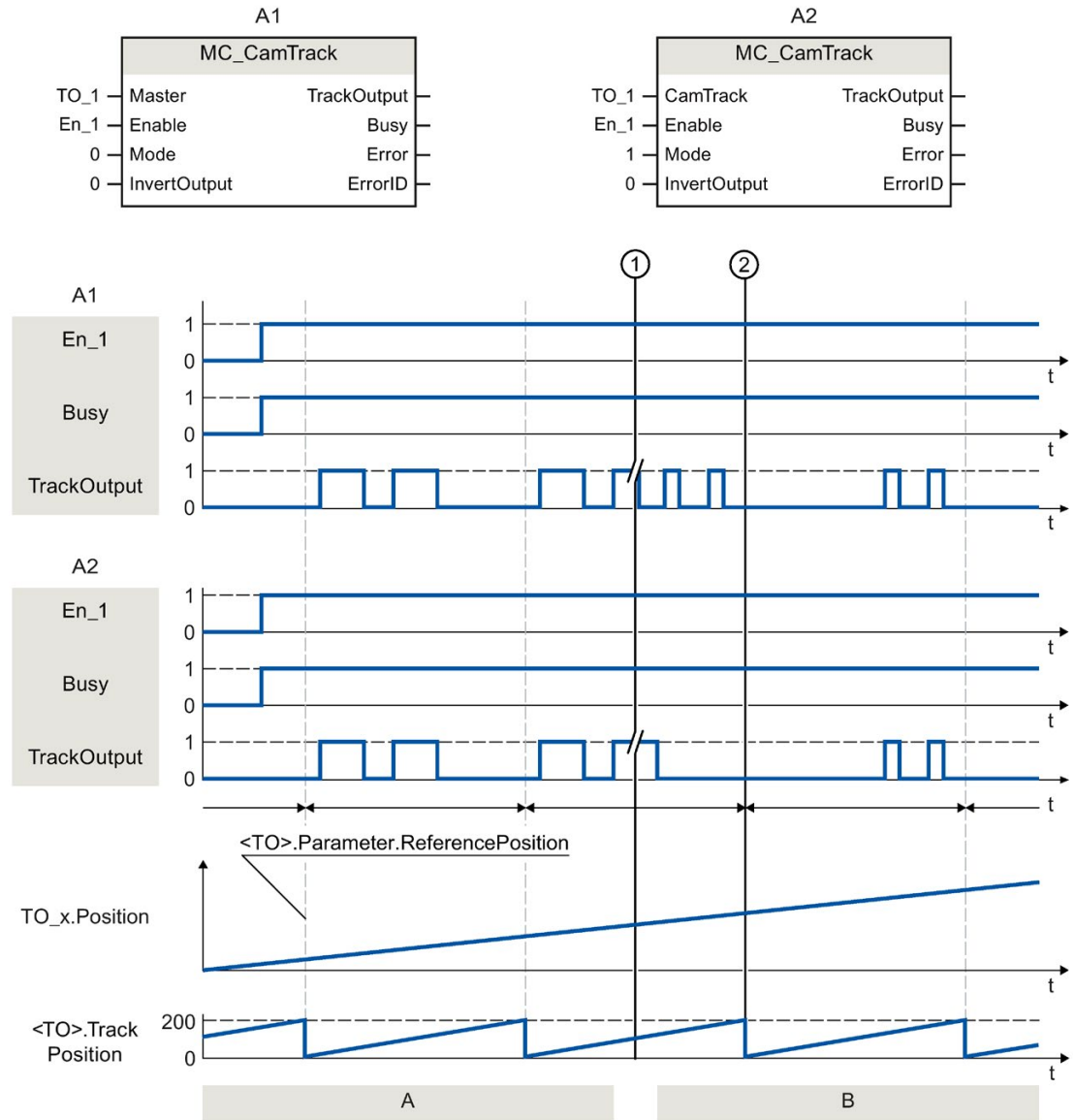
Changing cam track data when modulo length is not a multiple of the track length

For the switching times to be set correctly, we recommend the following procedure for changes:

- Enter changes as soon as possible after start of a new cam track
- Enter a new reference position (<TO>.Parameter.ReferencePosition) for the changed cam track. The new reference position is composed as follows depending on the direction:
 - Positive effective direction: Current reference position (<TO>.MatchPosition) + cam track length (<TO>.Parameter.CamTrackLength)
 - Negative effective direction: Current reference position (<TO>.MatchPosition) - cam track length (<TO>.Parameter.CamTrackLength)
- Output the changes of the cam track when calling the Motion Control instruction "MC_CamTrack" and "Mode" = 1.

Example

The following figure shows an example of the differences in the activation behavior.



A1	A	The cam track is activated the first time with "MC_CamTrack.Enable" = TRUE and the output cams are output immediately with set "MC_CamTrack.Mode" = 0.
	B	After cam track data were changed (①), the cam track is activated by calling Motion Control instruction "MC_CamTrack" with "Enable" = TRUE and the modified data takes effect immediately (①) with set "MC_CamTrack.Mode" = 0.
A2	A	The cam track is activated the first time with "MC_CamTrack.Enable" = TRUE and the output cams are output immediately with set "MC_CamTrack.Mode" = 1.
	B	After cam track data were changed (①), the cam track is activated by calling Motion Control instruction "MC_CamTrack" with "Enable" = TRUE and the modified data takes effect at the end of the current track cycle (②) with set "MC_CamTrack.Mode" = 1.

3.3 Cam track technology object (S7-1500, S7-1500T)

3.3.5 Hysteresis (S7-1500, S7-1500T)

The hysteresis is set in the cam track technology object. The behavior and effect of the hysteresis setting corresponds to the hysteresis (Page 35) for the cam technology object.

3.3.6 Time offset of cam switching points (S7-1500, S7-1500T)

Switching times of the output and the connected actuator (e.g. valve) can be compensated for using the activation time or deactivation time of the cam track technology object.

The time offset of cam switching points corresponds to the activation time or deactivation time (Page 38) for the cam technology object.

3.3.7 Tags: Cam track technology object (S7-1500, S7-1500T)

The following technology object tags are relevant:

Status indicator	
Tag	Description
<TO>.Status	Status of the cam track function
	0 Inactive
	1 Active
	2 Active and waiting for next track
<TO>.TrackOutput	An output cam of cam track is switched.
<TO>.SingleCamState	Switched on output cam (bit-masked)
<TO>.TrackPosition	Display of the current position within the cam track The distance to the current reference position of the current cam track (<TO>.MatchPosition) is displayed.
<TO>.MatchPosition	Reference position of the current cam track During cyclic processing of the cam track, the continued reference position of the current cam track is displayed. The unique detection and output of the position is only possible when the assigned technology object is in motion.

Parameters		
Tag	Description	
<TO>.Parameter.CamTrackType	Output cam type	
	0	Distance output cam
	1	Time-based output cam
<TO>.Parameter.PositionType	Position reference	
	0	Position setpoint
	1	Actual position
<TO>.Parameter.ReferencePosition	Reference position	
<TO>.Parameter.CamTrackLength	Track length	
<TO>.Parameter.CamMasking	Bit masking of individual output cams	
<TO>.Parameter.OnCompensation	Activation time (lead time for the switch-on edge)	
<TO>.Parameter.OffCompensation	Deactivation time (lead time for the switch-off edge)	
<TO>.Parameter.Hysteresis	Hysteresis value	
<TO>.Parameter.Cam[1..32].OnPosition	Start position (distance output cams and time-based output cams)	
<TO>.Parameter.Cam[1..32].OffPosition	End position (distance output cam)	
<TO>.Parameter.Cam[1..32].Duration	Switch-on duration (time-based output cam)	
<TO>.Parameter.Cam[1..32].Existent	Validity of an output cam	
	FALSE	Output cam is not used.
	TRUE	Output cam is used.

Interface		
Tag	Description	
<TO>.Interface.EnableOutput	Output cam output at the bit specified under "Address"	
	FALSE	No output
	TRUE	Output
<TO>.Interface.Address	I/O address for digital output cam output	

Units		
Tag	Description	
<TO>.Units.LengthUnit	Unit of the length data	
<TO>.Units.TimeUnit	Unit of the time data	

3.3 Cam track technology object (S7-1500, S7-1500T)

StatusWord	
Tag	Description
<TO>.StatusWord.X0 (Control)	The technology object is in operation.
<TO>.StatusWord.X1 (Error)	An error occurred at the technology object.
<TO>.StatusWord.X2 (RestartActive)	The technology object is being reinitialized. The tags of the technology data block are not updated with active restart.
<TO>.StatusWord.X3 (OnlineStartValuesChanged)	Data relevant for the restart has been changed. The changes are applied only after a restart of the technology object.
<TO>.StatusWord.X4 (OutputInverted)	The output cam output is inverted.
<TO>.StatusWord.X5 (CommunicationOk)	The cam track is synchronized with the output module and available for use.
<TO>.StatusWord.X6 (CamDataChanged)	The data of individual output cams has been changed but not yet taken effect with Motion Control instruction "MC_CamTrack".

ErrorWord	
Tag	Description
<TO>.ErrorWord.X0 (SystemFault)	A system-internal error has occurred.
<TO>.ErrorWord.X1 (ConfigFault)	Configuration error One or more configuration parameters are inconsistent or invalid. The technology object was incorrectly configured, or editable configuration data were incorrectly modified during runtime of the user program.
<TO>.ErrorWord.X2 (UserFault)	Error in user program at a Motion Control instruction or its use.
<TO>.ErrorWord.X3 (CommandNotAccepted)	Job cannot be executed. A Motion Control instruction cannot be executed because necessary requirements have not been met.
<TO>.ErrorWord.X13 (PeripheralError)	Error accessing a logical address.

ErrorDetail	
Tag	Description
<TO>.ErrorDetail.Number	Alarm number
<TO>.ErrorDetail.Reaction	Effective alarm reaction
	0 No reaction
	5 Cam track processing is complete.

Configuring (S7-1500, S7-1500T)

4.1 Configuring the technology object measuring input (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 measuring input in this field. The technology object is listed under this name in the project tree. The tags of the measuring input can be used in the user program under this name.

Assigned axis or external encoder

The axis or external encoder assigned to the measuring input is displayed. You can use the button  to directly access the configuration of the basic parameters of the higher-level technology object.

Unit of measure

The indicated unit of measure for the position of the measuring input corresponds to the unit of measure of the higher-level technology object.

To use six decimal places in the selected unit, select the check box "Use position values with higher resolution" in the higher-level technology object.

See also

Measuring input technology object (Page 11)

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

Measuring input type

Select the measuring input type.

- Measurement using Timer DI
- Measurement using SINAMICS (central probe)
- Measurement using PROFIdrive telegram (drive or external encoder)

Overview of possible measurement inputs and measuring types

Measuring input type	Possible measurement inputs	Possible measuring types
Measurement using Timer DI ("STANDARD")	With Timer DI <ul style="list-style-type: none"> • ET 200SP or ET 200MP TM Timer DIDQ • SIMATIC Drive Controller (X142) 	<ul style="list-style-type: none"> • "MC_MeasuringInput" (One-time measuring) • "MC_MeasuringInputCyclic" (Cyclic measuring)
Measurement using SINAMICS (central probe) ("STANDARD")	Using telegram 39x of the drive control: <ul style="list-style-type: none"> • SINAMICS S120 CU320-2 (X122/X132) • SINAMICS S120 CU310-2 (X121/X131) • SIMATIC Drive Controller (X122/X132) 	"MC_MeasuringInput" (One-time measuring)
Measurement using PROFIdrive telegrams ("PROFIDRIVE")	Using PROFIdrive telegram of the drive axis: <ul style="list-style-type: none"> • SINAMICS S210 (X130) • SINAMICS S120 CU320-2 (X122/X132) • SINAMICS S120 CU310-2 (X121/X131) • SIMATIC Drive Controller (X122/X132) 	"MC_MeasuringInput" (One-time measuring)

Measurement using Timer DI

Select a measurement input for a measurement using a Timer DI. The selection box shows all channels that are configured correctly. For this purpose, you need to have configured the I/O channels as Timer DI beforehand.

Measurement using SINAMICS (central probe)

Select a measuring input for a measurement via SINAMICS measurement sensing input. The selection box shows all compatible telegram types. You are shown all terminals that can potentially be used as measuring inputs. For this purpose, you need to have configured the necessary central measuring inputs on the drive side beforehand.

For SINAMICS drives that are not configured via Startdrive, you need to assign the inputs to the measuring inputs (p680) in the telegram without gaps and in ascending order.

With p728.8 to p728.15, you configure as input all DI/DQs used as measurement input on the control unit. Use p680 of the control unit to specify the terminals for the global measuring inputs.

You must configure a suitable telegram 39x for the drive control.

Measurement using PROFIdrive telegram (drive or external encoder)

For a measurement via PROFIdrive telegram, select the number of the measuring input in the telegram in the "Number of the measuring input" drop-down list. The input field is preset with the value "1".

Two communication channels are available for the transmission of measured values in the PROFIdrive telegram. These communication channels are assigned to one measurement input/digital input each in the drive. Use the PROFIdrive parameters to configure the digital input on the drive that is to be used for the configured communication channel.

- Measurement input for the first communication channel

("<TO>.Parameter.PROFIdriveProbeNumber" = 1)

If you use two encoders, you must select the associated DI in the SINAMICS for each encoder. Various results are then transferred to the technology object depending on the selected encoder. The encoders are configured using the parameters p488[0] and p488[1].

- Measurement input for the second communication channel

("<TO>.Parameter.PROFIdriveProbeNumber" = 2)

If you use two encoders, you must select the associated DI in the SINAMICS for each encoder. Various results are then transferred to the technology object depending on the selected encoder. The encoders are configured using the parameters p489[0] and p489[1].

Correction time for the measuring signal

Specify a correction time if possible delay times in the measurement signal are to be compensated.

See also

Measuring input technology object (Page 11)

4.1.3 Configuration - Extended parameters (S7-1500, S7-1500T)

Adjustment for activation time of the measuring range

To adjust the activation time defined on the system side, enter an additional activation time here.

The configuration window also displays the following times calculated on the system side:

- Time after the measuring job request until the measuring event can be recorded
- Time after the measuring event until the measurement result is displayed (for measuring of one or two edges)

See also

Measuring with measuring range (Page 20)

Time-related boundary conditions (Page 21)

Measuring input technology object (Page 11)

4.2 Configuring the output cam 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 output cam in this field. The technology object is listed under this name in the project tree. The tags of the output cam can be used in the user program under this name.

Assigned axis or external encoder

The axis or external encoder assigned to the output cam is displayed. You can use the button  to directly access the configuration of the basic parameters of the higher-level technology object.

Output cam type

Select based on the desired switching behavior of an output cam type:

- Distance output cam (position-dependent switch-on/switch-off)
- Time-based output cam (position-dependent switch-on and position-independent or time-dependent switch-off)

Output cam reference

Configure in this selection whether the switching points of the output cam are to reference the actual position or the position setpoint.

Unit of measure

The indicated unit of measure for the position of the output cam corresponds to the unit of measure of the higher-level technology object.

To use six decimal places in the selected unit, select the check box "Use position values with higher resolution" in the higher-level technology object.

When a time-based output cam is selected as the output cam type, the unit of measure for the switch-on duration and other times is also indicated. For output cams, this is always ms.

See also

Output cam technology object (Page 26)

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

Output cam output

Select whether the generated switching signals are to be output at the digital output.

- **Activate output**

Select one of the following two output options for the output cam output:

- **Output via Timer DQ**

With output via a Timer DQ, you select a suitable channel in the "Output" field. The selection box shows all channels that are configured as Timer DQ. For this purpose, you need to have configured the I/O channels as Timer DQ beforehand.

Timer DQs are supported by:

- ET 200MP TM Timer DIDQ 16x24V
- ET 200SP TM Timer DIDQ 10x24V
- SIMATIC Drive Controller (X142)

- **Output by digital output module**

For output by a digital output module, select this in the "Output cam output" field. Only the digital outputs with previously defined PLC tags are displayed for selection.

Select the logical operation of the output cam signal at the output. The logic operation relates to the last signal to be output after the set inversion, if any.

All output cams that use the selected output are shown graphically.

- **Output deactivated**

When the output is deactivated, the output cam is evaluated only in the software.

See also

Output cam technology object (Page 26)

4.2.3 Extended parameters (S7-1500, S7-1500T)

4.2.3.1 Configuration - Activation time (S7-1500, S7-1500T)

The specified output cam type is indicated in the upper area of the "Activation time" configuration window.

Activation time and deactivation time

For a time shift of the switch-on and switch-off times of an output cam, enter an activation time and a deactivation time.

See also

Compensation of actuator switching times (Page 38)

Output cam technology object (Page 26)

4.2.3.2 Configuration - Hysteresis (S7-1500, S7-1500T)

To prevent unwanted changes in the switching state of the output cams of a cam track, enter a hysteresis value.

When using an output cam with reference to actual position, always enter a hysteresis value (> 0.0).

See also

Hysteresis (Page 35)

Output cam technology object (Page 26)

4.3 Configuring the cam track technology object (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 cam track in this field. The technology object is listed under this name in the project tree. The tags of the cam track can be used in the user program under this name.

Assigned axis or external encoder

The axis or external encoder assigned to the cam track is displayed. You can use the button  to directly access the configuration of the basic parameters of the higher-level technology object.

Output cam type

Select based on the desired switching behavior of an output cam type for the cam track:

- Distance output cam (position-dependent switch-on/switch-off)
- Time-based output cam (position-dependent switch-on and position-independent or time-dependent switch-off)

Output cam reference

In this selection, configure whether the switching points of the cam track are to reference the actual position or the position setpoint.

Unit of measure

The indicated unit of measure for the position of the cam track corresponds to the unit of measure of the higher-level technology object.

To use six decimal places in the selected unit, select the check box "Use position values with higher resolution" in the higher-level technology object.

When a time-based output cam is selected as the output cam type, the unit of measure for the switch-on duration and other times is also indicated. For output cams, this is always ms.

See also

Cam track technology object (Page 41)

4.3.2 Configuration - Hardware interface (S7-1500, S7-1500T)

Output cam track

Select whether the generated switching signals are to be output at the digital output.

- **Activate output**

Select one of the following two output options for the output track:

- Output via Timer DQ

With output via a Timer DQ, you select a suitable channel in the "Output" field. The selection box shows all channels that are configured as Timer DQ. For this purpose, you need to have configured the I/O channels as Timer DQ beforehand.

Timer DQs are supported by:

- ET 200MP TM Timer DIDQ 16x24V
- ET 200SP TM Timer DIDQ 10x24V
- SIMATIC Drive Controller (X142)

- Output by digital output module

For output by a digital output module, select this in the "Output cam output" field. Only the digital outputs with previously defined PLC tags are displayed for selection.

- **Deactivate output**

When the output is deactivated, the cam track is evaluated only in the software.

See also

Cam track technology object (Page 41)

4.3.3 Extended parameters (S7-1500, S7-1500T)

4.3.3.1 Track data (S7-1500, S7-1500T)

Configuration - Activation time (S7-1500, S7-1500T)

The set output cam type is displayed.

Activation time and deactivation time

Enter the activation time and the deactivation time.

For a time shift of the switch-on and switch-off times of the output cam of a cam track, enter an activation time and a deactivation time.

See also

Time offset of cam switching points (Page 54)

Cam track technology object (Page 41)

Configuration - Hysteresis (S7-1500, S7-1500T)

To prevent unwanted changes in the switching state of the output cams of a cam track, enter a hysteresis value.

When using an output cam with reference to actual position, always enter a hysteresis value (> 0.0).

See also

Hysteresis (Page 54)

Cam track technology object (Page 41)

Configuration - Track dimensions (S7-1500, S7-1500T)

Track length

Enter the corresponding track length.

Also take into account the output cam data of the individual output cams when defining the track length. Output cams whose start position lies outside the cam track length are not included. They become active only if the cam track length is increased so that at least the respective start position of an output cam is within the new track length.

Axis reference position

Enter the position of an axis or external encoder starting from which the output of the cam track is to occur. The start of the cam track is placed at the entered position.

You can enter a negative or positive value for the reference position.

Modulo length of the axis

When an axis with modulo function is used, the modulo length of the axis is displayed.

See also

Cam track technology object (Page 41)

4.3.3.2 Configuration - Output cam data (S7-1500, S7-1500T)

The set output cam type is displayed.

Enter the properties for the output cams of the cam track that are to be output. You can set up to 32 individual output cams on a cam track.

Also take into account any previously defined track length when defining the output cam data. Output cams whose start position lies outside the cam track length are not included. They become active only if the cam track length is increased so that at least the respective start position of an output cam is within the new track length.

The input options described below are displayed in the Output cam data configuration window according to the configured output cam type.

- **Valid**

Only output cams set as "valid" are output and have a status display.

- **Start position**

- The start position may not be greater than the end position for distance output cams.
- If the start position is equal to the end position, the distance output cam does not switch.
- The switching ranges of individual output cams are permitted to overlap.

- **End position**

- The "End position" column is only displayed when distance output cam is set for the output cam type.
- The end position must not be less than the start position.

- **Switch-on duration**

The "Switch-on duration" column is only displayed when time-based output cam is set for the cam type.

See also

Cam track technology object (Page 41)

Diagnostics (S7-1500, S7-1500T)

The "Diagnostics" section is limited to describing the diagnostics view of the individual technology objects measuring input, output cam and cam track 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>):

- Diagnostic 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>).

5.1 Measuring input technology object (S7-1500, S7-1500T)

5.1.1 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.

Measuring input status

The following table shows the possible states of the measuring input:

Status	Description
Active	The technology object is in operation. (<TO>.StatusWord.X0 (Control))
Waiting for measuring event	The measuring input is waiting for a measuring event. The technology data block tag "<TO>.Status" has the value "1" ("WAITING_FOR_TRIGGER").
Measured value present	The measuring input has acquired one or more measured values. The technology data block tag "<TO>.Status" has the value "2" ("TRIGGER_OCCURRED").
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. The tags of the technology data block are not updated with active restart. (<TO>.StatusWord.X2 (RestartActive))
Measuring input ready	The measuring input is synchronized with the measuring module and can be used. (<TO>.StatusWord.X5 (CommunicationOK))
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))

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 was incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigFault))
User program	An error occurred in the user program at a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Job rejected	A job cannot be executed. A Motion Control instruction cannot be executed because the necessary conditions are not met (e.g. axis assigned to the measuring input is not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
I/O	An error occurred accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))

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 (measuring input) (Page 106)

"ErrorWord" tag (measuring input) (Page 107)

"WarningWord" tag (measuring input) (Page 109)

5.2 Output cam technology object (S7-1500, S7-1500T)

5.2.1 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.

Output cam status

The following table shows the possible states of the output cam:

Status	Description
Active	The technology object is in operation. (<TO>.StatusWord.X0 (Control))
Switched	The output cam is switched. (<TO>.CamOutput)
Inverted output for output cam	The output cam output is inverted. (<TO>.StatusWord.X4 (OutputInverted))
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. The tags of the technology data block are not updated with active restart. (<TO>.StatusWord.X2 (RestartActive))
Output cam output ready	The output cam is synchronized with the output module and available for use. (<TO>.StatusWord.X5 (CommunicationOk))
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))

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 was incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigFault))
User program	An error occurred in the user program at a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Job rejected	A job cannot be executed. A Motion Control instruction cannot be executed because the necessary conditions are not met (e.g. axis assigned to the output cam is not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
I/O	An error occurred accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))

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 (output cam) (Page 113)

"ErrorWord" tag (output cam) (Page 114)

"WarningWord" tag (output cam) (Page 116)

5.3 Cam track technology object (S7-1500, S7-1500T)

5.3.1 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.

Cam track status

The following table shows the possible states of the cam track:

Status	Description
Active	The technology object is in operation. (<TO>.StatusWord.X0 (Control))
Switched	An output cam of cam track is switched. (<TO>.TrackOutput)
Inverted output for output cam	The output cam output is inverted. (<TO>.StatusWord.X4 (OutputInverted))
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. The tags of the technology data block are not updated with active restart. (<TO>.StatusWord.X2 (RestartActive))
Cam track output ready	The cam track is synchronized with the output module and available for use. (<TO>.StatusWord.X5 (CommunicationOk))
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))

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 was incorrectly modified during runtime of the user program. (<TO>.ErrorWord.X1 (ConfigFault))
User program	An error occurred in the user program at a Motion Control instruction or its use. (<TO>.ErrorWord.X2 (UserFault))
Job rejected	A job cannot be executed. A Motion Control instruction cannot be executed because the necessary conditions are not met (e.g. axis assigned to the cam track is not homed). (<TO>.ErrorWord.X3 (CommandNotAccepted))
I/O	An error occurred accessing a logical address. (<TO>.ErrorWord.X13 (PeripheralError))

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 (cam track) (Page 121)

"ErrorWord" tag (cam track) (Page 122)

"WarningWord" tag (cam track) (Page 124)

5.3.2 Cam track status (S7-1500, S7-1500T)

You use the "Technology object > Diagnostics > Cam track status" diagnostics function in the TIA Portal to monitor the status of the cam track. The diagnostics function is available in online operation.

"Validity and masking of the output cams" area

The individual cams of a cam track are shown in this area along with the status for the following properties:

Status	Description
Valid	Validity of the individual cams of the cam track (<TO>.Parameter.Cam[1..32].Existent)
Masked	Bit masking of the individual cams of the cam track (<TO>.Parameter.CamMasking)
Effective	Switched on output cam (bit-masked) (<TO>.SingleCamState)

"Positions" area

The following status values are displayed in this area:

Status	Description
Current position in the cam track	Position during cam track processing within a cam track cycle The distance to the current reference position of the current cam track (<TO>.MatchPosition) is displayed. (<TO>.TrackPosition)
Current cam track start	Reference position of the current cam track During cyclic processing of the cam track, the continued reference position of the current cam track is displayed. The unique detection and output of the position is only possible when the assigned technology object is in motion. (<TO>.MatchPosition)

Instructions (S7-1500, S7-1500T)

6.1 MC_MeasuringInput V5 (S7-1500, S7-1500T)

6.1.1 MC_MeasuringInput: Start measuring once V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MeasuringInput", a one-time measuring is started.

With the one-time measuring, one or two edges can be detected with one measuring job. The position of the respective technology object axis or external encoder is assigned to the measuring event. The measurement result is indicated in the function block and in the technology data block and can be further processed in the user program. This completes the measuring job.

Another measuring job must be started again using "MC_MeasuringInput.Execute" = TRUE.

Applies to

- Measuring input

Requirement

- The technology object has been configured correctly.
- The encoder of the axis must have "valid" status (StatusSensor[1..4].State = valid). Otherwise, the measuring job is rejected in the function block with an error indication.
- Measurement using PROFIdrive is not possible during active or passive homing.

Override response

The override response for "MC_MeasuringInput" jobs is described in section "Override response V5: Measuring input jobs (Page 98)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MeasuringInput":

Parameters	Declaration	Data type	Default value	Description	
MeasuringInput	INPUT	TO_MeasuringInput	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE Start job with a positive edge	
Mode	INPUT	DINT	0	Type of measurement	
				0	Measurement of next positive edge
				1	Measurement of next negative edge
				2	Measurement of next two edges
				3	Measurement of two edges, beginning with the positive edge <ul style="list-style-type: none"> • Rising edge = "MeasuredValue1" (measured value 1) • Falling edge = "MeasuredValue2" (measured value 2)
4	Measurement of two edges, beginning with the negative edge <ul style="list-style-type: none"> • Falling edge = "MeasuredValue1" • Rising edge = "MeasuredValue2" 				
MeasuringRange	INPUT	BOOL	FALSE	Acquisition of measured values Observe the time-related boundary conditions (Page 21).	
				FALSE	Always acquire measured values
				TRUE	Acquire measured values only within the measuring range
StartPosition	INPUT	LREAL	0.0	Start position of the measuring range For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
EndPosition	INPUT	LREAL	0.0	End position of the measuring range For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
Done	OUTPUT	BOOL	FALSE	TRUE The block has been completely processed. Measured values are valid.	
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being processed.	

Parameters	Declaration	Data type	Default value	Description
CommandAborted	OUTPUT	BOOL	FALSE	TRUE The measuring job has been aborted.
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"
MeasuredValue1	OUTPUT	LREAL	0.0	First measured value
MeasuredValue2	OUTPUT	LREAL	0.0	Second measured value (for measurement of two edges)

See also

Time-related boundary conditions (Page 21)

One-time measurement (Page 14)

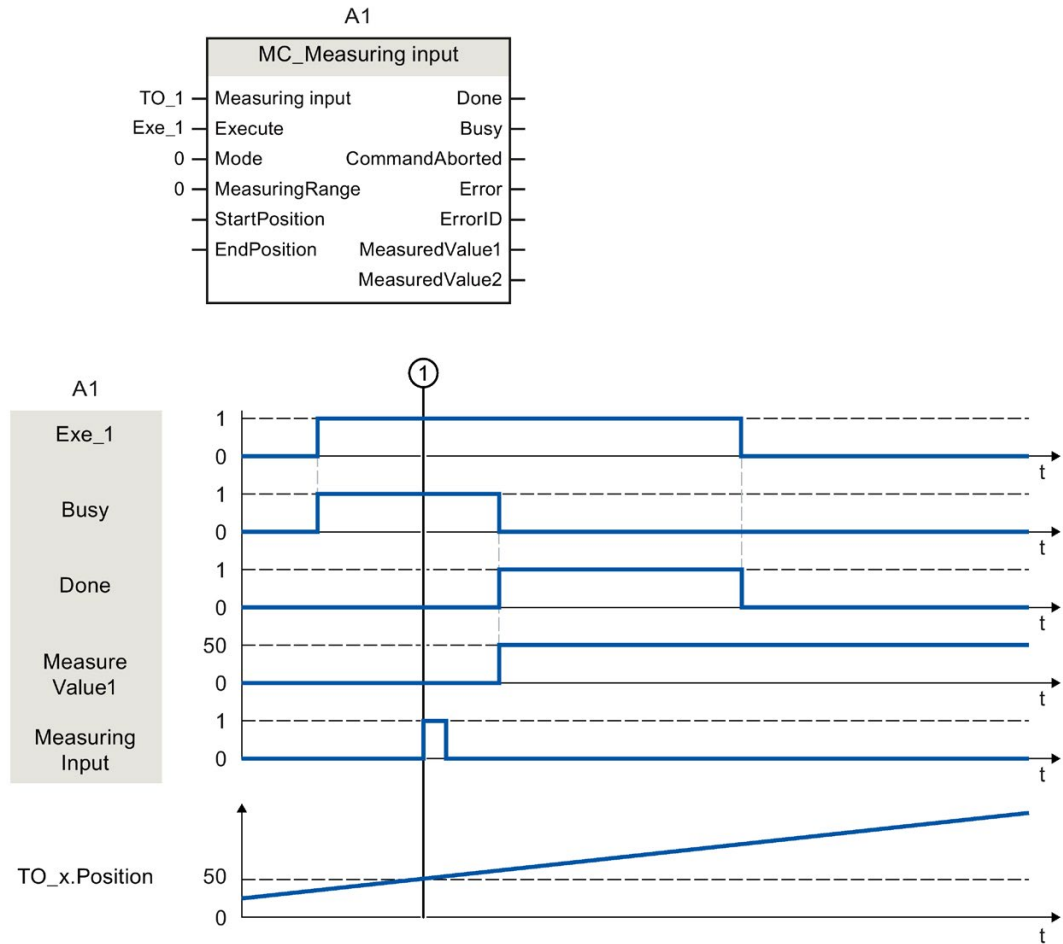
Override response V5: Measuring input jobs (Page 98)

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>)

6.1.2 MC_MeasuringInput: Function chart V5 (S7-1500, S7-1500T)

Function chart: Start measuring job once



A "MC_MeasuringInput" job with "Mode" = 0 initiated using "Execute" performs a measurement of the next positive edge. A successfully completed measurement is signaled with "Done" = TRUE. The determined measured value ① (in example: 50) is output using "MeasuredValue1".

6.2 MC_MeasuringInputCyclic V5 (S7-1500, S7-1500T)

6.2.1 MC_MeasuringInputCyclic: Start cyclic measuring V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_MeasuringInputCyclic", a cyclic measuring is started.

With cyclic measuring, up to two measuring events are detected by the system and the associated measuring positions displayed. The measurements are continued cyclically until they are ended per command.

Applies to

- Measuring input

Requirement

- The technology object has been configured correctly.
- Cyclic measuring is only possible when measuring using Timer DI.
- The encoder of the axis operationally in effect must have "valid" status "valid" ("StatusSensor[1..4].State" = valid). Otherwise, the measuring job is rejected in the function block with an error indication.

Override response

The override response for "MC_MeasuringInputCyclic" jobs is described in section "Override response V5: Measuring input jobs (Page 98)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_MeasuringInputCyclic":

Parameters	Declaration	Data type	Default value	Description	
MeasuringInput	INPUT	TO_MeasuringInput	-	Technology object	
Execute	INPUT	BOOL	FALSE	TRUE Start job with a positive edge	
Mode	INPUT	DINT	0	Type of measurement	
				0	Measurement of positive edges
				1	Measurement of negative edges
				2	Measurement of both edges
MeasuringRange	INPUT	BOOL	FALSE	Acquisition of measured values Observe the time-related boundary conditions (Page 21).	
				FALSE	Always acquire measured values
				TRUE	Acquire measured values only within the measuring range
StartPosition	INPUT	LREAL	0.0	Start position of the measuring range For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
EndPosition	INPUT	LREAL	0.0	End position of the measuring range For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
Busy	OUTPUT	BOOL	FALSE	TRUE The job is being processed.	
CommandAborted	OUTPUT	BOOL	FALSE	TRUE The measuring job has been aborted.	
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"	
MeasuredValue1	OUTPUT	LREAL		First measured value	
MeasuredValue2	OUTPUT	LREAL		Second measured value (when measuring multiple edges in one position control cycle)	
Measured Value1Counter	OUTPUT	UDINT	0	Count value for the first measured value	
Measured Value2Counter	OUTPUT	UDINT	0	Count value for the second measured value	
LostEdgeCounter1	OUTPUT	UDINT	0	Count value for the lost edges in the cycle clock of the first measured value acquisition	
LostEdgeCounter2	OUTPUT	UDINT	0	Count value for the lost edges in the cycle clock of the second measured value acquisition	

See also

Time-related boundary conditions (Page 21)

Cyclic measuring (Page 16)

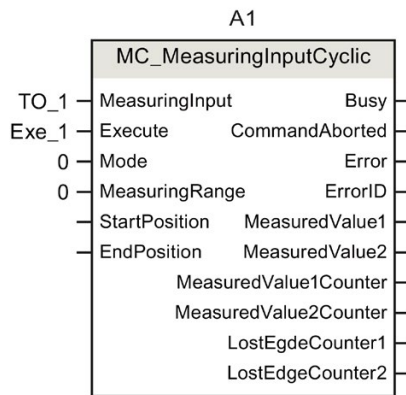
Override response V5: Measuring input jobs (Page 98)

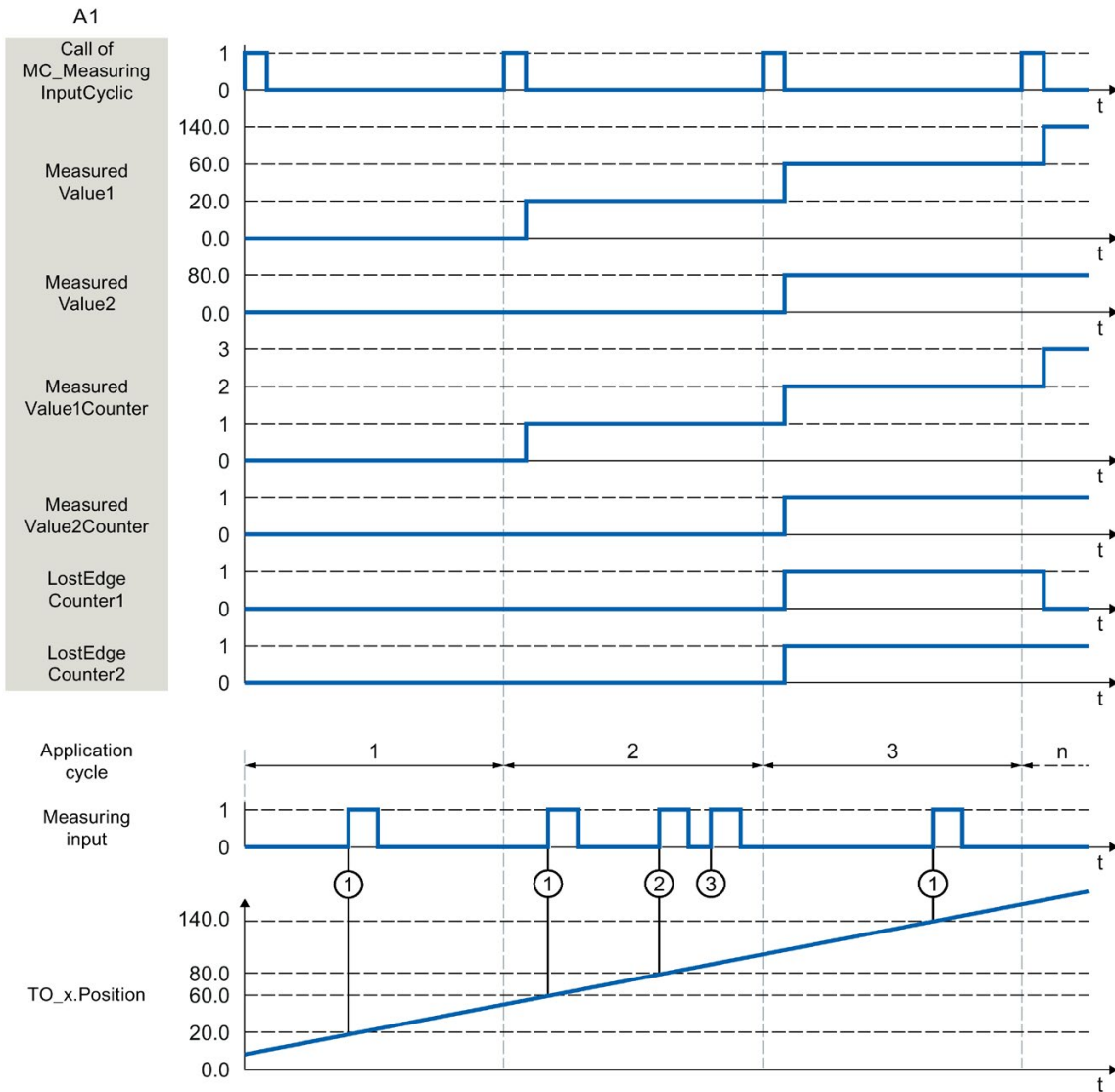
Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview".

<https://support.industry.siemens.com/cs/ww/en/view/109766459>

6.2.2 MC_MeasuringInputCyclic: Function chart V5 (S7-1500, S7-1500T)

Function chart: Start cyclic measuring job





A "MC_MeasuringInputCyclic" command initiated using "Execute" (signal and start point not shown) (e.g. call in MC-PreServo [OB67]) with "Mode" = 0 and without specified measuring range "MeasuringRange = FALSE" performs a measurement of the positive edges.

The actual position determined at the time of the first positive edge ① in the position control cycle is output using "MeasuredValue1", and count tag "MeasuredValue1Counter" is incremented by "1".

The actual position determined at the time of the second positive edge ② in the position control cycle is output using "MeasuredValue2", and count tag "MeasuredValue2Counter" is incremented by "1".

If additional positive edges occur in the same position control cycle ③, these are recorded in LostEdgeCounter1 and LostEdgeCounter2.

6.3 MC_AbortMeasuringInput V5 (S7-1500, S7-1500T)

6.3.1 MC_AbortMeasuringInput: Cancel active measuring job V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_AbortMeasuringInput", an active one-time or cyclic measuring job is aborted.

Applies to

- Measuring input

Requirement

- The technology object has been configured correctly.

Override response

The override response for "MC_AbortMeasuringInput" jobs is described in section "Override response V5: Measuring input jobs (Page 98)".

Parameters

The following table shows the parameters of Motion Control instruction "MC_AbortMeasuringInput":

Parameters	Declaration	Data type	Default value	Description
MeasuringInput	INPUT	TO_MeasuringInput	-	Technology object
Execute	INPUT	BOOL	FALSE	TRUE Start job with a positive edge
Done	OUTPUT	BOOL	0	The function block has been processed. The measuring job has been deactivated.
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 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: Measuring input jobs (Page 98)

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>)

Measuring input technology object (Page 11)

6.4 MC_OutputCam V5 (S7-1500, S7-1500T)

6.4.1 MC_OutputCam: Activate/deactivate output cam V5 (S7-1500, S7-1500T)

Description

You use Motion Control instruction "MC_OutputCam" to activate the specified output cam.

Depending on the output cam type, the following input parameters are in effect:

- Distance output cam
 - "OnPosition"
 - "OffPosition"
- Time-based output cam
 - "OnPosition"
 - "Duration"

You define the operating mode and the effective direction of the output cam with parameters "Mode" and "Direction".

When "MC_OutputCam.Enable" = TRUE, the input parameters are always read and take effect at the next position control cycle.

When a technological alarm occurs, the output cam is processed again after error acknowledgment.

Note

Enabling output cams

To guarantee precise switching, an output cam must be enabled for at least two application cycles before the output cam start is reached. Otherwise, distance output cams are imprecise and time-based output cams do not switch on.

Observe the switching behavior of the distance output cams (Page 29) and time-based output cams (Page 31).

Applies to

- Output cam

Requirement

- The technology object has been configured correctly.
- The higher-level technology object must have a valid position.
- Setpoint output cams are not output for an axis in non-position-controlled operation.
- A setpoint output cam with the setting "MC_OutputCam.OnPosition" = 0 switches at position setpoint = 0.

Override response

The "MC_OutputCam" is canceled by:

- Disabling of the output cam with "MC_OutputCam.Enable" = FALSE
- Only one instance of the "MC_OutputCam" function block can be active on an output cam in the user program. A second instance of the "MC_OutputCam" function block on a currently active output cam is rejected with an error.

Parameters

The following table shows the parameters of Motion Control instruction "MC_OutputCam":

Parameters	Declaration	Data type	Default value	Description	
OutputCam	INPUT	TO_OutputCam	-	Technology object	
Enable	INPUT	BOOL	FALSE	FALSE	Output cam is disabled.
				TRUE	Output cam is being processed.
OnPosition	INPUT	LREAL	0.0	Start position of the output cam [unit of measurement of the interconnected technology object] For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
OffPosition	INPUT	LREAL	0.0	End position of the distance output cam [unit of measurement of the interconnected technology object] For an axis or external encoder with active modulo function, position data outside the modulo range is mirrored in the modulo range.	
Duration	INPUT	LREAL	0.0	Switch-on duration of the time-based output cam [unit of measurement: ms] The value for the switch-on duration of a time-based output cam must be greater than 0.0.	
Mode	INPUT	DINT	1	Operating mode	
				1	Standard Output cam functionality (output not inverted)
				2	Output cam functionality with inverted output
				3	Output cam always ON (while "Enable" = TRUE)
Direction	INPUT	DINT	1	Activation direction of the output cam	
				1	Positive direction
				2	Negative direction
				3	Both directions
CamOutput	OUTPUT	BOOL	-	Status display based on last call of Motion Control instruction "MC_OutputCam"	
Busy	OUTPUT	BOOL	FALSE	TRUE	The processing of the output cam is active.
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"	

See also

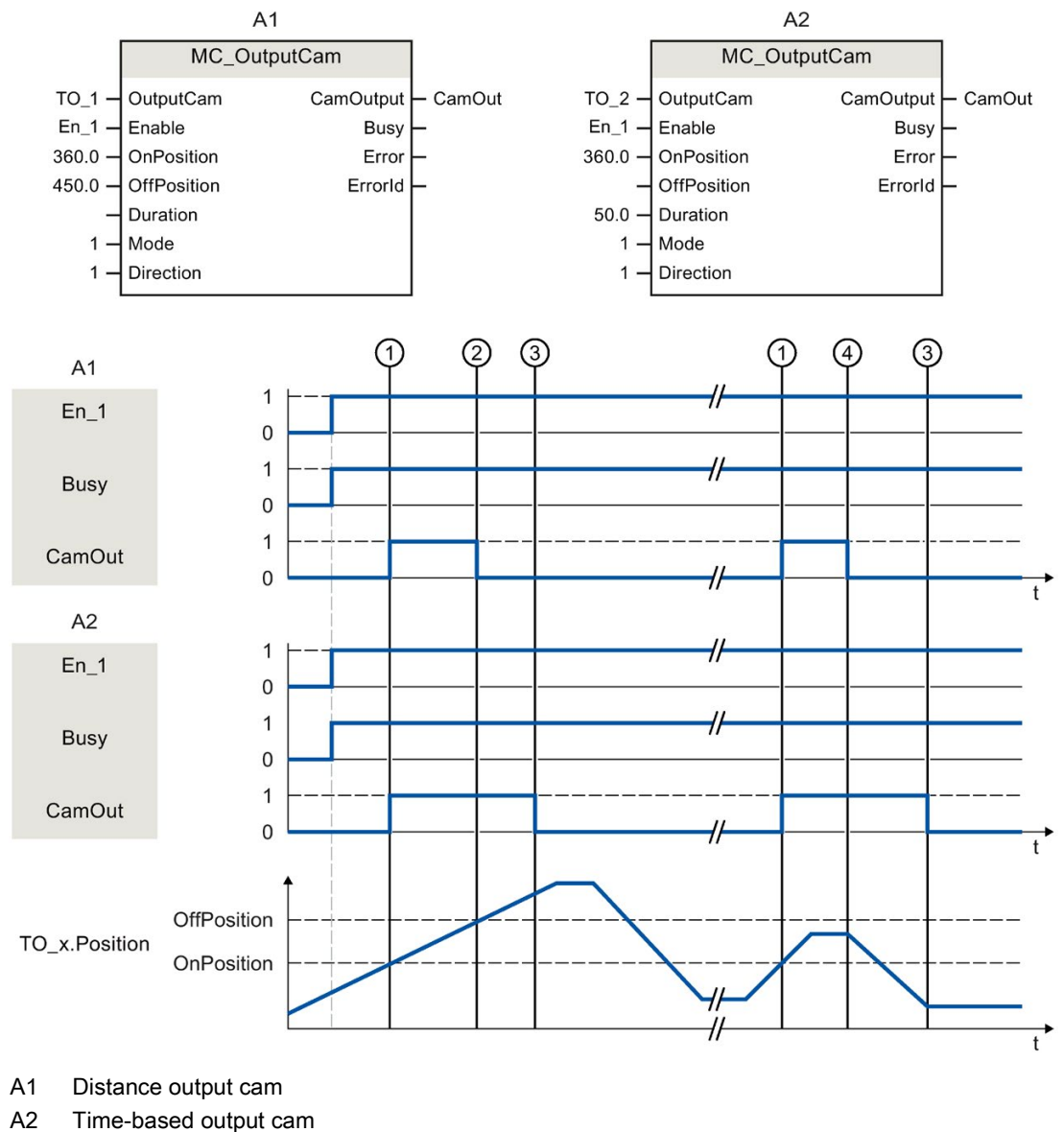
Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview".

<https://support.industry.siemens.com/cs/ww/en/view/109766459>

Output cam technology object (Page 26)

6.4.2 MC_OutputCam: Function chart V5 (S7-1500, S7-1500T)

Function chart: Activate the specified output cam type



An output cam is activated with "Enable" = TRUE. The output cam is output corresponding to the parameters.

The processing of the output cam is indicated with "Busy" = TRUE.

When activation direction "Direction" = 1 (positive) is set, the output cam behaves as follows, regardless of the output cam type setting:

- The distance output cam switches on at "OnPosition" ① and switches off again at "OffPosition" ②. At a direction reversal the output cam is switched off ④.
- The time-based output cam switches on at "OnPosition" ① and switches off again after expiration of the specified time "Duration" ③. A switched on time-based output cam remains active for the specified switch-on duration "Duration", even if overtravel of the start position occurs again in the reverse direction.

The switching state of the output cam is output using "CamOutput".

With "Enable" = FALSE, the specified output cam type is deactivated. "Busy" = FALSE shows that the output cam is not being processed.

6.5 MC_CamTrack V5 (S7-1500, S7-1500T)

6.5.1 MC_CamTrack: Activate/deactivate cam track V5 (S7-1500, S7-1500T)

Description

With the Motion Control instruction "MC_CamTrack", the processing of a cam track is enabled.

Applies to

- Cam track

Requirement

- The technology object has been configured correctly.
- The higher-level technology object must have a valid position.
- Setpoint output cams are not output for an axis in non-position-controlled operation.

Override response

- The "MC_CamTrack" is aborted by the disabling of the cam track with "MC_CamTrack.Enable" = FALSE.
- Only one instance of the "MC_CamTrack" function block can be active on a cam track in the user program. A second instance of the "MC_CamTrack" function block on a currently active cam track is rejected with an error.
- The cam track is recalculated at a change of the parameters of the Motion Control instruction "MC_CamTrack" or in the technology data block. The cam track is processed in accordance with all parameter settings.

Parameters

The following table shows the parameters of Motion Control instruction "MC_CamTrack":

Parameters	Declaration	Data type	Default value	Description	
CamTrack	INPUT	TO_CamTrack	-	Technology object	
Enable	INPUT	BOOL	FALSE	TRUE	The cam track is processed.
				FALSE	The cam track is disabled.
Mode	INPUT	INT	1	0	<p>When "Enable" = TRUE:</p> <p>The cam track processing is activated immediately. Cam track data takes effect immediately</p> <p>Previously activated distance output cams are aborted if their track signal is not still set due to the changed cam track data.</p> <p>Previously activated time-based output cams are always aborted.</p> <p>When "Enable" = FALSE:</p> <p>The cam track processing is ended immediately. Distance output cams/time-based output cams are aborted immediately.</p>
				1	<p>When "Enable" = TRUE:</p> <p>The cam track processing is activated immediately/with the next track cycle:</p> <ul style="list-style-type: none"> When a cam track is activated for the first time, the cam track processing begins immediately. If the cam track processing is already active, the current cam track is output up to the end of the track cycle. The new cam track data then takes effect. <p>When "Enable" = FALSE:</p> <p>The cam track processing is ended at the end of the cam track</p>
				2	<p>When "Enable" = TRUE:</p> <p>The cam track output is switched on immediately and remains switched on</p> <p>When "Enable" = FALSE:</p> <p>The cam track output is switched off immediately.</p>

Parameters	Declaration	Data type	Default value	Description	
InvertOutput	INPUT	BOOL	FALSE	Inverted output	
				TRUE	The track output is output inverted.
				FALSE	The track output is output non-inverted.
TrackOutput	OUTPUT	BOOL	-	Indicates the switching state of the cam track.	
Busy	OUTPUT	BOOL	FALSE	TRUE The processing of the cam track is active.	
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"	

See also

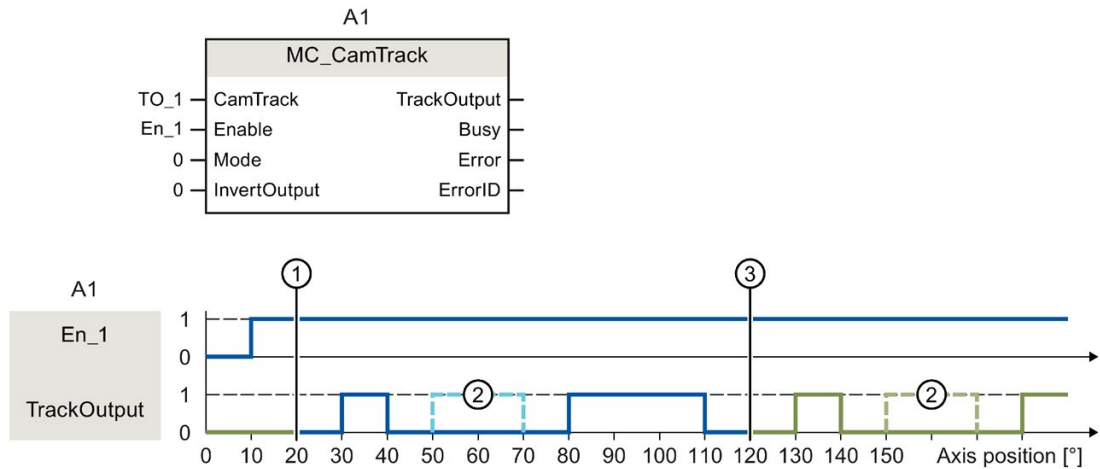
Section "Error detection Motion Control instructions" of the documentation "S7-1500/S7-1500T Motion Control Overview".

(<https://support.industry.siemens.com/cs/ww/en/view/109766459>)

Cam track technology object (Page 41)

6.5.2 MC_CamTrack: Function chart V5 (S7-1500, S7-1500T)

Function chart: Activate cam track



- ① Axis reference position
- ② Output cam configured as invalid
- ③ Start of cyclically continued cam track

A cam track is activated with "Enable" = TRUE. The cam track is output in accordance with the parameters set in the technology data block.

Tag	Value	Description
<TO>Parameter.		
CamTrackType	0	Specified output cam type for the cam track is distance output cam
ReferencePosition	20.0	Specified axis reference position for the cam track
CamTrackLength	100.0	Specified length of the cam track
CamTrack[1].Existent	TRUE	The first distance output cam of the cam track is specified as valid
CamTrack[1].OnPosition	10.0	Start position for the first output cam of the cam track
CamTrack[1].OffPosition	20.0	End position for the first output cam of the cam track
CamTrack[2].Existent	FALSE	The second distance output cam of the cam track is specified as invalid
CamTrack[2].OnPosition	30.0	Start position for the second output cam of the cam track
CamTrack[2].OffPosition	50.0	End position for the second output cam of the cam track
CamTrack[3].Existent	TRUE	The third distance output cam of the cam track is specified as valid
CamTrack[3].OnPosition	60.0	Start position for the third output cam of the cam track
CamTrack[3].OffPosition	90.0	End position for the third output cam of the cam track

6.6 Override response of Motion Control jobs V5 (S7-1500, S7-1500T)

6.6.1 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	MC_Home	MC_Home	MC_Halt	MC_Stop	MC_Move- Superimposed	MC_MotionIn- Velocity
↓ New job	"Mode" = 2, 8, 10	("Mode" = 3, 5)	MC_Move- Absolute MC_Move- Relative MC_Move- Velocity MC_MoveJog			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_MoveSuper- imposed	-	-	-	-	A	-
MC_Stop	A	A	A	B	A	A

6.6 Override response of Motion Control jobs V5 (S7-1500, S7-1500T)

⇒ Active job	MC_Home	MC_Home	MC_Halt	MC_Stop	MC_Move- Superimposed	MC_MotionIn- Velocity
↓ New job	"Mode" = 2, 8, 10	("Mode" = 3, 5)	MC_Move- Absolute MC_Move- Relative MC_Move- Velocity MC_MoveJog			MC_MotionIn- Position
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.

6.6.2 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	MC_GearIn	MC_GearInPos	MC_GearInPos	MC_Phasing- Absolute	MC_Leading- ValueAdditive
↓ New job		MC_CamIn waiting ¹⁾	MC_CamIn active ²⁾	MC_Phasing- Relative	
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.

6.6.3 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	MC_MeasuringInput	MC_MeasuringInputCyclic
↓ New job		
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.

6.6.4 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		MC_GroupInterrupt	MC_GroupStop
↓ 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_Home	N	N	N
MC_MoveSuperimposed			
MC_Halt	A	A	A
MC_MoveAbsolute			
MC_MoveRelative			
MC_MoveVelocity			
MC_MoveJog			
MC_Stop			
MC_GearIn			
MC_GearInPos			
MC_CamIn			
MC_MotionInVelocity			
MC_MotionInPosition			
MC_GroupStop	A	A	N
MC_GroupInterrupt	B	A	N
MC_GroupContinue			

6.6 Override response of Motion Control jobs V5 (S7-1500, S7-1500T)

⇒ Active job	MC_MoveLinearAbsolute	MC_GroupInterrupt	MC_GroupStop
↓ New job	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_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.1 Tags of the measuring input technology object (S7-1500, S7-1500T)

A.1.1 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 directly 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.1.2 Display data (measuring input) (S7-1500, S7-1500T)

The "<TO>.Status" and "<TO>.InputState" tags show the status of the measuring function and the measuring input.

Tags

Legend (Page 101)

Tag	Data type	Values	W	Description	
Status	DINT	-	RON	Status of the measuring input function	
				0	"INACTIVE" No measurement is active.
				1	"WAITING_FOR_TRIGGER" The measuring input is waiting for the measuring event.
				2	"TRIGGER_OCCURRED" One or more measured values have been captured.
				3	"MEASURING_ERROR" Error during the measurement
InputState	BOOL	-	RON	Status of measuring input	
				FALSE	Measuring input inactive
				TRUE	Input of measuring input active

A.1.3 "Parameter" tag (measuring input) (S7-1500, S7-1500T)

The tag structure "<TO>.Parameter.<tag name>" contains the configuration of the basic parameters of the measuring input technology object.

Tags

Legend (Page 101)

Tag	Data type	Values	W	Description	
Parameter.	TO_MeasuringInput_Struct_Parameter				
MeasuringInputType	DINT	0, 1	RON	Measuring input type	
				0	"STANDARD" Measurement using time stamp
				1	"PROFIDRIVE" Measuring event using PROFIdrive telegram
PROFIdriveProbe Number	UDINT	1, 2	RES	Number of the measuring input to be used for a measurement via PROFIdrive telegram	
MeasuringRange ActivationTime	LREAL	0.0 ... 1.0E12	RON	System share for activation time of measuring range	
MeasuringRangeAdditionalActivationTime	LREAL	0.0 ... 1.0E12	RES	Additional activation time when using measuring range limits [ms]	
CorrectionTime	LREAL	0.0 ... 1.0E12	RES	Correction time for the measurement result [ms]	

A.1.4 "Interface" tag (measuring input) (S7-1500, S7-1500T)

The tag structure "<TO>.Interface.<tag name>" contains the configuration of the input properties for the measuring input technology object.

Tags

Legend (Page 101)

Tag	Data type	Values	W	Description
Interface.	TO_MeasuringInput_Struct_Interface			
Address	VREF	-	RON	I/O address for the digital measurement input

A.1.5 "Units" tag (measuring input) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 101)

Tag	Data type	Values	W	Description	
Units.	TO_MeasuringInput_Struct_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⁾
TimeUnit	UDINT	-	RON	Unit for time	
				1056	ms

1) Position values with higher resolution or six decimal places.

A.1.6 "MeasuredValues" tag (measuring input) (S7-1500, S7-1500T)

The tag structure "<TO>.MeasuredValues.<tag name>" displays the measurement results.

Tags

Legend (Page 101)

Tag	Data type	Values	W	Description
MeasuredValues.	TO_MeasuringInput_Struct_MeasuringValues			
MeasuredValue1	LREAL	-1.0E12 ... 1.0E12	RON	First measured value
MeasuredValue2	LREAL	-1.0E12 ... 1.0E12	RON	Second measured value
MeasuredValue1 Counter	UDINT	0 ... 2147483647	RON	Count value for the first measured value
MeasuredValue2 Counter	UDINT	0 ... 2147483647	RON	Count value for the second measured value
LostEdgeCounter1	UDINT	0 ... 7	RON	LEC for measured value 1 (Zero in the case of one-time measurement)
LostEdgeCounter2	UDINT	0 ... 7	RON	LEC for measured value 2 (Zero in the case of one-time measurement)

A.1.7 "StatusWord" tag (measuring input) (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 2 "RestartActive") 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 101)

Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information of the technology object	
Bit 0	-	-	-	"Control"	
				0	Technology object not in operation
				1	Technology object in operation
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	-	-	-	Reserved	
Bit 5	-	-	-	"CommunicationOK"	
				Communication between measuring input and measuring module	
				0	Not established
				1	Established
Bit 6... Bit 31	-	-	-	Reserved	

A.1.8 "ErrorWord" tag (measuring input) (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.

Tags

Legend (Page 101)

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 the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.1.9 "ErrorDetail" tag (measuring input) (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 101)

Tag	Data type	Values	W	Description	
ErrorDetail.	TO_Struct_ErrorDetail				
Number	UDINT	-	RON	Alarm number	
Reaction	DINT	0, 6	RON	Effective alarm reaction	
				0	No reaction
				6	End measuring input processing

A.1.10 "WarningWord" tag (measuring input) (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 1 "ConfigWarning") 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 101)

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 the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13				"PeripheralWarning" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.2 Tags of the output cam technology object (S7-1500, S7-1500T)

A.2.1 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 directly 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.2.2 Display data (output cam) (S7-1500, S7-1500T)

The "<TO>.CamOutput" tag indicates the switching state of the output cam.

Tags

Legend (Page 110)

Tag	Data type	Values	W	Description	
CamOutput	BOOL	-	RON	Switching state of output cam	
				FALSE	Not switched
				TRUE	Switched

A.2.3 "Parameter" tag (output cam) (S7-1500, S7-1500T)

The tag structure "<TO>.Parameter.<tag name>" contains the configuration of the basic parameters of the output cam technology object.

Tags

Legend (Page 110)

Tag	Data type	Values	W	Description	
Parameter.	TO_OutputCam_Struct_Parameter				
OutputCamType	DINT	0 ... 2	RES	Output cam type	
				0	Distance output cam
				1	Time-based output cam
				2	Switching output cam
PositionType	DINT	0, 1	RES	Position reference	
				0	Position setpoint
				1	Actual position
OnCompensation	LREAL	0.0 ... 1.0E12	DIR	Activation time Lead time for the switch-on edge	
OffCompensation	LREAL	0.0 ... 1.0E12	DIR	Deactivation time Lead time for the switch-off edge	
Hysteresis	LREAL	0.0 ... 1.0E12	DIR	Hysteresis value For output cams with reference to actual position, always enter a hysteresis value (> 0.0).	

A.2.4 "Interface" tag (output cam) (S7-1500, S7-1500T)

The tag structure "<TO>.Interface.<tag name>" contains the configuration of the output properties for the output cam technology object.

Tags

Legend (Page 110)

Tag	Data type	Values	W	Description	
Interface.	TO_OutputCam_Struct_Interface				
EnableOutput	BOOL	-	RES	Activation of the output cam output	
				FALSE	Output is deactivated
				TRUE	Output is activated
Address	VREF	-	RON	I/O address of the output cam	
LogicOperation	DINT	0, 1	RON	Logical operation of the output cam signals at the output	
				0	OR logic operation
				1	AND logic operation

A.2.5 "Units" tag (output cam) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 110)

Tag	Data type	Values	W	Description	
Units.	TO_OutputCam_Struct_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⁾
TimeUnit	UDINT	-	RON	Unit for time	
				1056	ms

1) Position values with higher resolution or six decimal places.

A.2.6 "StatusWord" tag (output cam) (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 2 "RestartActive") 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 110)

Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information of the technology object	
Bit 0	-	-	-	"Control"	
				0	Technology object not in operation
				1	Technology object in operation
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	-	-	-	"OutputInverted"	
				0	Output cam output not inverted
				1	Output cam output inverted
Bit 5	-	-	-	"CommunicationOK"	
				Communication between output cam and output module	
				0	Not established
Bit 6... Bit 31	-	-	-	1	Established
				Reserved	

A.2.7 "ErrorWord" tag (output cam) (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.

Tags

Legend (Page 110)

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 the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.2.8 "ErrorDetail" tag (output cam) (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 110)

Tag	Data type	Values	W	Description	
ErrorDetail.	TO_Struct_ErrorDetail				
Number	UDINT	-	RON	Alarm number	
Reaction	DINT	0, 6	RON	Effective alarm reaction	
				0	No reaction
				6	Output cam processing is complete.

A.2.9 "WarningWord" tag (output cam) (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 1 "ConfigWarning") 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 110)

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 the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13				"PeripheralWarning" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.3 Tags of the cam track technology object (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 directly 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 Display data (cam track) (S7-1500, S7-1500T)

The following tags indicate the status of the cam track:

Tags

Legend (Page 117)

Tag	Data type	Values	W	Description	
Status	DINT	0 ... 2	RON	0	"INACTIVE" Inactive
				1	"ACTIVE" Active
				2	"ACTIVE_WAITING_FOR_NEXT_CYCLE" Active and waiting for next track
TrackOutput	BOOL	-	RON	FALSE	Cam track is not output.
				TRUE	Cam track is output.
SingleCamState	DWORD	16#0 ... 16#FFFF_FFFF	RON	Switched on output cam (bit-masked)	
				0	Output cam is not switched on
				1	Output cam is switched on
TrackPosition	LREAL	-1.0E12 ... 1.0E12	RON	Display of the current position within the cam track	
MatchPosition	LREAL	-1.0E12 ... 1.0E12	RON	Reference position of the current cam track During cyclic processing of the cam track, the continued reference position of the current cam track is displayed. The unique detection and output of the position is only possible when the assigned technology object is in motion.	

A.3.3 "Parameter" tag (cam track) (S7-1500, S7-1500T)

The tag structure "<TO>.Parameter.<tag name>" contains the configuration of the basic parameters of the cam track technology object.

Tags

Legend (Page 117)

Tag	Data type	Values	W	Description	
Parameter.	TO_CamTrack_Struct_Parameter				
CamTrackType	DINT	0, 1	RES	Output cam type 0 Distance output cam 1 Time-based output cam	
PositionType	DINT	0, 1	RES	Position reference 0 Position setpoint 1 Actual position	
ReferencePosition	LREAL	-1.0E12 ... 1.0E12	DIR	Reference position	
CamTrackLength	LREAL	0.001 ... 1.0E12	DIR	Track length	
CamMasking	DWORD	16#0 ... 16#FFFF_FFFF	DIR	Bit masking of individual output cams	
OnCompensation	LREAL	0.0 ... 1.0E12	DIR	Activation time Lead time for the switch-on edge	
OffCompensation	LREAL	0.0 ... 1.0E12	DIR	Deactivation time Lead time for the switch-off edge	
Hysteresis	LREAL	0.0 ... 1.0E12	DIR	Hysteresis value For output cams with reference to actual position, always enter a hysteresis value (> 0.0).	
Cam[1..32].	ARRAY[1..32] OF TO_CamTrack_Struct_CamData				
OnPosition	LREAL	0.0 ... 1.0E12	CAL	With distance output cams and time-based output cams: Start position	
Offposition	LREAL	0.0 ... 1.0E12	CAL	With distance output cams: End position	
Duration	LREAL	0.001 ... 1.0E12	CAL	With time-based output cams: Switch-on duration	
Existent	BOOL	-	CAL	FALSE	Output cam is not used.
				TRUE	Output cam is used.

A.3.4 "Interface" tag (cam track) (S7-1500, S7-1500T)

The tag structure "<TO>.Interface.<tag name>" contains the configuration of the output properties for the cam track technology object.

Tags

Legend (Page 117)

Tag	Data type	Values	W	Description	
Interface.	TO_CamTrack_Struct_Interface				
EnableOutput	BOOL	-	RES	Output cam output at the bit specified under "<TO>.Interface.Address"	
				FALSE	No output
				TRUE	Output
Address	VREF	-	RON	I/O address for digital output cam output	

A.3.5 "Units" tag (cam track) (S7-1500, S7-1500T)

The tag structure "<TO>.Units.<tag name>" shows the set technological units.

Tags

Legend (Page 117)

Tag	Data type	Values	W	Description	
Units.	TO_CamTrack_Struct_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⁾				
TimeUnit	UDINT	-	RON	Unit for time	
				1056	ms

¹⁾ Position values with higher resolution or six decimal places.

A.3.6 "StatusWord" tag (cam track) (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 2 "RestartActive") 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 117)

Tag	Data type	Values	W	Description	
StatusWord	DWORD	-	RON	Status information of the technology object	
Bit 0	-	-	-	"Control"	
				0	Technology object not in operation
				1	Technology object in operation
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	-	-	-	"OutputInverted"	
				0	Output cam output not inverted
				1	Output cam output inverted
Bit 5	-	-	-	"CommunicationOK"	
				Communication between cam track and output module	
				0	Not established
Bit 6... Bit 31	-	-	-	1	Established
				Reserved	

A.3.7 "ErrorWord" tag (cam track) (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.

Tags

Legend (Page 117)

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" Command cannot be executed A Motion Control instruction cannot be executed because the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralError" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

A.3.8 "ErrorDetail" tag (cam track) (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 117)

Tag	Data type	Values	W	Description	
ErrorDetail.	TO_Struct_ErrorDetail				
Number	UDINT	-	RON	Alarm number	
Reaction	DINT	0, 6	RON	Effective alarm reaction	
				0	No reaction
				6	Cam track processing is complete.

A.3.9 "WarningWord" tag (cam track) (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 1 "ConfigWarning") 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 101)

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" Command cannot be executed A Motion Control instruction cannot be executed because the necessary conditions are not met.
Bit 4... Bit 12	-	-	-	Reserved
Bit 13	-	-	-	"PeripheralWarning" Error accessing a logical address
Bit 14... Bit 31	-	-	-	Reserved

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