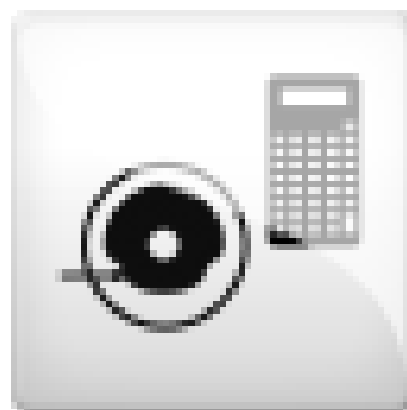


Technology module



Flex Cam _____

Reference manual

EN

Contents

1	About this document	4
1.1	Document history	6
1.2	Conventions used	7
1.3	Layout of the safety instructions	8
2	Safety instructions	9
3	Overview of the technology module functions	11
3.1	Functional description	11
3.2	TM-functional overview	12
3.3	Important notes on how to operate the technology module	13
4	Application ranges	14
5	L_TS2P_FlexCamState function block	15
5.1	inputs	16
5.2	outputs	18
5.3	Parameter	20
6	State machine	25
7	Signal flow diagram	27
7.1	Structure of the signal flow	28
7.2	Structure of the access points	30
8	Description of the basic functions	31
8.1	Manual jog (jogging)	32
8.2	Homing	34
8.3	QSP application	37
8.4	Halt	38
8.5	Absolute positioning	39
8.6	Relative positioning	41
8.7	Continuous travel with a defined velocity	44
8.8	Aborting and completing a positioning process	47
8.9	Override for speed	49
9	Description of the technology functions	51
9.1	Cam formats (cam handling)	51
9.2	Motion profiles	51
9.3	Executing the axes and cam	52
9.3.1	Executing the cam cyclically	52
9.3.2	Executing the cam once	54
9.3.3	Executing the master axis with cams of variable cycle lengths	55
9.3.4	Executing the slave axis with cams of variable cycle lengths	56
9.4	Changing the cam	57
9.5	Clutching in to the cam	58
9.5.1	Clutching-in with "Profile generator absolute" coupling mode	59
9.5.2	Clutching-in with "CAM absolute" coupling mode	61
9.5.3	Clutching-in with "Instant absolute" coupling mode	63
9.5.4	Clutching-in with "Instant relative" coupling mode	65
9.6	Declutching from the cam	67
9.6.1	Declutching in "Profile generator absolute" coupling mode	67
9.6.2	Declutching in "CAM absolute" coupling mode	69
9.6.3	Declutching in the "Instant absolute"/"Instant relative" coupling mode	71

Contents

9.7	Scaling the cam	72
9.7.1	Scaling the position via the ramp generator	74
9.7.2	Relative extension and compression factor of the master axis	75
9.7.3	Absolute extension and compression factor of the master axis	76
9.7.4	Relative extension and compression factor of the slave axis	77
9.7.5	Absolute extension and compression factor of the slave axis	78
9.8	Offset for the master and slave axis	79
9.8.1	Specify master offset	80
9.8.2	Specify slave offset	82
9.9	Specify the switching sequence for cams	84
	Index	87
	Your opinion is important to us	88

1 About this document

This documentation ...

- contains detailed information on the functionalities of the "Flex Cam State" technology module;
- is part of the "Controller-based Automation" manual collection. It consists of the following sets of documentation:

Documentation type	Subject
Product catalogue	Controller-based Automation (system overview, sample topologies) Lenze controllers (product information, technical data)
System manuals	Visualisation (system overview/sample topologies)
Communication manuals Online helps	Bus systems • Controller-based Automation EtherCAT® • Controller-based Automation CANopen® • Controller-based Automation PROFIBUS® • Controller-based Automation PROFINET®
Reference manuals Online helps	Lenze controllers: • Controller 3200 C • Controller c300 • Controller p300 • Controller p500
Software manuals Online helps	Lenze engineering tools: • »PLC Designer« (programming) • »Engineer« (parameterisation, configuration, diagnostics) • »VisiWinNET® Smart« (visualisation) • »Backup & Restore« (backup, restore, update)

Further sets of technical documentation with regard to Lenze products

Further information on Lenze products which can be used in conjunction with Controller-based Automation can be found in the following sets of documentation:

Design / configuration / technical data	
☐	Product catalogues • Controller-based Automation • Controllers • Inverter Drives/Servo Drives
Mounting and wiring	
☒	Mounting instructions • Controllers • Communication cards (MC-xxx) • I/O system 1000 (EPM-Sxxx) • Inverter Drives/Servo Drives • Communication modules
☐	Hardware manuals • Inverter Drives/Servo Drives
Parameterisation / configuration / commissioning	
☐	Online help/reference manuals • Controllers • Inverter Drives/Servo Drives • I/O system 1000 (EPM-Sxxx)
☐	Online help/communication manuals • Bus systems • Communication modules
Sample applications and templates	
☐	Online help / software and reference manuals • i700 application sample • Application Samples 8400/9400 • FAST Application Template Lenze/PackML • FAST technology modules

Symbols:

-  Printed documentation
- ☐ PDF file / online help in the Lenze engineering tool



Tip!

Current sets of documentation and software updates with regard to Lenze products can be found in the Download area at:

www.lenze.com

Target group

This documentation is intended for all persons who plan, program and commission a Lenze automation system on the basis of the Lenze FAST Application Software.

1 About this document

1.1 Document history

1.1 Document history

Version			Description
4.0	04/2021	TD06	Error corrections & supplements
3.0	07/2020	TD06	Error corrections & supplements
2.0	12/2019	TD06	Error corrections & supplements
1.0	09/2019	TD29	First edition

1 About this document

1.2 Conventions used

This documentation uses the following conventions to distinguish between different types of information:

Type of information	Writing	Examples/notes
Numeric notation		
Decimal separator	Point	The decimal point is always used. For example: 1234.56
Text		
Program name	» «	»PLC Designer« ...
Variable identifiers	<i>Italics</i>	By setting <i>bEnable</i> to TRUE...
Function blocks	Bold	The L_MC1P_AxisBasicControl function block ...
Function libraries		The L_TT1P_TechnologyModules function library ...
Source code	Font "Courier new"	... dwNumerator := 1; dwDenominator := 1; ...
Symbols		
Page reference	 7)	Reference to further information: Page number in PDF file.

Variable identifiers

The conventions used by Lenze for the variable names of Lenze system blocks, function blocks, and functions are based on the "Hungarian Notation". This notation makes it possible to identify the most important properties (e.g. the data type) of the corresponding variable by means of its name, e.g. xAxisEnabled.

1 About this document

1.3 Layout of the safety instructions

DANGER!

Indicates an extremely hazardous situation. Failure to comply with this instruction will result in severe irreparable injury and even death.

WARNING!

Indicates an extremely hazardous situation. Failure to comply with this instruction may result in severe irreparable injury and even death.

CAUTION!

Indicates a hazardous situation. Failure to comply with this instruction may result in slight to medium injury.

NOTICE

Indicates a material hazard. Failure to comply with this instruction may result in material damage.

Application notes

Pictograph	Signal word	Meaning
	Tip!	Useful tip for easy handling
		Reference to another document

2 Safety instructions

Please observe the safety instructions in this documentation when you want to commission an automation system or a plant with a Lenze Controller.



The device documentation contains safety instructions which must be observed!

Read the documentation supplied with the components of the automation system carefully before you start commissioning the Controller and the connected devices.

DANGER!

High electrical voltage

Injury to persons caused by dangerous electrical voltage

Possible consequences

Death or severe injuries

Protective measures

Switch off the voltage supply before working on the components of the automation system.

After switching off the voltage supply, do not touch live device parts and power terminals immediately because capacitors may be charged.

Observe the corresponding information plates on the device.

DANGER!

Injury to persons

Risk of injury is caused by ...

- unpredictable motor movements (e.g. unintended direction of rotation, too high velocities or jerky movement);
- impermissible operating states during the parameterisation while there is an active online connection to the device.

Possible consequences

Death or severe injuries

Protective measures

- If required, provide systems with installed inverters with additional monitoring and protective devices according to the safety regulations valid in each case (e.g. law on technical equipment, regulations for the prevention of accidents).
- During commissioning, maintain an adequate safety distance to the motor or the machine parts driven by the motor.

NOTICE

Damage or destruction of machine parts

Damage or destruction of machine parts can be caused by ...

- Short circuit or static discharges (ESD);
- unpredictable motor movements (e.g. unintended direction of rotation, too high velocities or jerky movement);
- impermissible operating states during the parameterisation while there is an active online connection to the device.

Protective measures

- Always switch off the voltage supply before working on the components of the automation system.
 - Do not touch electronic components and contacts unless ESD measures were taken beforehand.
 - If required, provide systems with installed inverters with additional monitoring and protective devices according to the safety regulations valid in each case (e.g. law on technical equipment, regulations for the prevention of accidents).
-

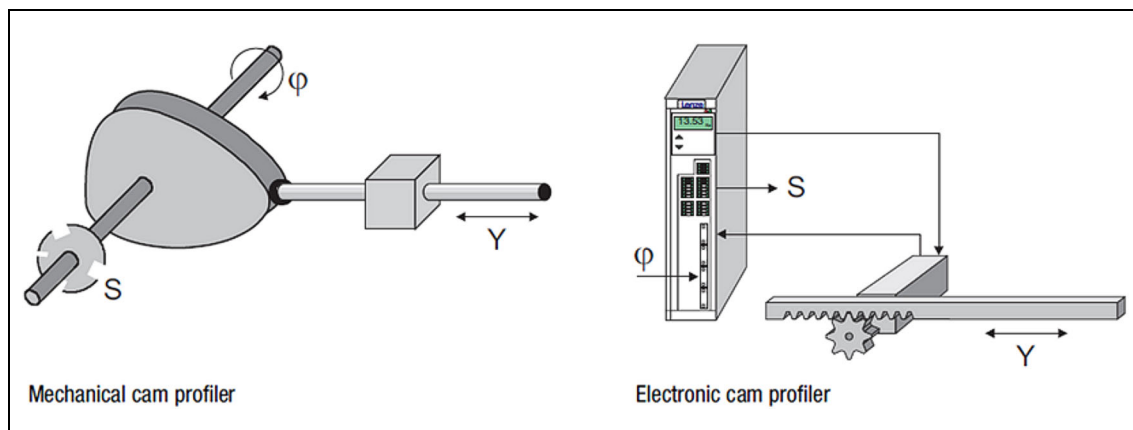
3

Overview of the technology module functions

3.1

Functional description

The "Flex Cam" technology module (TM) is a standardized application to implement electronic cams.



[3-1] Typical mechanics of a cam (left) and electronic implementation with the "Flex Cam" TM (right)

- The TM drives a linear reference value (φ) via a virtual cam into a non-linear movement (Y).
- The reference value (φ) is shown over the master axis, the resulting movement (Y) of an actuator over the slave axis.
- The TM supports up to 4 different cams that can be executed in a definable switching sequence.
- The TM supports different motion profiles (cam definitions) and travel profiles (cyclic or one-off).
- An offset factor and a scaling factor can be set at any time for the master and the slave axis, either using a ramp generator (continuous adjustment) or without using a ramp generator (erratic adjustment).
- It is possible to clutch-in or declutch the axes via various coupling modes.
- Switching points (S) are activated and deactivated depending on the cam.

3.2

TM-functional overview

Functionality	Description
Basic Motion Base:	
Manual jog (jogging) (📖 32)	Traverse axis in manual operation
Homing (📖 34)	Home the axis
QSP application (📖 37)	Stop motion via an application quick stop deceleration ramp (AxisRef)
Halt (📖 38)	Stop motion via a stop deceleration ramp
Absolute positioning (📖 39)	Move axis to an absolute target position
Relative positioning (📖 41)	Move axis to a target position relative to the current position
Continuous travel with a defined velocity (📖 44)	Execute continuous travel
Aborting and completing a positioning process (📖 47)	Stop positioning
Override for speed (📖 49)	Specify overrides for speed
Flex Cam:	
Executing the axes and cam (📖 52)	Execute cam once or cyclically; execute master or slave axis with cams of variable cycle lengths
Changing the cam (📖 57)	Change cam during operation
Clutching in to the cam (📖 58)	Clutch-in via various modes
Declutching from the cam (📖 67)	Declutch via various modes
Scaling the cam (📖 72)	Compress or extend the cam
Offset for the master and slave axis (📖 79)	Specify offset for the master or slave
Specify the switching sequence for cams (📖 84)	Execute several cams in succession

Furthermore the technology module can be used for status and error messages and for resetting an error.

3.3 Important notes on how to operate the technology module

Start of the axes

The start of the axes after the controller has been inhibited depends on the requested movement type.

A distinction is made between the movement type with level-activated function and the movement type with edge-activated function.

- The movement type with level-activated function is automatically activated when the controller is enabled, as long as no higher priority function is active. This movement type includes
 - [Manual jog \(jogging\)](#) (□ 32)
 - [QSP application](#) (□ 37)
- The movement type with edge-activated function must be activated with a FALSE→TRUE edge after the controller has been enabled. This movement type includes
 - [Homing](#) (□ 34)



Example for a movement type with level-activated function: manual jog ("JOGGING")

1. In the inhibited axis state ($xOperationEnabled = FALSE$), $xJogPos$ is set to TRUE.
 - $xEnableOperation = FALSE$ (axis is inhibited.)
==> "STANDBY" state ($xOperationEnabled = FALSE$)
 - $xJogPos = TRUE$ (manual jog is to be executed.)
2. Enable axis.
 - $xEnableOperation = TRUE$
==> "JOGGING" state ($xOperationEnabled = TRUE$)



Example for a movement type with edge-activated function: "HOMING"

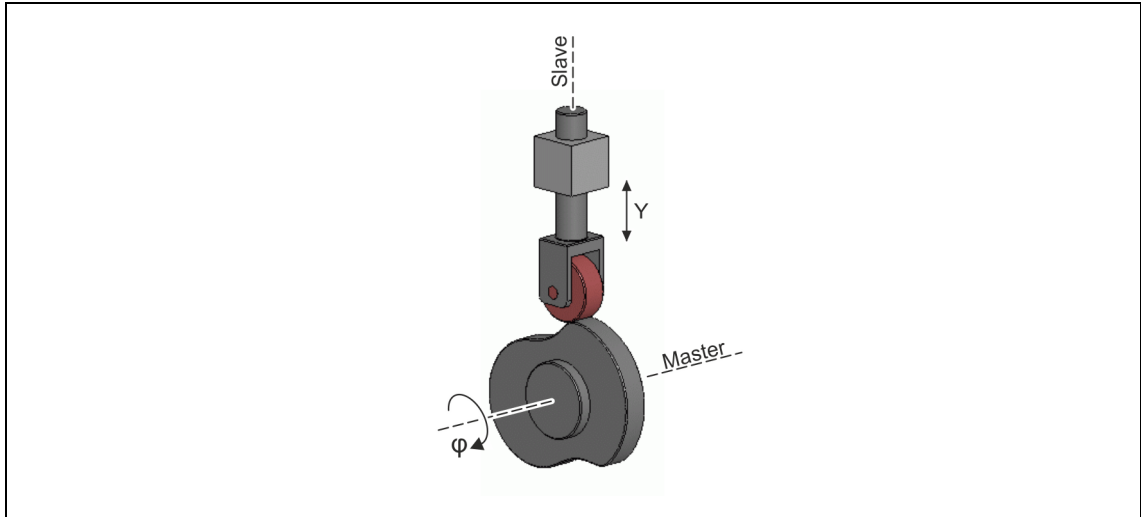
1. In the inhibited axis state ($xOperationEnabled = FALSE$), $xHomeExecute$ is set to TRUE.
 - $xEnableOperation = FALSE$ (axis is inhibited.)
==> "STANDBY" state ($xEnableOperation = FALSE$)
 - $xHomeExecute = TRUE$ ("HOMING" is to be executed.)
2. Enable axis.
 - $xEnableOperation = TRUE$
==> "STANDBY" state (output $xOperationEnabled = TRUE$)
3. Execute "HOMING".
 - $xHomeExecute = FALSE \rightarrow TRUE$
==> "HOMING" state

Setting of the operating mode

The operating mode for the axis has to be set to "cyclically synchronous position" (csp) because the axis is led via the master position value.

4 Application ranges

The "Flex Cam" technology module is always used when a uniform master movement is to be converted into a non-linear drive movement.



[4-1] Definition of the axes and movements

The movement of the drive is based on a motion profile (curve) stored as a path-path function, which is traversed depending on a master angle.

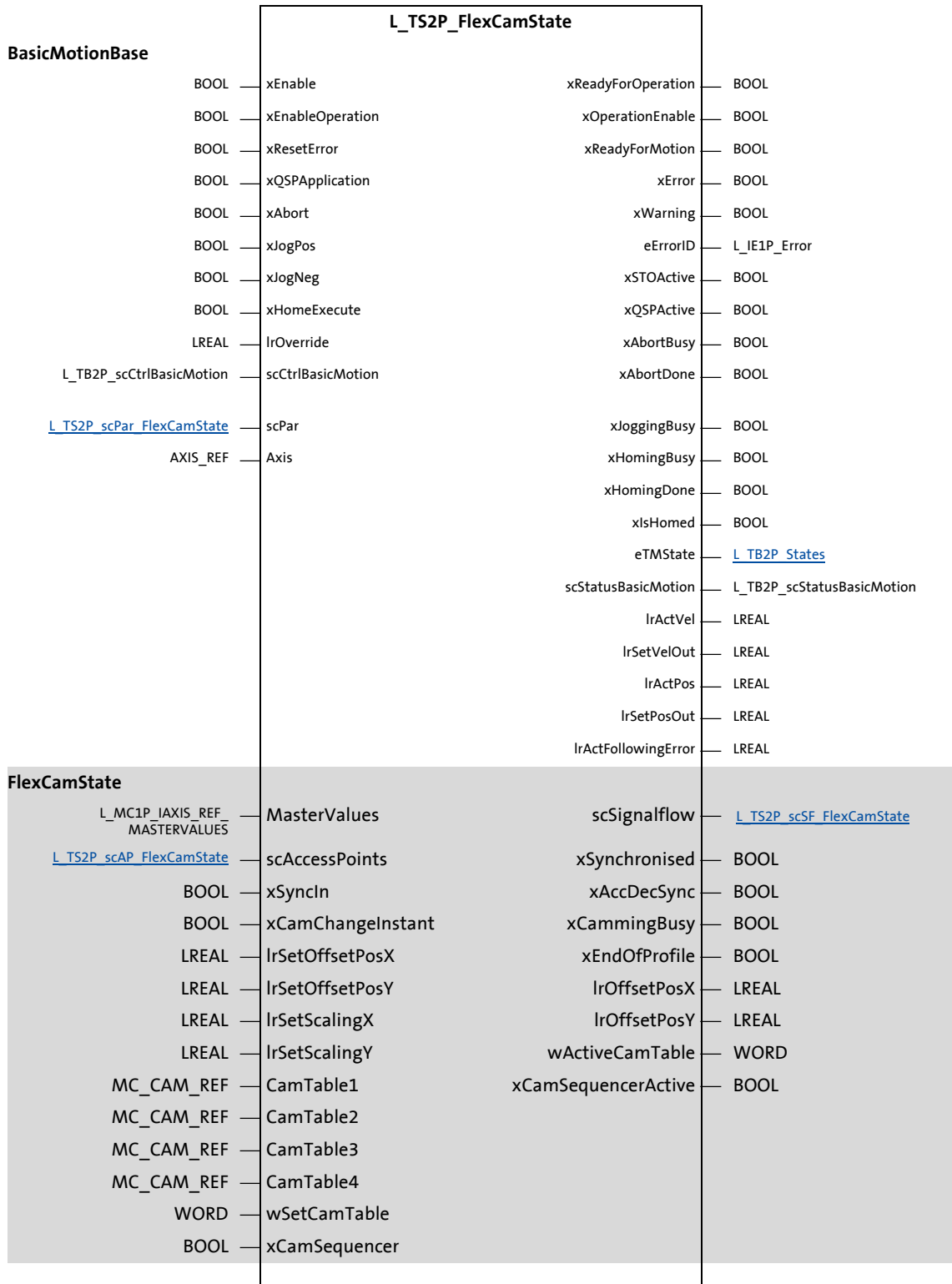
Each position of the master angle, e.g. from a master axis, is assigned to a setpoint position of the slave axis via the motion profile. The slave axis thus moves in a fixed angular reference to the master axis, even if the master speed varies.

Cams are used in machine tool construction, textile machine construction and the packaging industry. Typical mechanics are:

- Cross cutters
- Flying saw
- Punch
- Stamp
- Machines that are synchronously led via master values and trigger switching operations at certain angular settings.

5 L_TS2P_FlexCamState function block

The figure shows the affiliation of the inputs and outputs of the function block.



5.1

inputs

Designator	Data type	Description
xEnable	BOOL	Execution of the function block
		TRUE The function block is executed.
		FALSE The function block is not executed.
xEnableOperation	BOOL	TRUE The axis is switched to ready for operation. Controller enable is issued.
		FALSE The axis is not ready for operation.
xResetError	BOOL	The input is edge-controlled and evaluates the rising edge.
		FALSE Reset axis error or software error.
xQSPApplication	BOOL	The input is level-controlled and evaluates a high level.
		TRUE An active motion is aborted and brought to a standstill via the QSP application deceleration ramp. - The state changes to "STOP". - The technology module remains in the "STOP" state as long as <i>xQSPApplication</i> = TRUE.
xAbort	BOOL	TRUE An active motion is aborted and is brought to a standstill via the active profile deceleration. The state changes to "STOP". The deceleration ramp can be aborted by activating a new motion (e.g. <i>xMoveVelExecute</i>).
		FALSE The active motion is not aborted.
xJogPos	BOOL	The input is level-controlled and evaluates a high level.
		TRUE Traverse axis in positive direction (manual jog). If <i>xJogNeg</i> is also TRUE, the InvalidInputJogPosJogNeg error message is output via the <i>eErrorID</i> output and the axis stops.
xJogNeg	BOOL	The input is level-controlled and evaluates a high level.
		TRUE Traverse axis in negative direction (manual jog). If <i>xJogPos</i> is also TRUE, the InvalidInputJogPosJogNeg error message is output via the <i>eErrorID</i> output and the axis stops.
xHomeExecute	BOOL	The input is edge-controlled and evaluates the rising edge.
		FALSE Start "HOMING".
IrOverride	LREAL	TRUE The function is aborted via the <i>scCtrlBasicMotion.xHalt</i> structure input.
		FALSE The function is not aborted.
IrOverride	LREAL	Using the <i>IrOverride</i> factor, the specified setpoint speed is multiplied (e.g. an override value of 0.5 generates half the setpoint speed). - Value range: 0 ... 1.0 - Initial value: 1.0 Note: The acceptance of the value is independent of the status in <i>xContinuousUpdate</i>
scCtrlBasicMotion L_TB2P_scCtrlBasicMotion		Structure of the status data You can find information on status data here: "Basic Motion Base" reference manual
scPar L_TS2P_scPar_FlexCamState		The parameter structure contains the parameters of the TM.
Axis AXIS_REF		Reference to the axis
MasterValues L_MC1P_IAXIS_REF_MASTervalUES		Connection for the master values (master axis)
scAccessPoints L_TS2P_scAP_FlexCamState		Structure of the access points The access points can be used to influence the signal flow or TM functions.

Designator	Data type	Description
xSyncIn	BOOL	Synchronize the slave axis to the position resulting from the cam. The input is level-controlled and evaluates a high level. - Parameter: <i>eSyncMode</i> coupling mode - Initial value: FALSE
		TRUE Clutching in to the cam
		FALSE Decutching from the cam
xCamChangeInstant	BOOL	The input is edge-controlled and evaluates the rising edge. ▶ Changing the cam ▶ Specify the switching sequence for cams
		FALSE A changeover from the currently used cam to the newly created cam takes place in the current clock cycle. TRUE
IrSetOffsetPosX	LREAL	Master axis position offset The resulting x position of the cam results from adding the master axis position to the offset as per this input. ▶ Offset for the master and slave axis (79) - Unit: Units - Initial value: 0
IrSetOffsetPosY	LREAL	Slave axis position offset The resulting position of the slave axis is obtained by adding the y position to the offset as per this input. ▶ Offset for the master and slave axis (79) - Unit: Units - Initial value: 0
IrSetScalingX	LREAL	Scaling factor of the master axis The resulting x position of the cam is obtained by multiplying the master axis position by the scaling factor as per this input. ▶ Offset for the master and slave axis (79) - Value range: 0 to infinity - Initial value: 1
IrSetScalingY	LREAL	Scaling factor of the slave axis The resulting extended/compressed y setpoint position is obtained by multiplying the y value of the cam by the scaling factor as per this input. ▶ Offset for the master and slave axis (79) - Value range: 0 to infinity - Initial value: 1
CamTable1	MC_CAM_REF	Reference to cam 1
CamTable2	MC_CAM_REF	Reference to cam 2
CamTable3	MC_CAM_REF	Reference to cam 3
CamTable4	MC_CAM_REF	Reference to cam 4
wSetCamTable	WORD	Selection of a cam ▶ Specify the switching sequence for cams (84) - Initial value: 1
		1 Cam 1
		2 Cam 2
		3 Cam 3
		4 Cam 4
xCamSequencer	BOOL	TRUE Activate switching sequence for cams. Cams are executed according to the switching sequence in the <i>eCamSequenceMode</i> parameter. ▶ Specify the switching sequence for cams (84)

5.2

outputs

Designator	Data type	Description
xReadyForOperation	BOOL	The axis is in correct working order. The DC-bus voltage is available. "Safe Torque Off" (STO) is not active.
xOperationEnabled	BOOL	The axis is enabled. The brake is released.
xReadyForMotion	BOOL	The axis is enabled and in correct working order. The brake is released.
xErro	BOOL	TRUE There is an error in the technology module.
xWarning	BOOL	TRUE There is a warning in the technology module.
eErrorID	L_IE1P_Error	ID of the error or warning message if <i>xErro</i> = TRUE or <i>xWarning</i> = TRUE. "FAST technology modules" reference manual: Here you can find information on error or warning messages.
xSTOActive	BOOL	TRUE "Safe Torque Off" (STO) was triggered and is active. The axis is free of torque, the controller is inhibited.
xQSPActive	BOOL	TRUE The <i>xQSPApplication</i> input was set. The technology module is in the "STOP" state; the axis is brought to a standstill. The output is reset as soon as the axis is at standstill.
xAbortBusy	BOOL	TRUE The activated function is aborted via the <i>xAbo</i> input.
xAbortDone	BOOL	TRUE The activated function is aborted via the <i>xAbo</i> input.
xJoggingBusy	BOOL	TRUE The Manual jog (jogging) (□ 32) function is active. The technology module is in the "JOGGING" state.
xHomingBusy	BOOL	TRUE The Homing (□ 34) is executed. The technology module is in the "HOMING" state.
xHomingDone	BOOL	TRUE "HOMING" has been successfully completed.
xIsHomed	BOOL	TRUE The axis has been referenced ("Reference known"). <i>xIsHomed</i> may only be evaluated when the <i>scStatusBasicMotion.xAxisAvailable</i> status is reported.
eTMState		Current state of the technology module ▶ State machine (□ 25)
scStatusBasicMotion	L_TB2P_scStatusBasicMotion	Structure of the status data You can find information on status data here: "Basic Motion Base" reference manual
IrActVel	LREAL	Current speed • Unit: unit / s
IrSetVelOut	LREAL	Setpoint speed • Unit: unit / s
IrActPos	LREAL	Current position • Unit: unit
IrSetPosOut	LREAL	Setpoint position • Unit: unit
IrActFollowingError	LREAL	Current following error • Unit: unit
scSignalFlow	L_TS2P_scSF_FlexCamState	Structure of the signal flow ▶ L_TS2P_scSF_FlexCamState (□ 20)

Designator	Data type	Description	
xSynchronised	BOOL	TRUE	The y axis is synchronous with the cam.
xAccDecSync	BOOL	TRUE	The synchronisation function is active. The axis is synchronized or desynchronized; i.e. the clutch opens or closes.
xCammingBusy	BOOL	TRUE	The cam is executed.
xEndOfProfile	BOOL	Last cycle in the current cam profile	
		- The current values are extrapolated for detection. - The signal is applied for one clock cycle.	
		FALSE	The x-curve position jumps to the next or previous profile pulse.
		TRUE	
		FALSE	The x-curve position is not zero and no cycle transition has occurred.
IrOffsetPosX	LREAL	Position offset between the master position and the x position of the cam	
		• Unit: unit	
IrOffsetPosY	LREAL	Position offset between the y position and the slave axis position	
		• Unit: unit	
wActiveCamTable	WORD	Currently switched cam	
		1	Cam 1
		2	Cam 2
		3	Cam 3
		4	Cam 4
xCamSequencerActive	BOOL	TRUE	Switching sequence for cams is active Cams are executed according to the switching sequence in the <i>eCamSequenceMode</i> parameter. ▶ Specify the switching sequence for cams

5.3

Parameter

L_TS2P_scPar_FlexCamState

Designator	Data type	Description								
IrVel	LREAL	Speed for motions activated via the scCtrlBasicMotion structure. You can find information on status data here: "Basic Motion Base" reference manual - Unit: unit/s - Initial value: 3600								
IrAcc	LREAL	Acceleration for motions activated via the scCtrlBasicMotion structure. Specification of the maximum velocity variation which is to be used for acceleration. - Unit: unit/s² - Initial value: 36000								
IrDec	LREAL	Deceleration for motions activated via the scCtrlBasicMotion structure. Specification of the maximum speed variation which is to be used for deceleration to standstill. - Unit: unit/s² - Initial value: 100								
IrJerk	LREAL	Jerk for motions activated via the scCtrlBasicMotion structure. - Unit: unit/s³ - Initial value: 0								
eDirection	MC_DIRECTION	Traversing direction: <i>mcCurrentDirection</i>: Retain current direction (only in case of modulo axis) <i>mcPositiveDirection</i>: Positive direction <i>mcNegativeDirection</i>: Negative direction <i>mcShortestWay</i>: Shortest distance (only in case of modulo axis) - Initial value: <i>mcPositiveDirection</i>								
scHomeExtTP	MC_TRIGGER_REF	Transfer of an external touch probe event: - Only relevant for "external encoder" touch probe configuration. - For describing the MC_TRIGGER_REF structure, see the MC_TouchProbe function block.								
eSyncMode	L_TS2P_SyncModeFlexCam	Mode for the clutch-in/declutch process ▶ Clutching in to the cam (□ 58) ▶ Declutching from the cam (□ 67) - Initial value: 0 (profile generator absolute) <table><tr><td>0</td><td>"Profile generator absolute": Profile-based coupling</td></tr><tr><td>4</td><td>"CAM absolute": Path-based coupling to the cam</td></tr><tr><td>10</td><td>"Instant absolute": Immediate coupling; the slave position is set to the y position.</td></tr><tr><td>11</td><td>"Instant relative": Immediate coupling; the slave position is set to the y position with a relative reference.</td></tr></table>	0	"Profile generator absolute": Profile-based coupling	4	"CAM absolute": Path-based coupling to the cam	10	"Instant absolute": Immediate coupling; the slave position is set to the y position.	11	"Instant relative": Immediate coupling; the slave position is set to the y position with a relative reference.
0	"Profile generator absolute": Profile-based coupling									
4	"CAM absolute": Path-based coupling to the cam									
10	"Instant absolute": Immediate coupling; the slave position is set to the y position.									
11	"Instant relative": Immediate coupling; the slave position is set to the y position with a relative reference.									
eAllowedDirection	L_TB2P_AllowedDirection	Clutch-in direction relating to the movement of the master axis The coupling process is started when the master axis rotates in the valid direction. ▶ Clutching-in with "Profile generator absolute" coupling mode (□ 59) ▶ Clutching-in with "CAM absolute" coupling mode (□ 61) - Initial value: 0 (<i>mcCurrentDirection</i>) <table><tr><td>-1</td><td><i>mcNegativeDirection</i>: Clutch-in in negative direction of the master axis</td></tr><tr><td>0</td><td><i>mcCurrentDirection</i>: Clutch-in in both directions of the master axis</td></tr><tr><td>1</td><td><i>mcPositiveDirection</i>: Clutch-in in positive direction of the master axis</td></tr></table>	-1	<i>mcNegativeDirection</i> : Clutch-in in negative direction of the master axis	0	<i>mcCurrentDirection</i> : Clutch-in in both directions of the master axis	1	<i>mcPositiveDirection</i> : Clutch-in in positive direction of the master axis		
-1	<i>mcNegativeDirection</i> : Clutch-in in negative direction of the master axis									
0	<i>mcCurrentDirection</i> : Clutch-in in both directions of the master axis									
1	<i>mcPositiveDirection</i> : Clutch-in in positive direction of the master axis									
IrMasterSyncInDist	LREAL	Distance of the clutch-in movement of the master axis in the path-based coupling mode (<i>eSyncMode</i> parameter = 4) ▶ Clutching-in with "CAM absolute" coupling mode (□ 61) - Unit: Units - Initial value: 100								

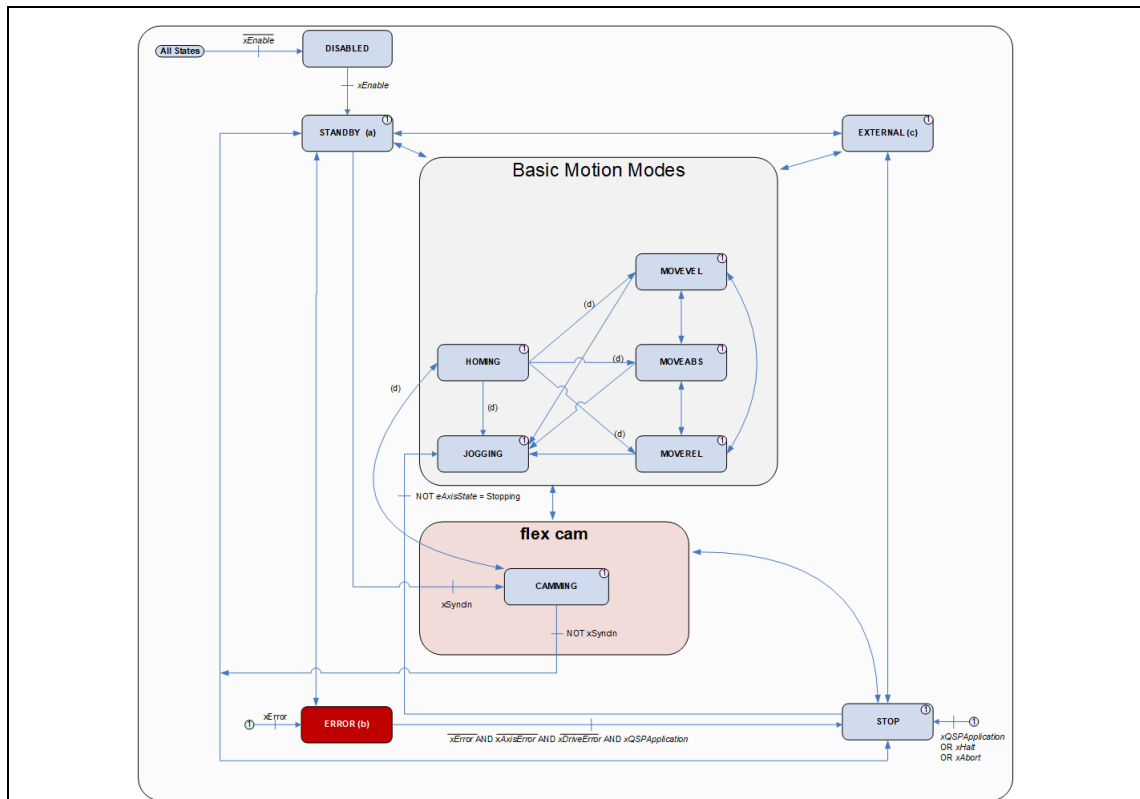
Designator	Data type	Description
IrMasterSyncInPos	LREAL	The master setpoint position in the path-based coupling mode (<i>eSyncMode</i> parameter = 4) from which the clutch is fully closed. ▶ Clutching-in with "CAM absolute" coupling mode (61) • Unit: Units • Initial value: 0
IrMasterSyncOutDist	LREAL	Distance of the declutch movement of the master axis in the path-based coupling mode (<i>eSyncMode</i> parameter = 4) ▶ Clutching-in with "CAM absolute" coupling mode (61) • Unit: Units • Initial value: 100
IrSlaveSyncOutPos	LREAL	Declutch setpoint position of the slave axis in the ... • path-based coupling mode (<i>eSyncMode</i> parameter = 4) • profile-based coupling mode (<i>eSyncMode</i> = 0) In this position, the slave axis is stopped when the declutch process has been completed. ▶ Declutching in "CAM absolute" coupling mode (69) ▶ Declutching in "Profile generator absolute" coupling mode (67) • Unit: Units • Initial value: 0
IrSyncVel	LREAL	Maximum speed at which the clutch-in/declutch process in <i>eSyncMode</i> mode = 0 (profile generator absolute) is to be carried out. ▶ Clutching-in with "Profile generator absolute" coupling mode (59) ▶ Declutching in "Profile generator absolute" coupling mode (67) • Unit: Units/s • Initial value: 100
IrSyncAcc	LREAL	Acceleration for the clutch-in/declutch process in <i>eSyncMode</i> mode = 0 (profile generator absolute) Specification of the maximum velocity variation which is to be used for acceleration. ▶ Clutching-in with "Profile generator absolute" coupling mode (59) ▶ Declutching in "Profile generator absolute" coupling mode (67) • Unit: Units/s ² • Initial value: 100
IrSyncDec	LREAL	Deceleration for the clutch-in/declutch process in <i>eSyncMode</i> mode = 0 (profile generator absolute) Specification of the maximum speed variation which is to be used for deceleration to standstill. ▶ Clutching-in with "Profile generator absolute" coupling mode (59) ▶ Declutching in "Profile generator absolute" coupling mode (67) • Unit: Units/s ² • Initial value: 100
IrSyncJerk	LREAL	Jerk for the clutch-in/declutch process in <i>eSyncMode</i> mode = 0 (profile generator absolute) ▶ Clutching-in with "Profile generator absolute" coupling mode (59) ▶ Declutching in "Profile generator absolute" coupling mode (67) • Unit: units/s ³ • Initial value: 1 000 000
xCamCyclic	BOOL	Driving mode of the cam ▶ Executing the axes and cam (52) • Initial value: TRUE
		TRUE The cam is executed cyclically.
		FALSE The cam is executed once.
xMasterAbsolute	BOOL	Reference to the position of the master axis • Initial value: TRUE
		TRUE Absolute reference between the position of the master axis and the cam
		FALSE Relative reference between the position of the master axis and the cam

Designator	Data type	Description
xSlaveAbsolute	BOOL	Reference to the position of the slave axis Initial value: TRUE
		TRUE Absolute reference between the position of the slave axis and the cam
		FALSE Relative reference between the position of the slave axis and the cam (initial value)
eOffsetModeX L_TS2P_OffsetMode		Mode for accepting the offset for the master axis (<i>IrSetOffsetPosX</i> input) ► Offset for the master and slave axis (79) - Initial value: 0 (x_zero)
		0 x_zero: Acceptance of the offset in the "zero crossing" of the cam
		1 Instant absolute: Immediate acceptance of the offset
		2 Profile generator absolute: Acceptance of the offset via the ramp generator with the parameters <i>IrSetOffsetScalingXVel</i> <i>IrSetOffsetScalingXAcc</i> <i>IrSetOffsetScalingXDec</i> <i>IrSetOffsetScalingXJerk</i>
eOffsetModeY L_TS2P_OffsetMode		Mode for accepting the offset for the slave axis (<i>IrSetOffsetPosY</i> input) ► Offset for the master and slave axis (79) - Initial value: 0 (x_zero)
		0 x_zero: Acceptance of the offset in the "zero crossing" of the cam
		1 Instant absolute: Immediate acceptance of the offset
		2 Profile generator absolute: Acceptance of the offset via the ramp generator with the parameters <i>IrSetOffsetScalingYVel</i> <i>IrSetOffsetScalingYAcc</i> <i>IrSetOffsetScalingYDec</i> <i>IrSetOffsetScalingYJerk</i>
IrSetOffsetScalingXVel	LREAL	Limitation of the speed for compensating an offset and scaling change ► Scaling the position via the ramp generator (74) - Unit: Units/s - Initial value: 100
IrSetOffsetScalingXAcc	LREAL	Limitation of the acceleration for compensating an offset and scaling change ► Scaling the position via the ramp generator (74) - Unit: Units/s² - Initial value: 1000
IrSetOffsetScalingXDec	LREAL	Limitation of the deceleration for compensating an offset and scaling change ► Scaling the position via the ramp generator (74) - Unit: Units/s² - Initial value: 1000
IrSetOffsetScalingXJerk	LREAL	Specification of the jerk for compensating an offset and scaling change between the master and x axis ► Scaling the position via the ramp generator (74) - Unit: units/s³ - Initial value: 1000000

Designator	Data type	Description
eScalingModeX L_TS2P_ScalingMode		Mode for accepting the scaling factor for the master axis (<i>IrSetOffsetPosX</i> input) ► Scaling the cam (□ 72) Initial value: 0 (x_zero)
	0	x_zero: Scaling in "zero crossing" of the cam
	1	Instant absolute: Absolute scaling of the position
	2	Instant relative: Relative scaling of the position, absolute scaling of the speed
	3	Profile generator absolute: Absolute scaling of the position via the ramp generator with the parameters <i>IrSetOffsetScalingXVel</i> <i>IrSetOffsetScalingXAcc</i> <i>IrSetOffsetScalingXDec</i> <i>IrSetOffsetScalingXJerk</i>
	4	Profile generator relative: Relative scaling of the position via the ramp generator with the parameters <i>IrSetOffsetScalingXVel</i> <i>IrSetOffsetScalingXAcc</i> <i>IrSetOffsetScalingXDec</i> <i>IrSetOffsetScalingXJerk</i>
eScalingModeY L_TS2P_ScalingMode		Mode for accepting the scaling factor for the slave axis (<i>IrSetOffsetPosY</i> input) ► Scaling the cam (□ 72) Initial value: 0 (x_zero)
	0	x_zero: Scaling in "zero crossing" of the cam
	1	Instant absolute: Absolute scaling of the position
	2	Instant relative: Relative scaling of the position, absolute scaling of the speed
	3	Profile generator absolute: Absolute scaling of the position via the ramp generator with the parameters <i>IrSetOffsetScalingYVel</i> <i>IrSetOffsetScalingYAcc</i> <i>IrSetOffsetScalingYDec</i> <i>IrSetOffsetScalingYJerk</i>
	4	Profile generator relative: Relative scaling of the position via the ramp generator with the parameters <i>IrSetOffsetScalingYVel</i> <i>IrSetOffsetScalingYAcc</i> <i>IrSetOffsetScalingYDec</i> <i>IrSetOffsetScalingYJerk</i>
IrSetOffsetScalingYVel LREAL		Limitation of the speed for compensating an offset and scaling change ► Scaling the cam (□ 72) ► Offset for the master and slave axis (□ 79) - Unit: Units/s - Initial value: 100
IrSetOffsetScalingYAcc LREAL		Limitation of the acceleration for compensating an offset and scaling change - Unit: Units/s² - Initial value: 1000
IrSetOffsetScalingYDec LREAL		Limitation of the deceleration for compensating an offset and scaling change - Unit: Units/s² - Initial value: 1000
IrSetOffsetScalingYJerk LREAL		Specification of the jerk for compensating an offset and scaling change between the slave and y axis - Unit: units/s³ - Initial value: 1000000

Designator	Data type	Description
xCalcCamBounds	BOOL	TRUE Extreme values of the slave axis (MP_IrSlaveMaxPos, MP_IrSlaveMinPos, MP_IrSlaveMaxVel, MP_IrSlaveMaxAcc) are calculated depending on the parameters IrMasterMaxVel and IrMasterMaxAcc.
IrMasterMaxVel	LREAL	Maximum speed of the master axis for checking the cams • Unit: unit/s • Initial value: 100
IrMasterMaxAcc	LREAL	Maximum acceleration of the master axis for checking the cams • Unit: Units/s ² • Initial value: 1000
eCamSequenceMode L_TS2P_CamSequenceMode		Switching sequence of the cams The switching sequence is enabled via the xCamSequencer input. ► Specify the switching sequence for cams (84) • Initial value: 0 (execute cam 1 cyclically)
	0	xCamSequencer = TRUE: Execute cam 1 cyclically
	1	xCamSequencer = TRUE: Execute cam 3 cyclically
	2	xCamSequencer = TRUE: • Execute cam 1 once, then • Execute cam 3 cyclically xCamSequencer = TRUE⇒FALSE: • Execute cam 3 once, then • Execute cam 1 once
	3	xCamSequencer = TRUE: • Execute cam 1 once, • Execute cam 2 once, then • Execute cam 3 cyclically xCamSequencer = TRUE⇒FALSE: • Execute cam 3 once, • Execute cam 4 once, then • Execute cam 1 once

6 State machine



① A transition to the "ERROR" or "STOP" state is possible.

(a) In the "STANDBY" state, *xEnableOperation* has to be set to TRUE.

(b) In the "ERROR" state, *xResetError* has to be set to TRUE in order to acknowledge and reset the errors.

(c) The "EXTERNAL" state is set if a function generates setpoints for the connected axis outside the technology module, e.g. **MC_CamIn**, **MC_MoveAbsolute**.

(d) *eAxisState* = "STANDSTILL"

States of the eTMState output (L_TB2P_States)

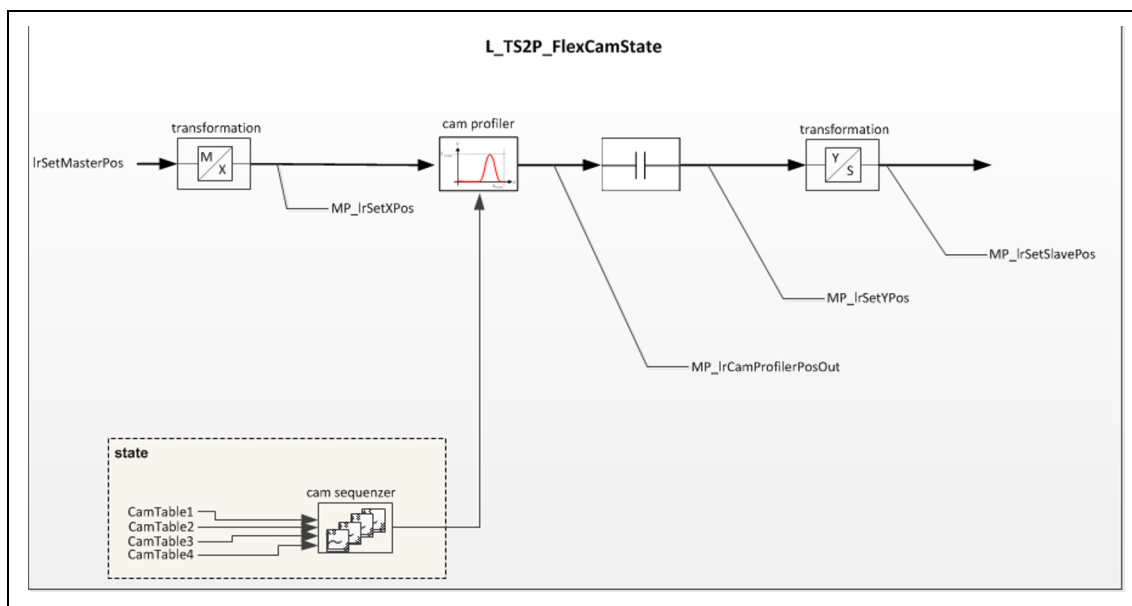
No.	L_TB2P_States	Description
-1	DISABLED	Technology module deactivated
0	STANDBY	Technology module is on standby
1	STOP	Stop/Halt active
2	HOMING	HOMING active
3	JOGGING	Manual jog active
4	MOVEVEL	Continuous travel with a defined velocity active
5	MOVEABS	Absolute positioning active
6	MOVEREL	Relative positioning active
7	EXTERNAL	An external function generates setpoints for the connected axis
8	ERROR	Error state
33	CAMMING	Coupling with cam active
1000	SYSTEMFAULT	System fault

7 Signal flow diagram

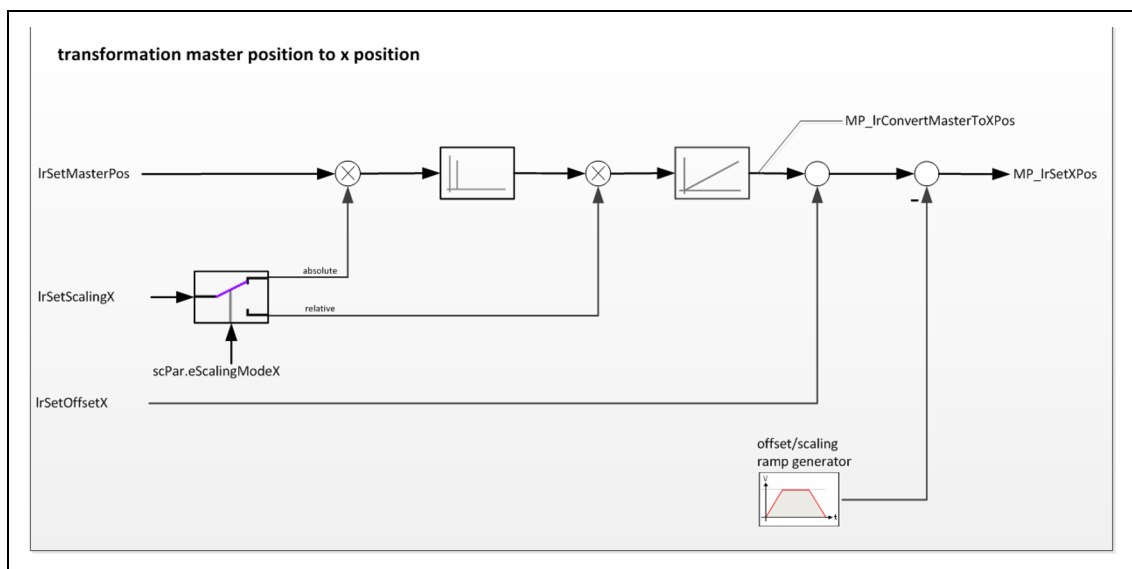
7 Signal flow diagram

The illustrations show the main signal flow of the functions implemented.

The signal flow of the additional functions such as "manual jog" is not displayed here.



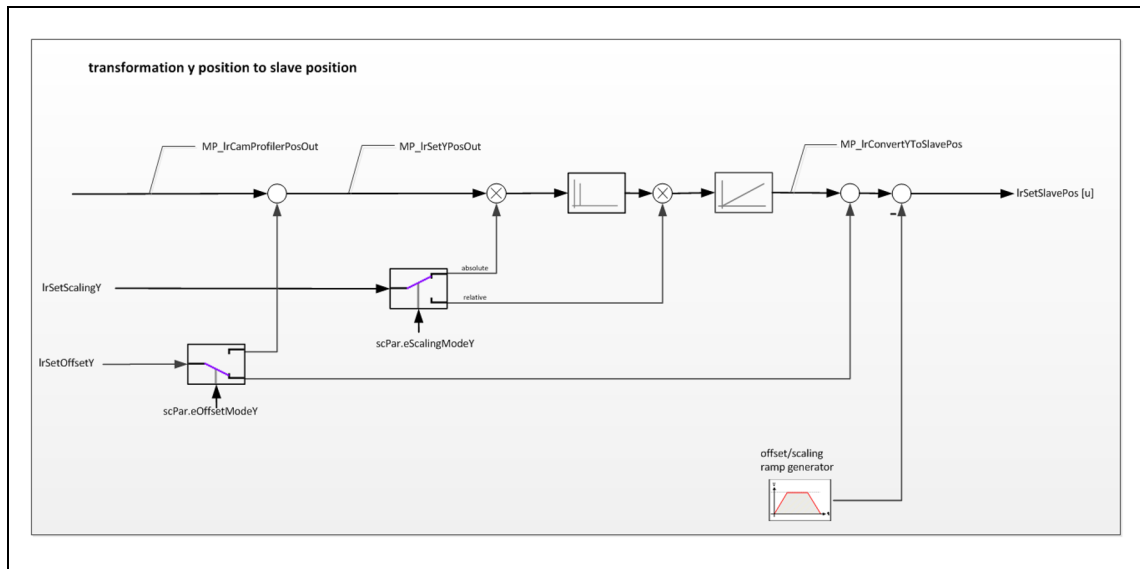
[7-1] Flex Cam signal flow



[7-2] FlexCam signal flow - Master to x position transformation

7 Signal flow diagram

7.1 Structure of the signal flow



[7-3] FlexCam signal flow - y to slave position transformation

7.1 Structure of the signal flow

L_TS2P_scSF_FlexCamState

The contents of the `L_TS2P_scSF_FlexCamState` structure are read-only and offer a practical diagnostics option within the signal flow ([Signal flow diagram](#) (27)).

Designator	Data type	Description
MP_IrSetMasterPos	LREAL	Setpoint position of the master axis. The position is read directly from the AxisRef. • Unit: Units
MP_IrSetSlavePos	LREAL	Setpoint position of the slave axis. The position is read directly from the AxisRef. • Unit: Units
MP_IrConvertMasterToXPos	LREAL	Calculated position of the x axis. This position results from the position of the master axis as well as the slave offset and slave scaling factor. • Unit: Units
MP_IrCamProfilerPosOut	LREAL	Y position from the cam generator • Unit: Units
MP_IrConvertYToSlavePos	LREAL	Resulting position of the slave axis after the clutch function. This position results from the position of the y axis as well as the master offset and the master scaling factor. • Unit: Units
MP_IrSetXPos	LREAL	Position of the x axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units
MP_IrSetXVel	LREAL	Speed of the x axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units/s
MP_IrSetXAcc	LREAL	Acceleration of the x axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units/s²

Designator	Data type	Description
MP_IrSetYPos	LREAL	Position of the y axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units
MP_IrActYPos		Current position of the y axis Here the value is converted from the current speed of the slave axis to the y axis. Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units
MP_IrSetYVel	LREAL	Speed of the y axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: units/s
MP_IrActYVel		Current speed of the y axis Here the value is converted from the current speed of the slave axis into the y axis. Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units/s
MP_IrSetYAcc	LREAL	Acceleration of the y axis as per the cam Note: This output only shows valid values in the "CAMMING" state. In other states, it is deactivated (value = 0). • Unit: Units/s ²
MP_xEndOfProfPositive	BOOL	Last cycle in the current cam profile when the master speed is positive. • The current values are extrapolated for detection. • The signal is applied for one clock cycle.
		FALSE↗ TRUE The x-curve position jumps to the next or previous profile pulse.
		FALSE No cycle transition has occurred.
MP_xEndOfProfNegative	BOOL	Last cycle in the current cam profile when the master speed is negative. • The current values are extrapolated for detection. • The signal is applied for one clock cycle.
		FALSE↗ TRUE The x-curve position jumps to the next or previous profile pulse.
		FALSE No cycle transition has occurred.
MP_IrSlaveMaxPos	LREAL	Maximum position of the slave axis • Unit: Units This value is determined from the cam applied at the TM. The parameters <i>scPar.IrMasterMaxVel</i> (master speed) and <i>scPar.IrMasterMaxAcc</i> (master acceleration) are included in the calculation. It is calculated if: • The <i>scPar.xCalcCamBounds</i> parameter = TRUE • <i>scPar.IrMasterMaxVel</i> > 0 AND <i>scPar.IrMasterMaxAcc</i> > 0
MP_IrSlaveMaxPos	LREAL	Minimum position of the slave axis • Unit: Units This value is determined from the cam applied at the TM. The parameters <i>scPar.IrMasterMaxVel</i> (master speed) and <i>scPar.IrMasterMaxAcc</i> (master acceleration) are included in the calculation. It is calculated if: • The <i>scPar.xCalcCamBounds</i> parameter = TRUE • <i>scPar.IrMasterMaxVel</i> > 0 AND <i>scPar.IrMasterMaxAcc</i> > 0

Designator	Data type	Description
MP_IrSlaveMaxVel	LREAL	Maximum velocity of the slave axis - Unit: Units/s This value is determined from the cam applied at the TM. The parameters <i>scPar.IrMasterMaxVel</i> (master speed) and <i>scPar.IrMasterMaxAcc</i> (master acceleration) are included in the calculation. It is calculated if: - The <i>scPar.xCalcCamBounds</i> parameter = TRUE <i>scPar.IrMasterMaxVel</i> > 0 AND <i>scPar.IrMasterMaxAcc</i> > 0
MP_IrSlaveMaxAcc	LREAL	Maximum acceleration of the slave axis - Unit: Units/s² This value is determined from the cam applied at the TM. The parameters <i>scPar.IrMasterMaxVel</i> (master speed) and <i>scPar.IrMasterMaxAcc</i> (master acceleration) are included in the calculation. It is calculated if: - The <i>scPar.xCalcCamBounds</i> parameter = TRUE <i>scPar.IrMasterMaxVel</i> > 0 AND <i>scPar.IrMasterMaxAcc</i> > 0

7.2

Structure of the access points

L_TS2P_scAP_FlexCamState

The access points (AP) can be used to influence signals. In the initial state, the access points do not have any effect.

Each access point acts as an alternative branch and is activated via an OR operation or a switch.

Designator	Data type	Description
AP_xCalcCamProfiler	BOOL	TRUE The curve generator is already calculated in the "STANDBY" state and the setpoints for the Y axis are set.
AP_xSetValueMode	BOOL	TRUE <i>AP_eSetValueMode</i> access point enabled
AP_eSetValueMode L_MC1P_SetValueMode		Mode for the setpoint selection: Pos: Position Vel: Velocity PosVel: Position + velocity VelAcc: Velocity + acceleration PosVelAcc: Position + velocity + acceleration

8 Description of the basic functions

Overview of the basic functions

- [Manual jog \(jogging\)](#) (📖 32)
- [Homing](#) (📖 34)
- [QSP application](#) (📖 37)
- [Halt](#) (📖 38)
- [Absolute positioning](#) (📖 39)
- [Relative positioning](#) (📖 41)
- [Continuous travel with a defined velocity](#) (📖 44)
- [Aborting and completing a positioning process](#) (📖 47)
- [Override for speed](#) (📖 49)

8 Description of the basic functions

8.1 Manual jog (jogging)

8.1 Manual jog (jogging)

Prerequisite

- The axis is enabled (*xReadyForMotion* = TRUE).

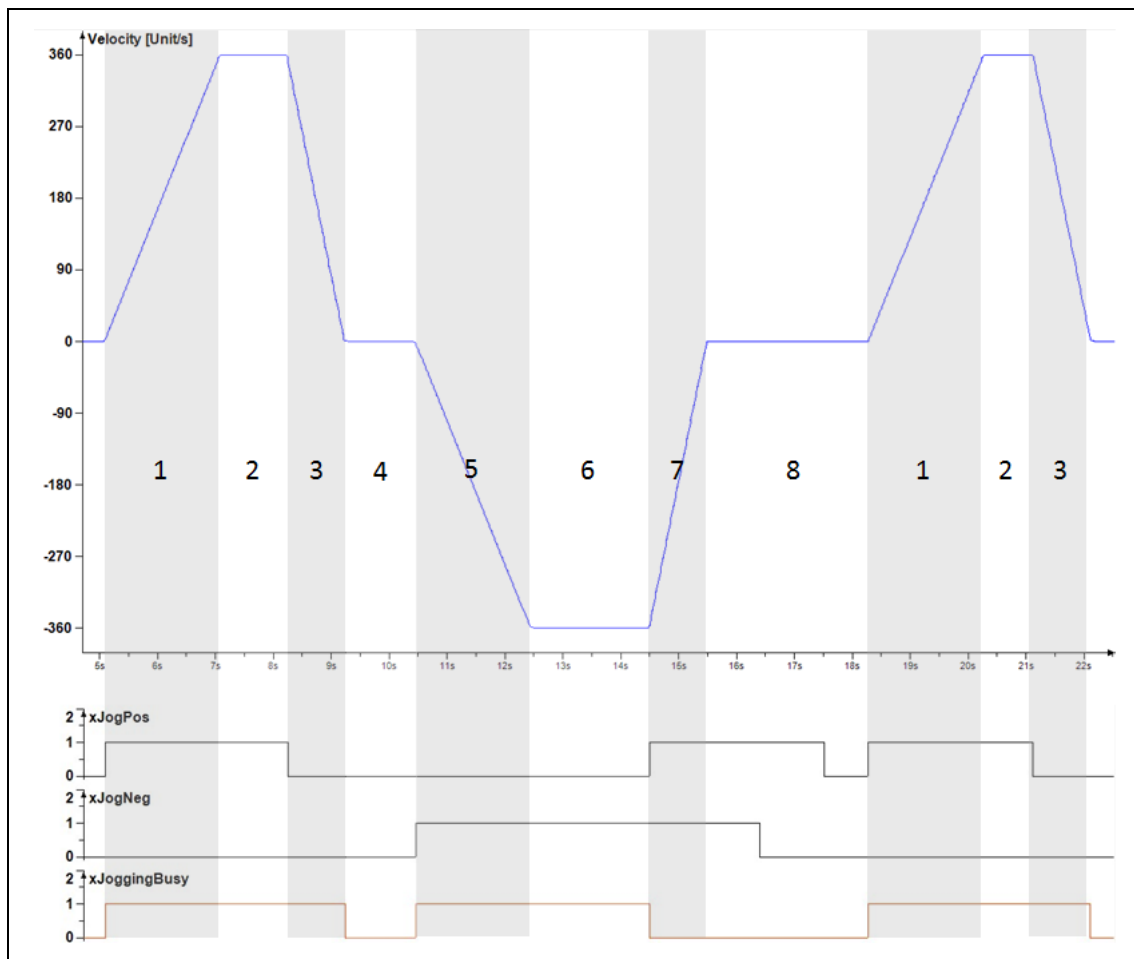
Execution

With the *xJogPos* input = TRUE, the axis is traversed in the positive direction and with the *xJogNeg* input = TRUE, it is traversed in the negative direction. The axis is traversed as long as *xJogPos* or *xJogNeg* remain set to TRUE.

The current travel command cannot be replaced by the other jog command. If *xJogPos* = TRUE and *xJogNegPos* = TRUE, the axis brakes into standstill and the *eTMState* status output changes to the "ERROR" state.

Only if both inputs have been reset, the technology module changes back to the "STANDBY" state.

Travel diagram



No	xJogPos	xJogNeg	xJogging Busy	eTMState	Info
1	FALSE → TRUE	FALSE	FALSE → TRUE	STANDBY → JOGGING	The axis accelerates to the positive manual speed 360 units/s with 180 unit/s².
2	TRUE	FALSE	TRUE	JOGGING	The axis travels constantly with 360 units/s.
3	FALSE → TRUE	FALSE	TRUE	JOGGING	The axis decelerates to a standstill with 360 unit/s².
4	FALSE	FALSE	TRUE → FALSE	JOGGING → STANDBY	The axis has reached a standstill.
5	FALSE	FALSE → TRUE	FALSE → TRUE	STANDBY → JOGGING	The axis accelerates to the negative manual speed -360 units/s with 180 unit/s².
6	FALSE	TRUE	TRUE	JOGGING	The axis travels constantly with -360 units/s.
7	TRUE	TRUE	TRUE → FALSE	ERROR	The axis decelerates to a standstill with 360 unit/s².
8	FALSE	FALSE	FALSE	ERROR → STANDBY	The axis is at a standstill and changes to "STANDBY" if both inputs xJogPos and xJogNeg have the value FALSE.

Parameters to be set

The parameters for manual jog can be found in the AXIS_REF in subindex 181 ... 184.

The parameter values can be changed during operation. They are accepted and become effective immediately when setting the inputs xJogPos = TRUE or xJogNeg = TRUE.

The manual jog parameters from the PLC program can also be written via the L_MC1P_SetBasicParameter block.

8.2 Homing

Prerequisites

- The technology module is in "STANDBY" mode.
- The axis is enabled (*xReadyForMotion* = TRUE).

Execution

With a rising edge (FALSE→TRUE) at the *xHomeExecute* input, homing is started (output *xHomingBusy* = TRUE). The axis travels until the home position is reached.

When the reference switch has been reached, *xisHomed* switches to TRUE.

When the homing process has been completed successfully, *xHomingDone* changes to TRUE.

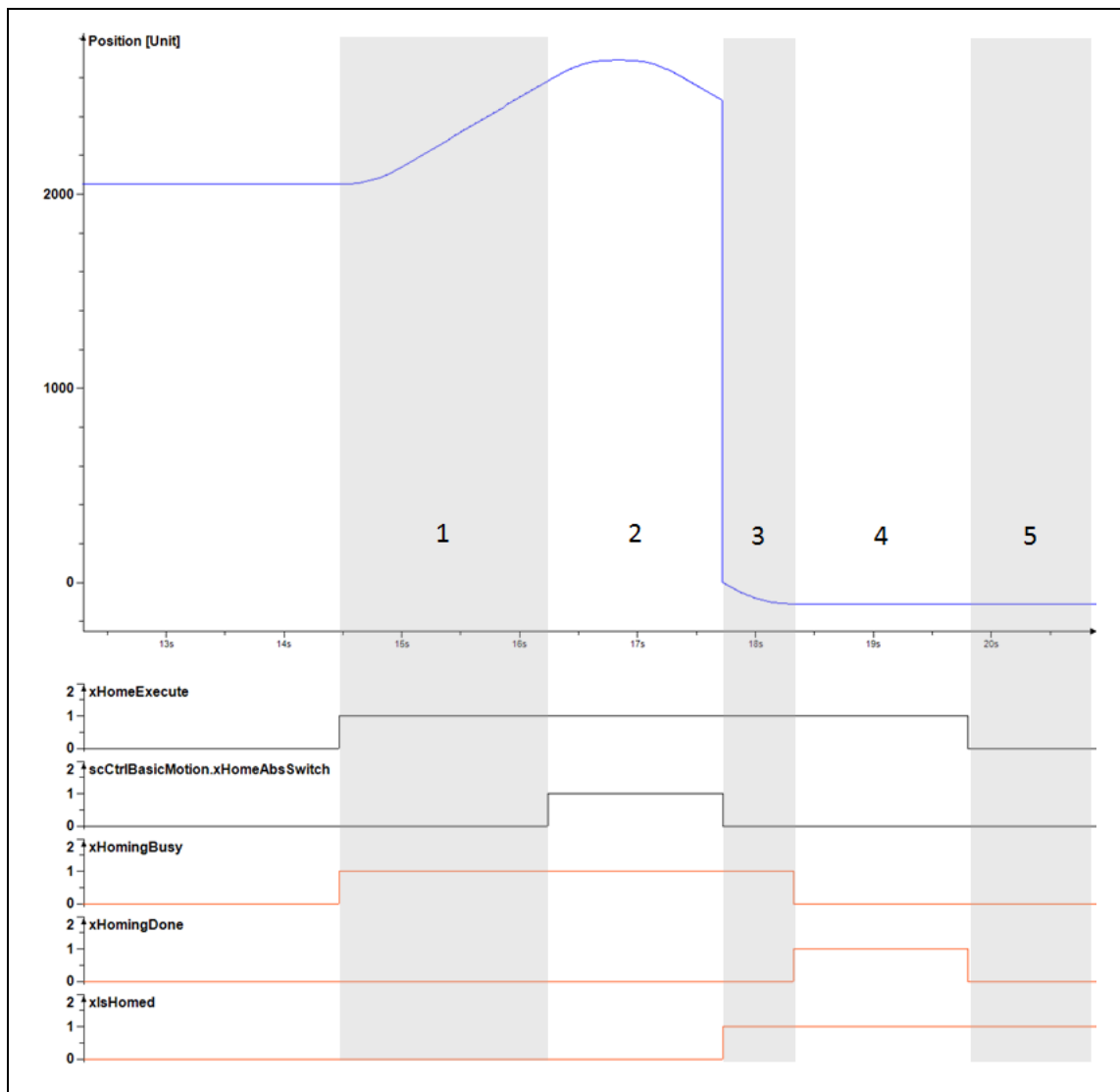
If *xHomeExecute* = FALSE, the state is changed to "STANDBY" and *xHomingDone* is set = FALSE.

Abort of the homing process

The function is aborted via the *xHalt* input.

Homing is not interrupted if *xHomeExecute* is set to = FALSE early.

Travel diagram



[8-1] Homing in the CwRpCwRn module with the home position "0"

No	xHome Execute	xHome AbsSwitch	xHoming Busy	xHoming Done	xisHomed	eTMState	Info
1	FALSE → TRUE	FALSE	FALSE → TRUE	FALSE	FALSE	STANDBY → HOMING	The axis starts homing in positive direction.
2	TRUE	TRUE → FALSE	TRUE	FALSE	FALSE	HOMING	The axis changes the direction of rotation due to the positive edge of <i>xHomeAbsSwitch</i> .
3	TRUE	FALSE → TRUE	TRUE	FALSE	FALSE → TRUE	HOMING	The negative edge of <i>xHomeAbsSwitch</i> sets the position of the axis to the home position 0 units and the axis is brought to a standstill.
4	TRUE	FALSE	TRUE → FALSE	FALSE → TRUE	TRUE	HOMING	As soon as the axis has reached the standstill, <i>xHomingBusy</i> is set = FALSE and <i>xHomingDone</i> is set = TRUE. <i>xHomingDone</i> remains TRUE for as long as <i>xHomeExecute</i> is set = TRUE, but always at least for one clock cycle.
5	TRUE → FALSE	FALSE	FALSE	TRUE → FALSE	TRUE	HOMING → STANDBY	The axis is ready for operation and can be positioned in an absolute fashion.

Parameters to be set

The parameters for homing can be found in the `AXIS_REF` in subindex 70 ... 83.

The manual jog parameters from the PLC program can also be written via the `L_MC1P_SetBasicParameter` block.

8.3 QSP application

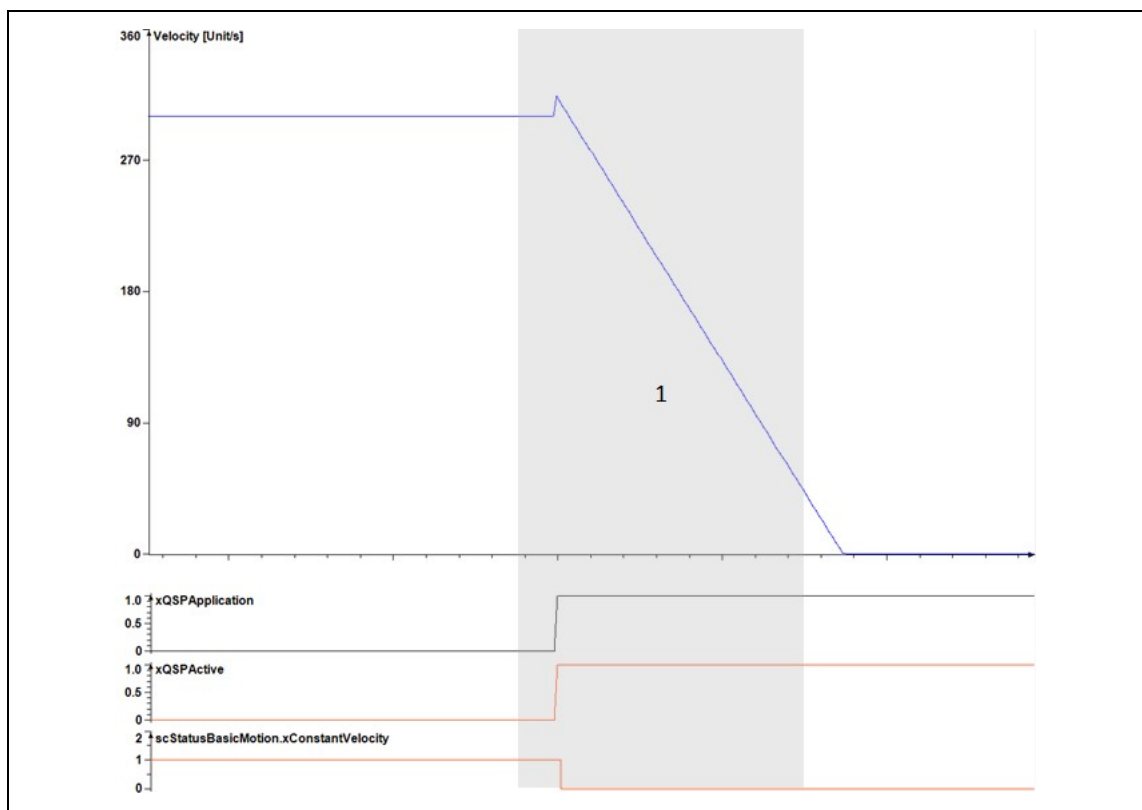
Prerequisite

- The axis is enabled (*xReadyForMotion* = TRUE).

Execution

With a rising edge (FALSE→TRUE) at the *xQSPApplication* input, the current movement of the axis is interrupted and the axis is brought to a standstill on the basis of its last current speed value on the QSP application deceleration ramp. The parameter for the QSP application deceleration ramp is set in the AXIS_REF.

Travel diagram



No	xQSP Application	xQSPActive	xConstant Velocity	eTMState	Info
1	FALSE→TRUE	FALSE→TRUE	TRUE→FALSE	MOVEVEL→STOP	The speed setpoint of the axis is set to the last current speed and brought to a standstill via the QSP deceleration ramp.

Parameters to be set

The parameters for "QSP Application" can be found in the AXIS_REF in subindex 48 and 49.

The manual jog parameters from the PLC program can also be written via the **L_MC1P_SetBasicParameter** block.

8.4 Halt

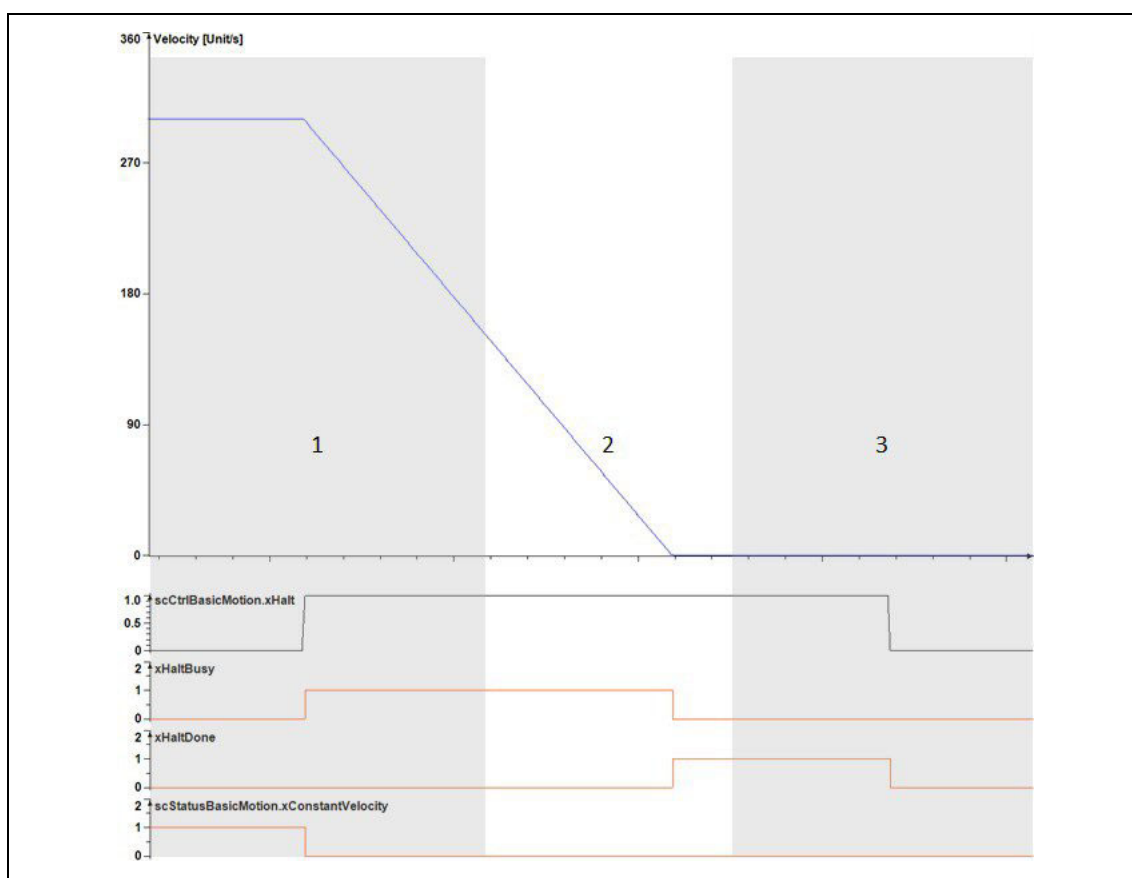
Prerequisite

- The axis is enabled ($xReadyForMotion = TRUE$).

Execution

With a rising edge ($FALSE \rightarrow TRUE$) at the `scCtrlBasicMotion.xHalt` structure input, the current movement of the axis is interrupted and the axis is brought to a standstill with a halt deceleration ramp.

Travel diagram



No	xHalt	xHaltBusy	xHaltDone	xConstant Velocity	eTMState	Info
1	$FALSE \rightarrow TRUE$	$FALSE \rightarrow TRUE$	$FALSE$	$TRUE \rightarrow FALSE$	$MOVEVEL \rightarrow STOP$	The axis decelerates with the halt deceleration ramp: $xHaltBusy = TRUE$ $xConstantVelocity = FALSE$.
2	$TRUE$	$TRUE \rightarrow FALSE$	$FALSE \rightarrow TRUE$	$FALSE$	$STOP$	The axis is brought to a standstill: $xHaltBusy = FALSE$ $xHaltDone = TRUE$
3	$TRUE \rightarrow FALSE$	$FALSE \rightarrow TRUE$	$TRUE \rightarrow FALSE$	$FALSE$	$STOP \rightarrow STANDBY$	$xHalt = FALSE$ $xHaltDone = TRUE \rightarrow FALSE$.

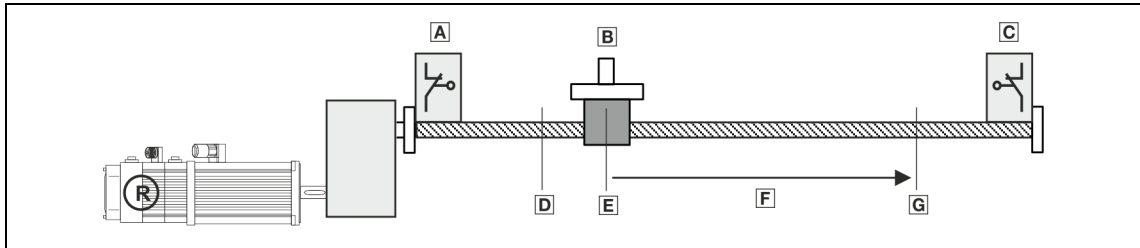
Parameters to be set

The parameter for the halt can be found in the `AXIS_REF` in subindex 186 and 187.

8 Description of the basic functions

8.5 Absolute positioning

8.5 Absolute positioning



[8-2] Example: Absolute positioning of a linear axis

Pos.	Description
A	Negative hardware limit switch
B	Load (e.g. slide)
C	Positive hardware limit switch
D	Zero position of the measuring system
E	Current actual position
F	Distance to be travelled
G	Target position (<i>lrPos_Dist</i> input)

With absolute positioning, the target position in the *lrPos_Dist* input (G) is defined as a unique absolute position, relating to the zero position of the measuring system (D). The distance to be travelled (F) results from the distance between the current actual position (E) and the absolute target position (G).

Prerequisites

- The axis is enabled (*xReadyForMotion* = TRUE).
- The axis is referenced (*xisHomed* = TRUE).

Execution

With a rising edge (FALSE→TRUE) at the *xMoveAbsExecute* input, a travel to the absolute target position in the *lrSetPos_Dist* input is started on the basis of the parameters for the motion profile (see below). The technology module changes to the "MOVEABS" state.

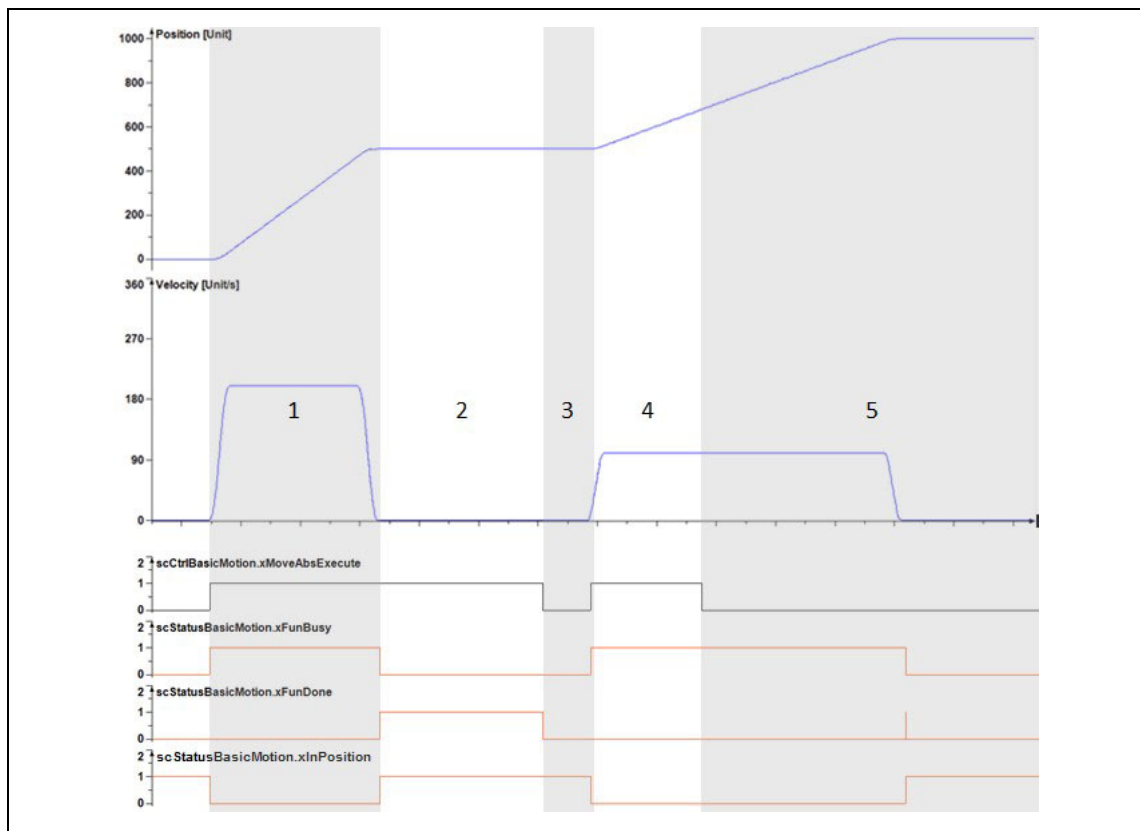
In order to reach the target position, the axis is brought to a standstill via the *lrDec* parameter. The axis reaches a standstill exactly in the target position.

After reaching the target position, the state changes back to STANDBY (*xMoveAbsExecute* = FALSE).

During the travel process, the absolute target position in the *lrPos_Dist* input can be changed, which requires triggering the Execute input for positioning again.

Positioning can be interrupted via *xAbort*, *xHalt* or *xQSPApplication*. Via *xFinishPositioning*, positioning can be continued again and completed.

Travel diagram



No	xMoveAbsExecute	xFuncBusy	xFuncDone	xInPosition	eTMState	Info
1	FALSE ↗ TRUE	FALSE ↗ TRUE	FALSE	TRUE ↘ FALSE	STANDBY → MOVEABS	The axis starts the positioning run to the absolute target position 500 units.
2	TRUE	TRUE ↘ FALSE	FALSE ↗ TRUE	FALSE ↗ TRUE	MOVEABS → STANDBY	When the target position has been reached, <i>xInPosition</i> is set to TRUE.
3	TRUE ↘ FALSE	FALSE	TRUE ↘ FALSE	TRUE	STANDBY	When <i>xMoveAbsExecute</i> is set to FALSE, the <i>xFuncDone</i> status signal changes from TRUE ↘ FALSE.
4	FALSE ↗ TRUE	FALSE ↗ TRUE	FALSE	TRUE ↘ FALSE	STANDBY → MOVEABS	The axis starts the positioning run to the absolute target position 1000 units.
5	TRUE ↘ FALSE	TRUE ↘ FALSE	FALSE ↗ TRUE ↘ FALSE	FALSE ↗ TRUE	MOVEABS → STANDBY	After the target position has been reached, <i>xFuncDone</i> remains TRUE for exactly one cycle, because <i>xMoveAbsExecute</i> = FALSE has been requested during the positioning process.

Parameters to be set

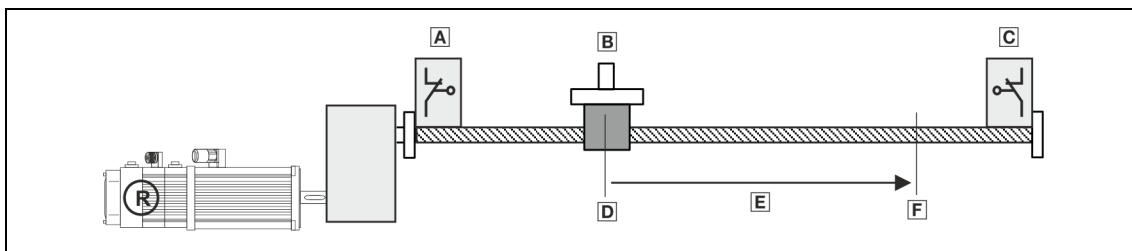
- *IrVel*, initial value: 3600 [units/s]
- *IrAcc*, initial value: 36000 [units/s²]
- *IrDcc*, initial value: 36000 [units/s²]
- *IrJerk*, initial value: 0 [units/s³]

Further parameters for absolute positioning can be found in the *AXIS_REF* in subindex 130 ... 137.

8 Description of the basic functions

8.6 Relative positioning

8.6 Relative positioning



[8-3] Example: Relative positioning of a linear axis

Pos.	Description
A	Negative hardware limit switch
B	Load (e.g. slide)
C	Positive hardware limit switch
D	Current actual position
E	Distance to be travelled (= <i>lrPos_Dist</i> input)
F	Target position (input current actual position + <i>lrPos_Dist</i>)

With relative positioning, the target position defined in the *lrPos_Dist* input corresponds to the distance to be travelled ($F = E$), meaning that the drive exactly travels the distance defined from the current actual position (D).

Prerequisite

- The axis is enabled (*xReadyForMotion* = TRUE).

Execution

With a rising edge (FALSE→TRUE) at the *xMoveRelExecute* input, a travel to the relative target position (*lrPos_Dist* input) is started on the basis of the parameters for the motion profile (see below). The technology module changes to the "MOVEREL" state.

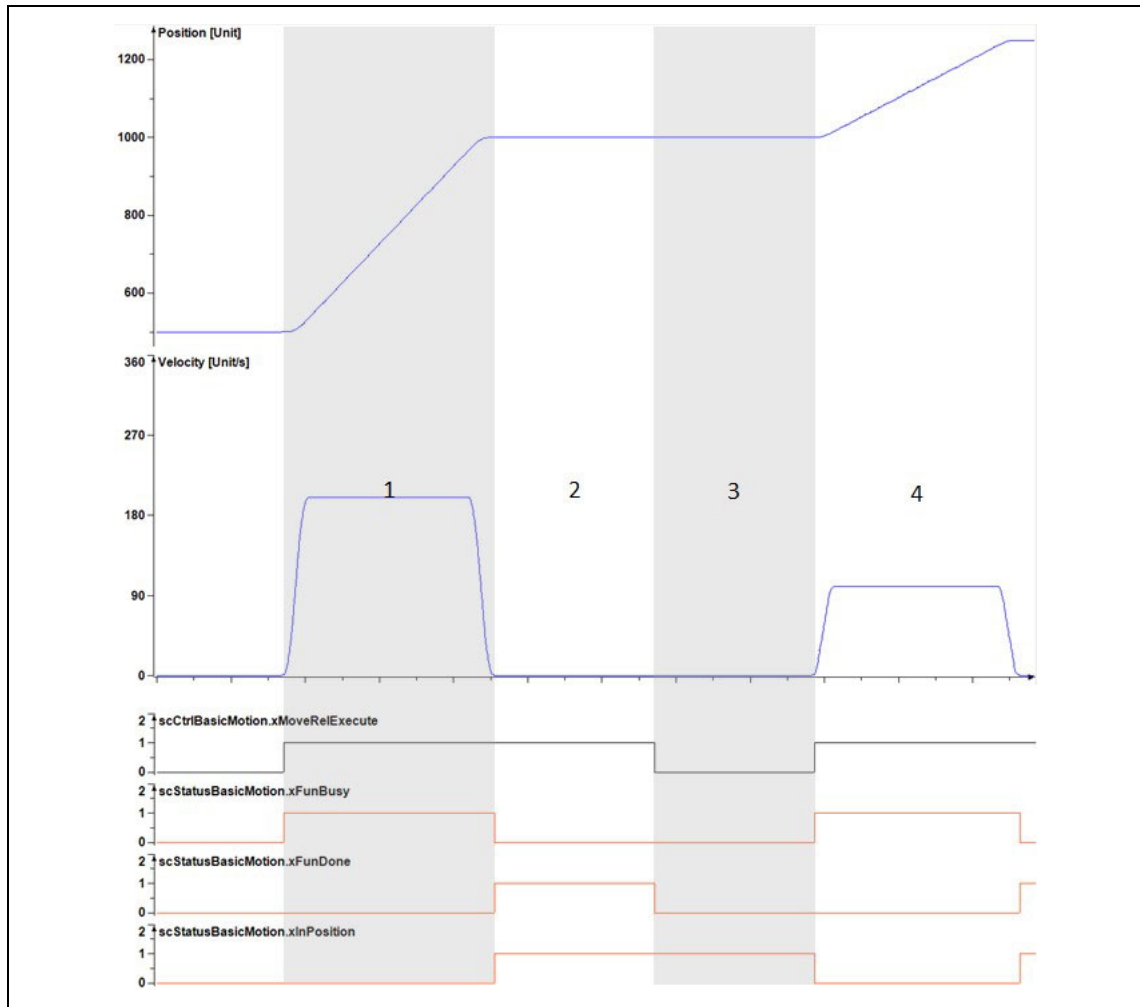
In order to reach the target position, the axis is brought to a standstill via the *lrDec* parameter. The axis reaches a standstill exactly in the target position.

After reaching the target position, the state changes back to STANDBY (*xMoveRelExecute* = FALSE).

During the travel process, the absolute target position in the *lrPos_Dist* input can be changed, which requires triggering the Execute input for positioning again.

Positioning can be interrupted via *xAbort*, *xHalt* or *xQSPApplication*. Via *xFinishPositioning*, positioning can be continued again and completed.

Travel diagram



No	xMoveRelExecute	xFuncBusy	xFuncDone	xInPosition	eTMState	Info
1	FALSE ↗ TRUE	FALSE ↗ TRUE	FALSE	FALSE	STANDBY → MOVEREL	The axis starts the positioning run to the relative target position 500 units.
2	TRUE	TRUE ↘ FALSE	FALSE ↗ TRUE	FALSE ↗ TRUE	MOVEREL → STANDBY	As soon as the relative target position has been reached, <i>xInPosition</i> and <i>xFuncDone</i> are set to TRUE.
3	FALSE ↗ TRUE	FALSE-	TRUE ↘ FALSE	TRUE	STANDBY	When <i>xMoveRelExecute</i> is set = FALSE, <i>xFuncDone</i> changes from TRUE ↘ FALSE.
4	FALSE ↗ TRUE	FALSE ↗ TRUE ↘ FALSE	TRUE ↘ FALSE ↗ TRUE	TRUE ↘ FALSE ↗ TRUE	STANDBY → MOVEREL → STANDBY	The axis starts the positioning run to the relative target position 250 units. After reaching the relative target position, <i>xInPosition</i> and <i>xFuncDone</i> are set to TRUE.

Parameters to be set

- *IrVel*, initial value: 3600 [units/s]
- *IrAcc*, initial value: 36000 [units/s²]
- *IrDcc*, initial value: 36000 [units/s²]
- *IrJerk*, initial value: 0 [units/s³]

Further parameters for relative positioning can be found in the AXIS_REF in subindex 130 ... 137.

8.7 Continuous travel with a defined velocity

Prerequisite

- The axis is enabled (*xReadyForMotion* = TRUE).

Execution

With a rising edge (FALSE→TRUE) at the *xMoveVelExecute* input, the continuous travel is started on the basis of the parameters for the motion profile (see below). The technology module changes to the "MOVEVEL" state.

The axis travels until a software limit position has been reached or a hardware limit switch has been approached:

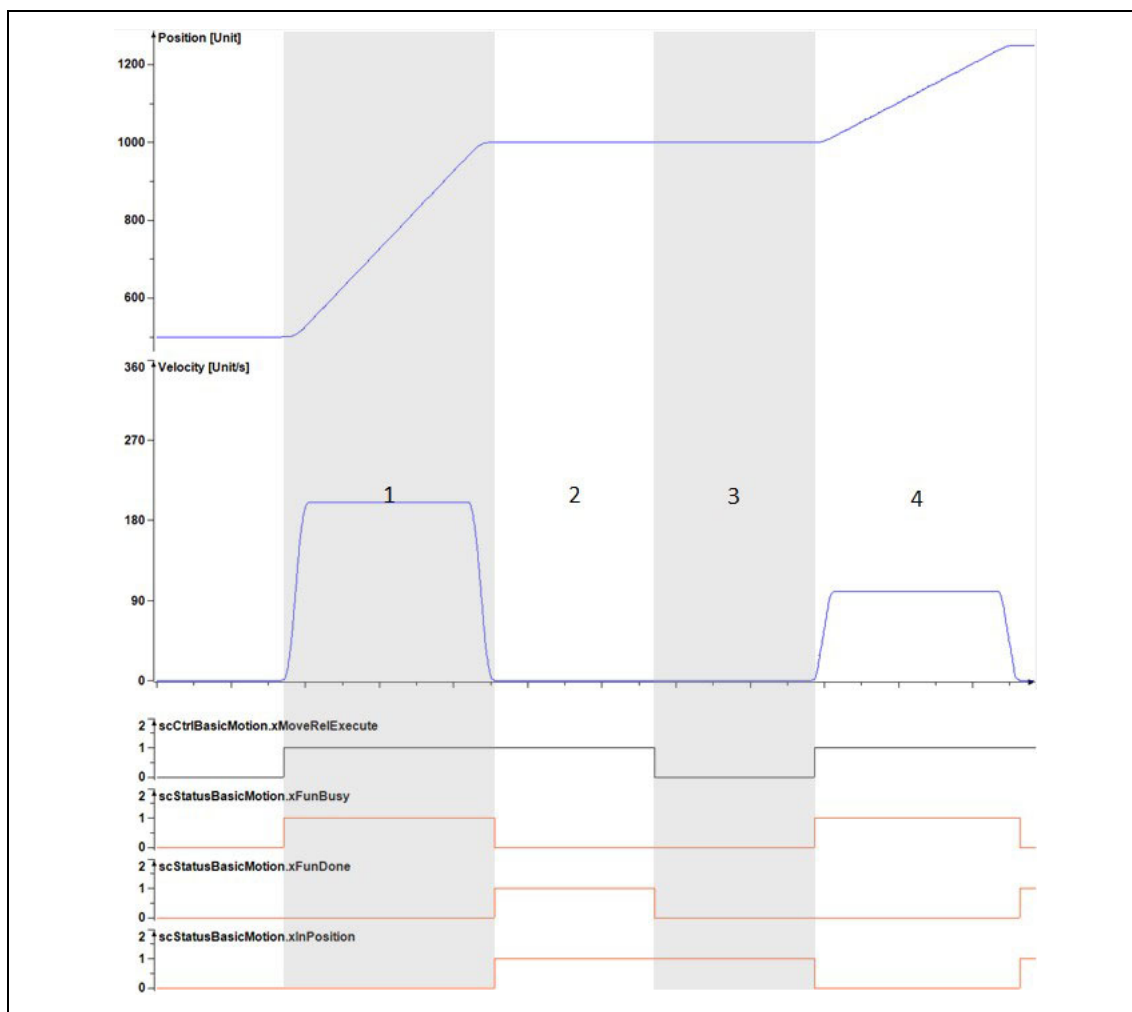
- Input *xDisableSWLimit* = FALSE
- Output *xSwLimitEnabled* = TRUE
- Output *xSwLimitSwitchPos/Neg* = TRUE
- Output *xHwLimitSwitchPos/Neg* = TRUE

When a software limit position has been reached, the axis is brought to a standstill via the *IrDec* parameter.

When a hardware limit switch has been reached, the axis is brought to a standstill via the QSP application deceleration ramp.

Then the state is changed back to "STANDBY".

Travel diagram



No	<code>xMoveVelExecute</code>	<code>xAbort</code>	<code>xFuncBusy</code>	<code>xFuncDone</code>	<code>xConstantVelocity</code>	<code>eTMState</code>	Info
1	FALSE ↗ TRUE ↘ FALSE	FALSE	FALSE ↗ TRUE	FALSE	FALSE	STANDBY → MOVEVEL	The axis accelerates to the target speed of 200 units/s.
2	FALSE	FALSE	TRUE	FALSE ↗ TRUE	FALSE ↗ TRUE	MOVEVEL	After reaching the target speed, <code>xFuncDone</code> changes from FALSE ↗ TRUE and <code>xConstantVelocity</code> changes from FALSE ↗ TRUE.
3	FALSE	FALSE ↗ TRUE	TRUE ↘ FALSE	TRUE ↘ FALSE ↗ TRUE	TRUE ↘ FALSE	MOVEVEL → STANDBY	The speed run is terminated by <code>xAbort = TRUE</code> and brought to a standstill with the profile deceleration. When standstill has been reached, <code>xFuncBusy</code> is set = FALSE.

Parameters to be set

- *IrVel*, initial value: 3600 [units/s]
- *IrAcc*, initial value: 36000 [units/s²]
- *IrDcc*, initial value: 36000 [units/s²]
- *IrJerk*, initial value: 0 [units/s³]

Further parameters for continuous travel can be found in the AXIS_REF in subindex 50 ... 53 and subindex 104 ... 105.

8.8 Aborting and completing a positioning process

Prerequisite

- The axis is enabled ($xReadyForMotion = TRUE$).

Execution

An active positioning process is aborted with a rising edge ($FALSE \rightarrow TRUE$) at the $xAbort$ input.

The axis travels to a standstill with the deceleration ramp $scPar.IrDec$.

- Exception: **TM SpeedControl** and **TM TablePositioning**

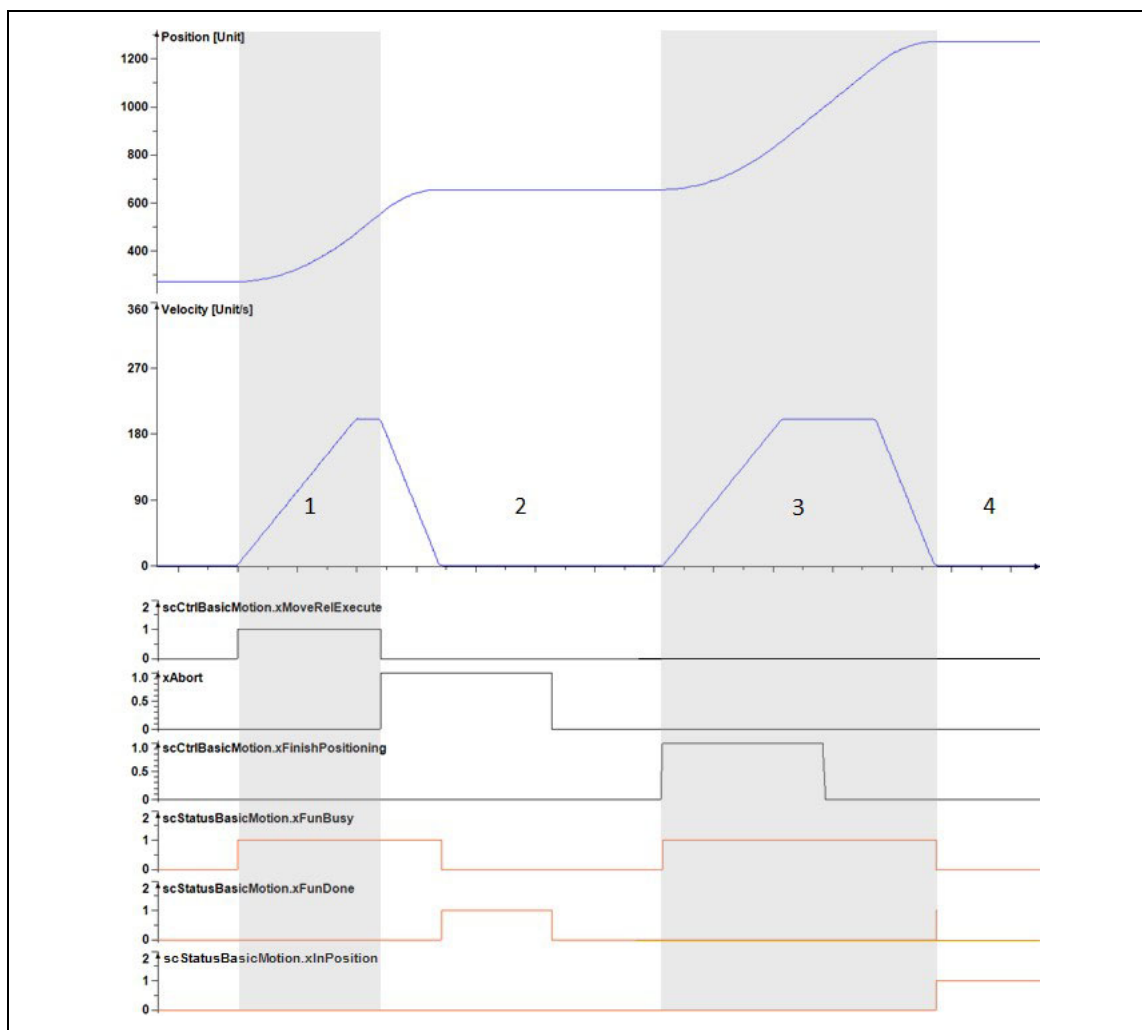
Both technology modules provide several profile data sets, one of which can be active.

If one of these profile data sets is active, the axis moves to standstill with the deceleration ramp of this active profile data set.

If no profile data set is active, the default deceleration ramp $scPar.IrDec$ is used.

The positioning process is completed with a rising edge ($FALSE \rightarrow TRUE$) at the $xFinishPositioning$ input.

Travel diagram



No	xMoveRel Execute	xAbort	xFinish Positioning	xInPosition	eTMState	Info
1	FALSE ↗ TRUE	FALSE	FALSE	FALSE	STANDBY→ MOVEREL	The axis starts the positioning process with the relative target position 1000 units.
2	TRUE↘ FALSE	TRUE↘ FALSE	FALSE	FALSE	MOVEREL→ STOP→ STANDBY	The positioning process is aborted with <i>xAbsort</i> = TRUE. The axis is brought to a standstill with the profile deceleration.
3	FALSE	FALSE ↗ TRUE	FALSE↗ TRUE↘ FALSE	FALSE	STANDBY→ MOVEREL	With <i>xFinishPositioning</i> = TRUE, the positioning process is continued.
4	FALSE	FALSE	FALSE	FALSE ↗ TRUE	MOVEREL→ STANDBY	As soon as the relative target position has been reached, <i>xInPosition</i> and <i>xFunDone</i> are set to TRUE.
	FALSE ↗ TRUE	FALSE↗ TRUE↘ FALSE	TRUE↘ FALSE↗ TRUE	TRUE↘ FALSE↗ TRUE	STANDBY→ MOVEREL→ STANDBY	The axis starts the positioning process with the relative target position 250 units. After reaching the relative target position, <i>sxInPosition</i> and <i>xFunDone</i> are set to TRUE.

8.9 Override for speed

Prerequisite

- The axis is enabled ($xReadyForMotion = \text{TRUE}$).

Execution

In order to be able to set overrides for the active profile data, the following inputs are available at the technology module:

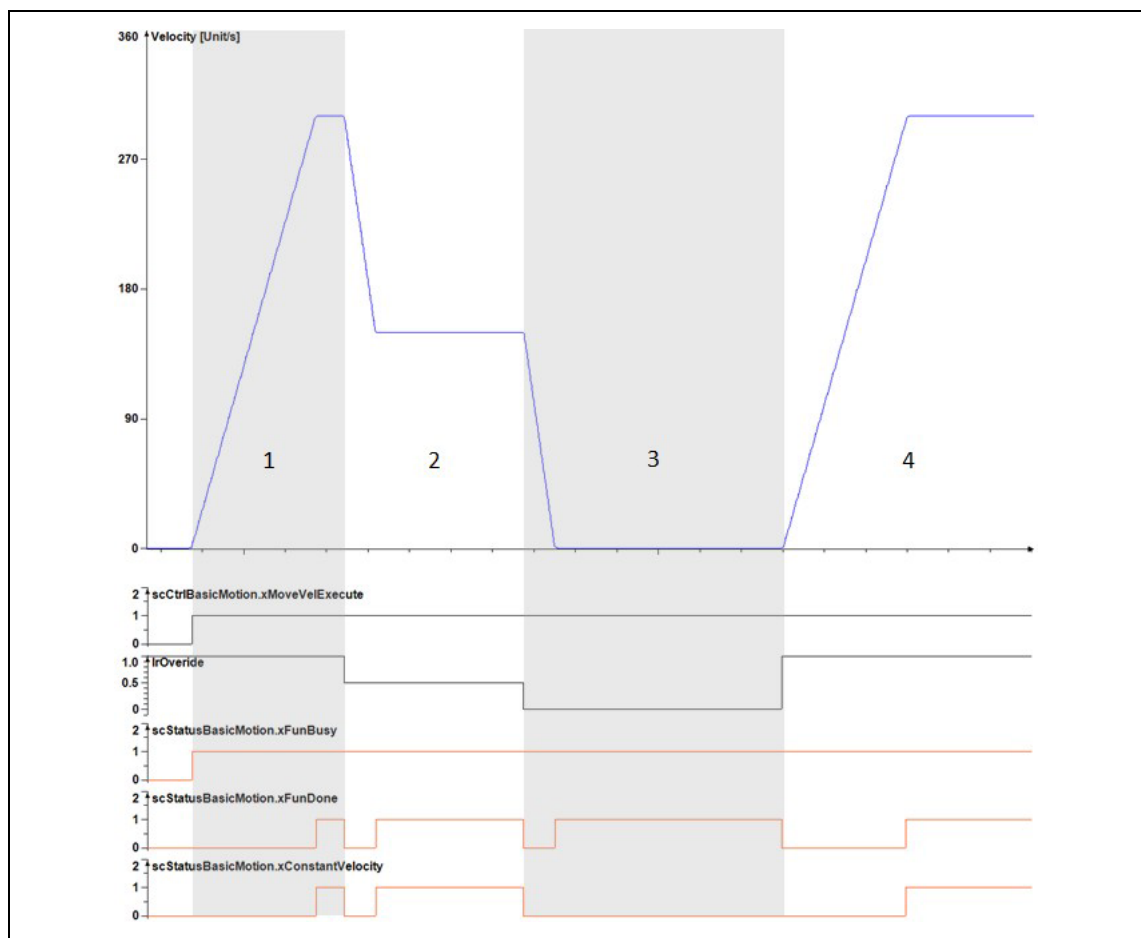
- *IrOverride*, initial value: 1.0
- *scCtrlBasicMotion.IrOverrideAcc*, initial value: 1.0 (100 %)
- *scCtrlBasicMotion.IrOverrideJerk*, initial value: 1.0 (100 %)

For profile-generating functions, separate overrides for speed, acceleration, deceleration and jerk can be set.

The values set act as a factor and are multiplied with the value active in each case.

Example

In this example, the use of the *IrOverride* input is shown.



8 Description of the basic functions

8.9 Override for speed

No	xMoveVel Execute	IrOverride	xFuncBusy	xFunDone	xConstant Velocity	eTMState	Info
1	FALSE ↗ TRUE	1	FALSE ↗ TRUE	FALSE ↗ TRUE	FALSE ↗ TRUE	STANDBY→ MOVEVEL	The axis accelerates to the target speed of 300 units/s.
2	TRUE	0.5	TRUE	TRUE↘ FALSE↗ TRUE	TRUE↘ FALSE↗ TRUE	MOVEVEL	The override value is set to 0.5 and the axis decelerates to 150 unit/s with the profile deceleration
3	TRUE	0	TRUE	TRUE↘ FALSE↗ TRUE	TRUE↘ FALSE	MOVEVEL	The override value is set to 0 and the axis is brought to a standstill to 0 unit/s with the profile deceleration
4	TRUE	1	TRUE	TRUE↘ FALSE↗ TRUE	FALSE ↗ TRUE	MOVEVEL	The override value is set to 1 and the axis accelerates to 300 unit/s with the profile deceleration

9 Description of the technology functions

9.1 Cam formats (cam handling)

9 Description of the technology functions

9.1 Cam formats (cam handling)

The input format for the cam is defined in the **MC_CAM_REF** function block, which represents a generic cam table. The data for the cams can be provided by the cam editor during runtime. An additional use of the **MC_CamTableSelect** function block is not required. The cam can be filled with either segments or point tables.

NOTICE

During the travel process of a cam, the interpolation points within the structure must not be changed. The cam data, basic conditions, or interpolation points are not copied internally, but are directly used for motion control by the TM. Changing the data has a direct impact on the active cam.

9.2 Motion profiles

The "Flex Cam" TM supports the following motion profiles:

- Straight line (linear)
- 2nd grade polynomial
- 3rd grade polynomial
- 5th grade polynomial
- Modified acceleration trapezium

The motion profiles can be selected if the grid points are specified in **MC_CAM_REF** via the **L_MC2P_CamDataPointXYVA** structure.

Criteria for the motion profiles differ depending on the application. In the following table the motion profiles are presented with different evaluation criteria. All these profiles move on the same path (from break to break).

	Speed		Acceleration		Jerk		Peak power	
Bezeichner	[%]							
2nd grade polynomial	100.00	(+)	100.00	(+)	infinite	(--)	100.00	(+)
3rd grade polynomial	100.00	(+)	200.00	(-)	32	(++)	109.08	(+)
5th grade polynomial	93.75	(+)	144.34	(0)	59.64	(++)	83.85	(++)
7th grade polynomial	109.37	(+)	187.83	(-)	52.50	(++)	134.65	(0)
Sine	78.85	(++)	123.37	(+)	infinite	(--)	48.54	(++)
Inclined sine	100.00	(+)	157.08	(0)	39.48	(++)	102.23	(+)
Modified sine	87.98	(++)	138.20	(0)	69.46	(++)	68.36	(++)
Modified acceleration trapezoid	100.00	(+)	122.20	(+)	61.42	(++)	101.33	(+)
	(++) low real mechanical wear (0) average real mechanical wear (--) high real mechanical wear							

In practice, the "5th grade polynomial" and "Modified acceleration trapezoid" motion profiles are often used.

9 Description of the technology functions

9.3 Executing the axes and cam

9.3 Executing the axes and cam

9.3.1 Executing the cam cyclically

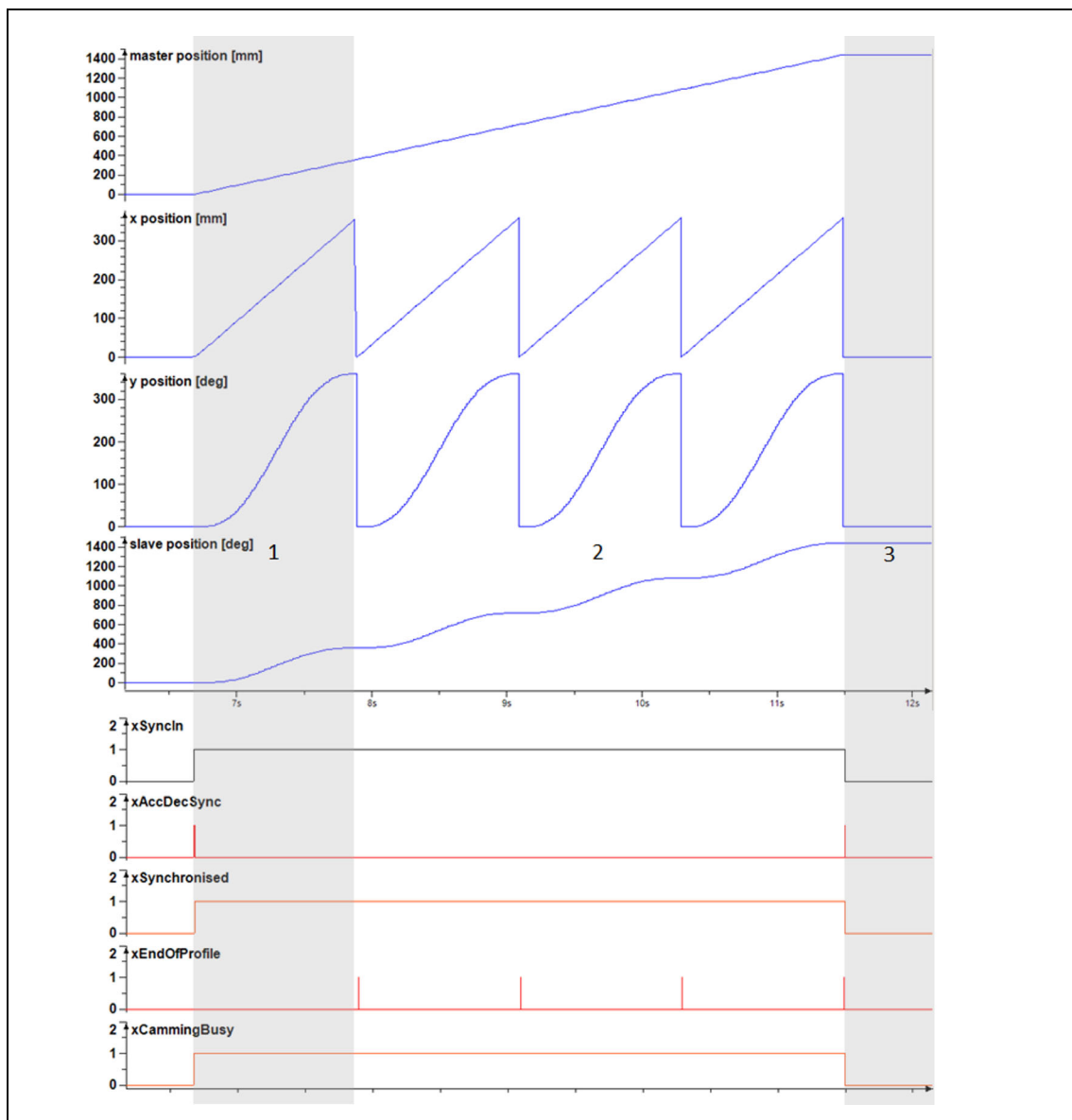
The *xCamCyclic* parameter is set to TRUE to execute the cams cyclically one after the other, i.e. after reaching the cam end point (*xEndOfProfile* output = TRUE), the cam is executed once again from its start.

If the position of the master axis is located outside the defined x axis range, it is included in the cam calculation, i.e. from the second cam the reference to the master position is relative. In this way, cam-dependent cycle lengths can be implemented without having to adapt the "external" modulo cycle length of the master axis. However, in this case the absolute assignment between the master cycle and the profile pulse is lost.

Parameters to be set

The parameters to be set are located in the [L TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.xCamCyclic*, BOOL, initial value: TRUE



[9-1] Executing the cam cyclically (absolute master, relative slave)

No	xSyncln	xCammingBusy	xSynchronised	Info
1	FALSE→TRUE	FALSE→TRUE	TRUE	A cam with the following settings is executed: xCamCyclic := TRUE // cyclic execution of the cams xMasterAbsolute := TRUE // absolute reference between master axis and x axis (parameterization) xSlaveAbsolute := FALSE // relative reference between slave axis and x axis The x axis is set absolutely to the master axis.
2	TRUE	TRUE	TRUE	After completion of the 1st cam cycle, the x axis reference is set relative to the master axis. The slave axis is traversed relatively to the y axis as per the parameterization.
3	TRUE→FALSE	TRUE→FALSE	FALSE	After completion of the 4th cycle, xSyncln = FALSE declutches from the cam.

9.3.2 Executing the cam once

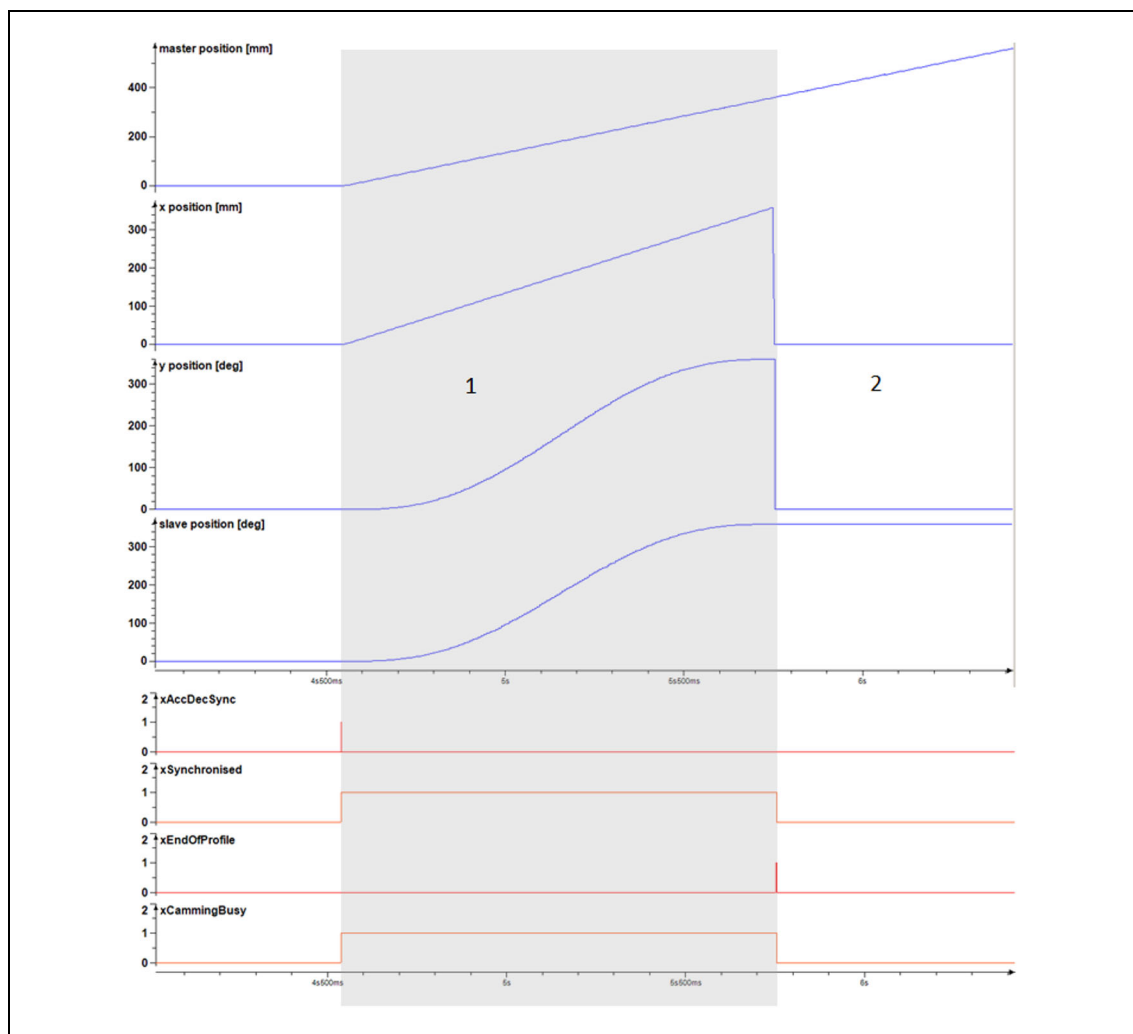
The *xCamCyclic* parameter is set to FALSE to execute the cam once, i.e. after reaching the cam end point (*xEndOfProfile* output = TRUE), the master axis stops while the setpoint for the slave axis remains unchanged.

If the master position is outside the defined cam, the last valid value for the slave axis is output.

Parameters to be set

The parameters to be set are located in the [L TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.xCamCyclic*, BOOL, initial value: TRUE



[9-2] Executing the cam once

No	xSyncIn	xCammingBusy	xEndOfProfile	Info
1	FALSE → TRUE	FALSE → TRUE	FALSE	A cam with the following settings is executed: <i>xCamCyclic</i> := FALSE // cam executed once
2	TRUE	TRUE	TRUE	After one cam cycle, the master axis stops while the setpoint for the slave axis remains unchanged. For a PLC clock cycle, <i>xEndOfProfile</i> is set to TRUE; this means that the cam processing will be completed.

9.3.3 Executing the master axis with cams of variable cycle lengths

The master axis is the reference value for the cam. The x axis is coupled with the master axis via the position without smoothing. The x axis is included in the cam profile as an input. A non-linear movement of the y axis is calculated from the cam profile. The slave axis is coupled with the y axis via the position.

This makes it possible to derive a linear movement of the master axis to a non-linear movement of the slave axis.

Reference between the master axis and x axis:

In some applications it is necessary to adapt the master value for the cam. Since the master axis cannot be controlled from the TM, an intermediate value is inserted; a virtual x axis that can only be used within the "Flex Cam" TM.

- The x axis is the direct master value for the cam and is synchronous with the master axis via position coupling.
- The x axis can be manipulated in relation to the master axis via scaling factors and offset. The specification of the scaling value has a multiplicative effect on the x axis. The specification of the offset has an additional effect on the x axis.
- The x axis has a variable cycle length that is specified in accordance with the cam format. The master axis has a constant cycle length and may not be simply modified during operation.

The *xMasterAbsolute* parameter is used to establish the reference of the position between the x axis and the master axis. This always refers to the first start or cycle of the currently active cam:

- *xMasterAbsolute* = FALSE

The x position of the cam is executed relative to the master position.

For this purpose, the starting point of the x axis is set to the start of the cam when the cam is activated. In this way, cam-dependent cycle lengths can be implemented without having to adapt the "external" modulo cycle length of the master axis. However, in this case the absolute assignment between the master cycle and the x cycle of the cam is lost.

- *xMasterAbsolute* = TRUE

The master position is included directly in the cam calculation.

For this purpose, the x position is directly set to the master position when the cam is activated. The cycle assignment between the master cycle and the x cycle of the cam is always maintained if the x cycle length corresponds to the modulo cycle length of the master axis.

If the x cycle length is set so that it does not equal the modulo cycle length of the master axis, the relative reference to the master axis is set automatically after the first cam cycle (see above, *xMasterAbsolute* = FALSE).

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *xMasterAbsolute*, BOOL, initial value: TRUE

9.3.4 Executing the slave axis with cams of variable cycle lengths

The non-linear motion profile of an actuator is generated from the linear reference of the master axis. The motion profile of an actuator is led via the slave axis. The reference value is the x axis, which is coupled with the master axis.

NOTICE

Reference between the slave axis and y axis:

In some applications, it is necessary to adapt the setpoint for the actuator.

An intermediate value is inserted so the cam does not have to be modified; a virtual y axis that can only be used within the "Flex Cam" TM.

- The y axis returns the raw value from the cam.
- The y axis can be manipulated in relation to the slave axis via scaling factors and offset. The specification of the offset has an additional effect on the y axis. The specification of the scaling factor has a multiplicative effect on the y axis.
- The setpoint from the cam (y axis) resulting from the manipulated offset and scaling factor is connected through to the slave axis.

The slave axis is coupled with the y axis via the parameters "speed", "acceleration" and "jerk". The *xSlaveAbsolute* parameter is used to establish the reference of the position between the y axis and the slave axis. This always refers to the first start or cycle of the currently active cam:

- *xSlaveAbsolute* = FALSE

When the cam is activated for the first time, an internal offset is set between the current slave position and the y starting position. This activates the cam without any step changes of the slave axis. In this way, cam-dependent cycle lengths can be implemented without having to adapt the "external" modulo cycle length of the slave axis. However, in this case the absolute assignment between the slave cycle and the y cycle of the cam is lost.

- *xSlaveAbsolute* = TRUE

The position of the slave axis is set to the y position from the cam. During the second cam cycle, the position of the slave axis is calculated relative to the y axis. The cycle assignment between the y cycle of the cam and the modulo cycle of the slave axis is always maintained if the y cycle length corresponds to the modulo cycle length of the slave axis. If the y cycle length is set so that it does not equal the modulo cycle length of the slave axis, the relative reference to the slave axis is set automatically after the first cam cycle (see above, *xMasterAbsolute* = FALSE).

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *xSlaveAbsolute*, BOOL, initial value: TRUE

9.4

Changing the cam

NOTICE

During the travel process of a cam, the interpolation points within the structure must not be changed.

The cam data, basic conditions, or interpolation points are not copied internally, but are directly used for motion control by the technology module. Changing the data has a direct impact on the currently active cam.

The adaptation of the cam during operation via the *CamTable1* input is only effective if the slave axis has reached the cam end (*xEndOfProfile* output = TRUE).

The cam end is the end point of the cam at which the y-side end point ends in the representation. This ensures that the cam is always switched over at the y-side cam end, even when there is an x offset.

A plausibility check as to whether the cams are fitting together is not carried out and must be ensured by the user.

An immediate cam change can be forced by setting the *xCamChangeInstant* input to TRUE. When a changeover is active, the data of the new cam are accepted immediately. A new coupling process does not take place.

9.5 Clutching in to the cam

If the *xSyncIn* input is set to TRUE, the slave axis clutches in to the position of the cam (resulting y position of the cam including the y offset and y scaling).

Changes in the y offset or the y scaling factor during the clutch-in process are not accepted. These parameters are internally "frozen" at the start of the clutch-in process and are only re-enabled when the slave axis is successfully coupled to the y position of the cam.

The coupling mode for the clutch-in process can be specified via the *eSyncMode* parameter of the [L_TS2P_scPar_FlexCamState](#) (📖 20):

Coupling mode <i>eSyncMode</i>	Description
0 (profile generator absolute)	The slave axis is clutched in to the y axis via the profile generator with the modified acceleration trapezoid. ▶ Clutching-in with "Profile generator absolute" coupling mode (📖 59)
4 (CAM absolute)	The slave axis is clutched in to the y axis via a cam with a 5th grade polynomial. ▶ Clutching-in with "CAM absolute" coupling mode (📖 61)
10 (Instant absolute)	The slave position is set without smoothing to the y position from the cam. ▶ Clutching-in with "Instant absolute" coupling mode (📖 63)
11 (Instant relative)	The slave axis contains the current position and is clutched-in relatively (with the current offset between the y axis and the slave axis). ▶ Clutching-in with "Instant relative" coupling mode (📖 65)

9.5.1 Clutching-in with "Profile generator absolute" coupling mode

The slave axis clutches in from its current position to the resulting y position of the cam via the profile generator and using the parameters *lrSyncVel*, *lrSyncAcc*, *lrSyncDec* and *lrSyncJerk*.

The movement is executed for the modulo axes within the cycle.

The resulting speed of the slave axis in the clutch-in phase results from the sum of the cam speed and the speed in parameter *lrSyncVel*.

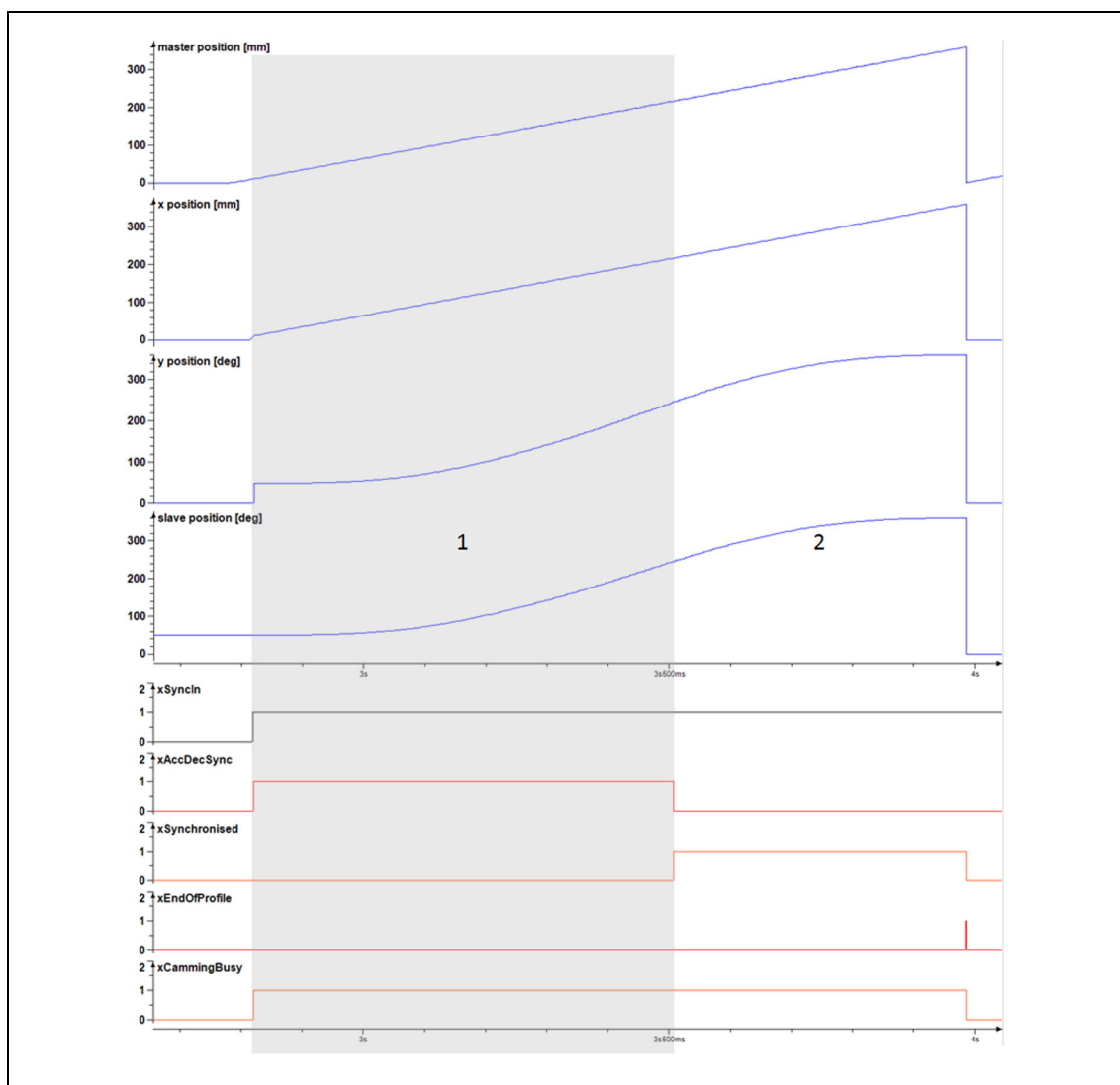
The acceleration of the slave axis in the clutch-in phase also results from the sum of the cam acceleration and the acceleration and deceleration of the coupling (parameters *lrSyncAcc*, *lrSyncDec*).

This coupling mode is independent of the movement of the master axis. The slave axis is also synchronized to the y position of the cam if the master axis is at standstill.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (□ 20) structure.

- *scPar.eSyncMode*, data type: L_TS2P_SyncModeFlexCam, initial value: "Profile generator absolute"
- *scPar.eAllowedDirection*, data type: L_TB2P_AllowedDirection, initial value: "both"
- *scPar.lrSyncVel*, data type: LREAL, initial value: 100
- *scPar.lrSyncAcc*, data type: LREAL, initial value: 1 000
- *scPar.lrSyncDec*, data type: LREAL, initial value: 1 000
- *scPar.lrSyncJerk*, data type: LREAL, initial value: 1 000 000



[9-3] Clutching in to the cam via the "Profile generator absolute" mode

No	xSyncln	xCammingBusy	xAccDecSync	xSynchronised	Info
1	FALSE → TRUE	FALSE → TRUE	FALSE → TRUE	FALSE	A cam is executed with the following settings: xCamCyclic = FALSE (one-time execution of the curve) The slave axis is clutched in to the y axis if there is a rising edge at the xSyncln input. In doing so, the slave axis is moved to the y position via the profile generator with the modified acceleration trapezoid. During the clutch-in process, xAccDecSync is set to TRUE.
2	TRUE	TRUE	FALSE	TRUE	If the slave axis has reached the y position, the coupling process is completed.

9.5.2 Clutching-in with "CAM absolute" coupling mode

The slave axis is positioned to the resulting y position of the cam in a path-based manner using a 5th grade polynomial.

In this mode, the slave axis can synchronise to a cam movement that is already running, providing the possibility that the clutch-in process takes several cam cycles, the transition to cam operation taking a bit longer.

The clutch-in direction relating to the direction of rotation of the master axis is set via the *eAllowedDirection* parameter.

The *lrMasterSyncInPos* parameter determines the position of the master axis from which the slave axis is to be synchronised.

The *lrMasterSyncInDist* parameter is used to define the distance of the master axis over which the slave axis is traversed to the curve position. The slave axis can only be synchronized to the y position of the cam while the master axis is running.

If the master axis is stopped during the clutch-in process, the slave axis is also stopped. If the master axis continues to run, the slave axis clutch-in process continues.

NOTICE

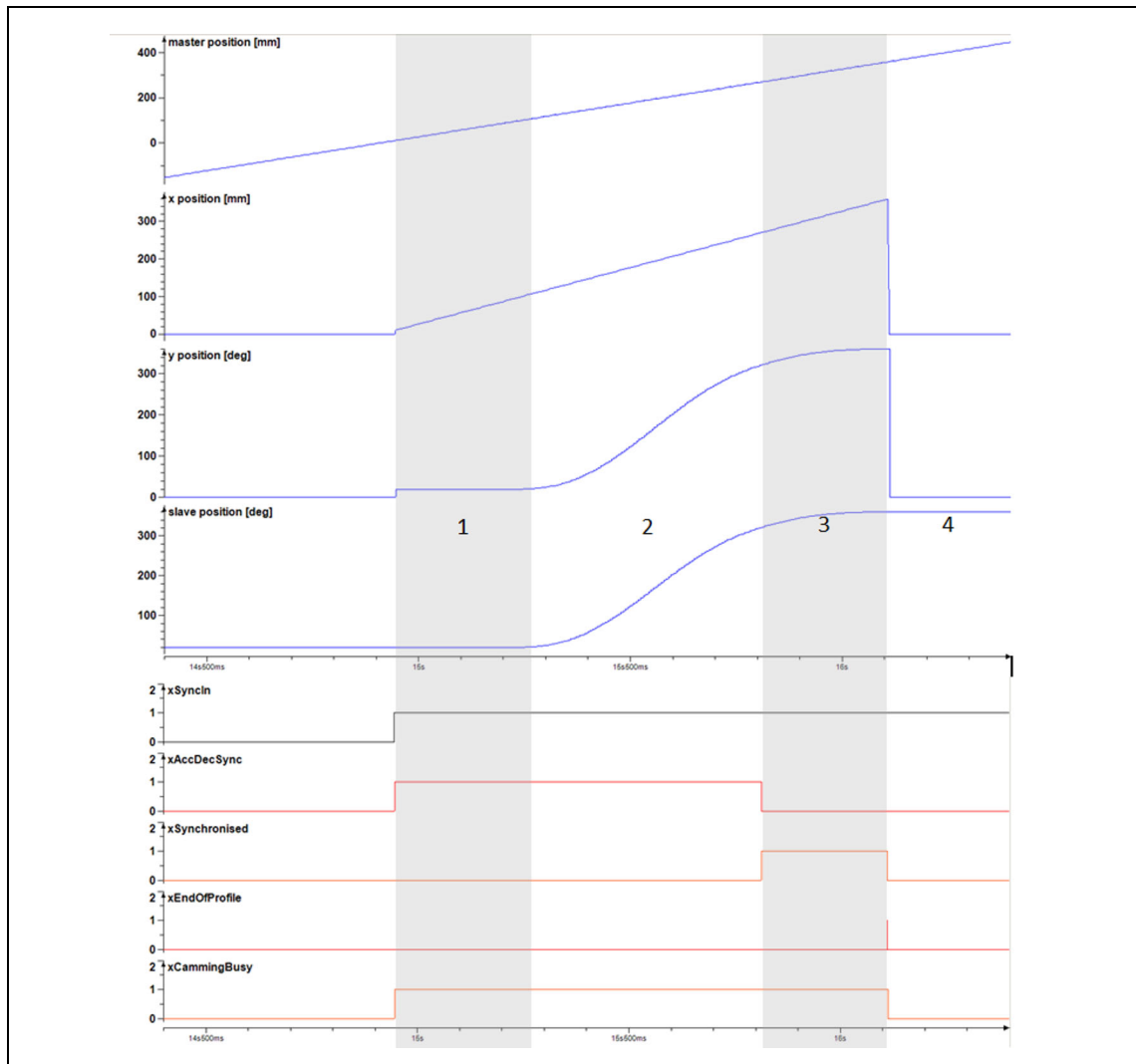
Path-based clutch-in of the slave axis with or without reversing:

If the *eAllowedDirection* parameter is set to 0 (both), the slave axis is allowed to reverse (movement against the master axis) during the clutch-in process. If reversing during the clutch-in process should be inhibited, the *eAllowedDirection* parameter must be set to 1 (positive) or the *eAllowedDirection* parameter must be set to -1 (negative).

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.eSyncMode*, data type: L_TS2P_SyncModeFlexCam, initial value: "Profile generator absolute"
- *scPar.eAllowedDirection*, data type: L_TB2P_AllowedDirection, initial value: "both"
- *scPar.lrMasterSyncInDist*, data type: LREAL, initial value: 100
- *scPar.lrMasterSyncInPos*, data type: LREAL, initial value: 0



[9-4] Clutching in to the cam via the "CAM absolute" mode

No	xSyncln	xCammingBusy	xAccDecSync	xSynchronised	Info
1	FALSE → TRUE	FALSE → TRUE	FALSE → TRUE	FALSE	A cam is executed with the following settings: xCamCyclic := FALSE // cam executed once If there is a rising edge at the xSyncln input, the slave axis is clutched in to the y axis within one PLC cycle. In doing so, the slave position is maintained. The internal offset is set between the y position and the slave position. The y position is calculated from the cam. The xAccDecSync output is set for one PLC cycle.
2	TRUE	TRUE	TRUE	FALSE	The cam reaches the end of the defined range. The xEndOfProfile status is set for one PLC cycle.
3	TRUE	TRUE	FALSE	TRUE	The slave axis reaches the position of the y axis. This completes the clutch-in process. The slave axis moves synchronously to the y axis.
4	TRUE	FALSE	FALSE	FALSE	The cam reaches the end of the defined range. xEndOfProfile is set for one PLC cycle.

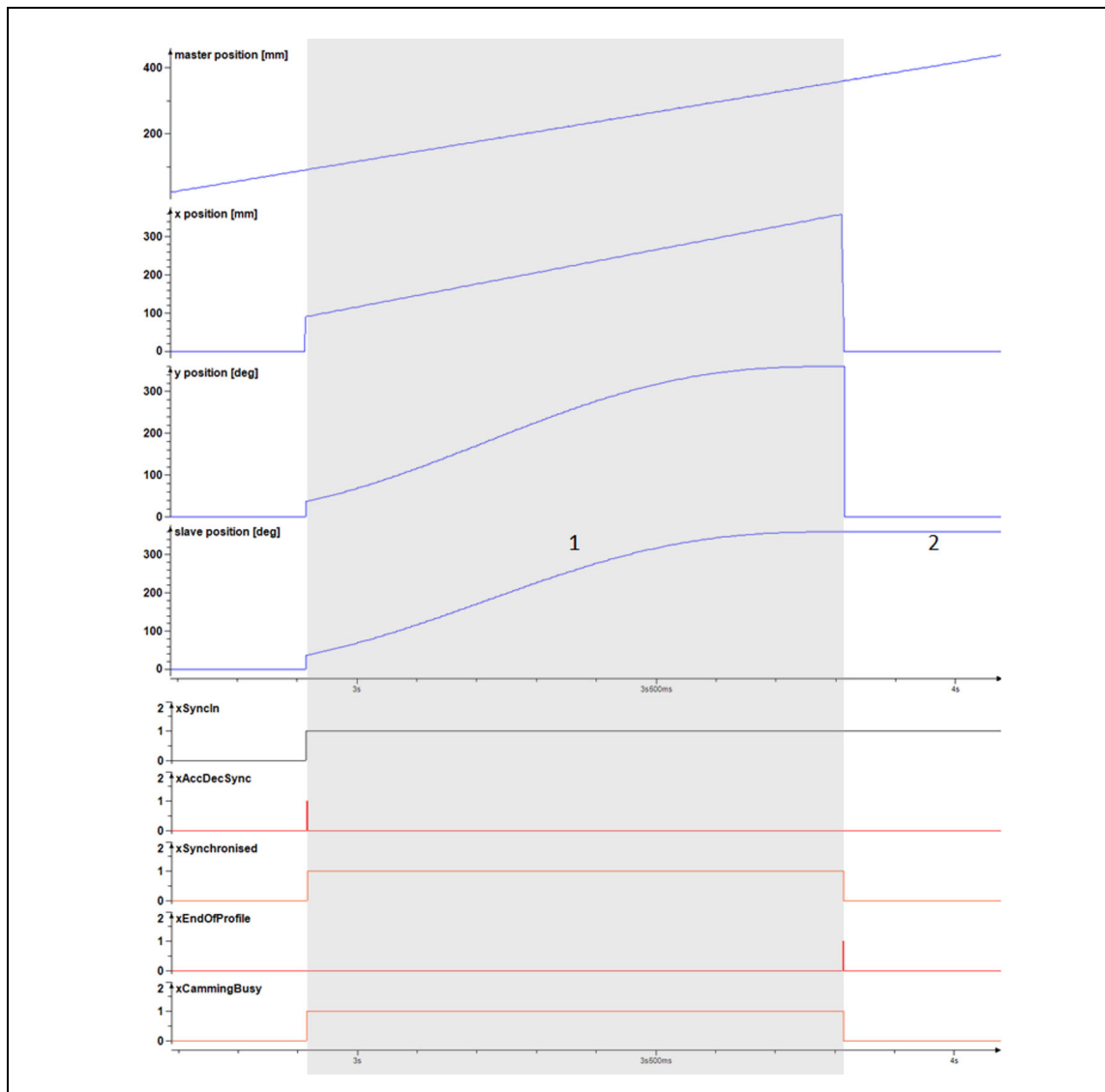
9.5.3 Clutching-in with "Instant absolute" coupling mode

The position, speed and acceleration of the slave axis are set directly to the resulting y position of the cam. In order to avoid irregularities in the drive movement, the slave axis must be traversed to the resulting y position of the cam beforehand, or it has to be there already. If this cannot be ensured, an alternative coupling mode must be set.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- `scPar.eSyncMode`, data type: `L_TS2P_SyncModeFlexCam`, initial value: "Profile generator absolute"



[9-5] Clutching in to the cam via the "Instant absolute" mode

No	xSyncln	xCammingBusy	xAccDecSync	xSynchronised	Info
1	FALSE↗TRUE	FALSE↗TRUE	TRUE for 1 PLC clock cycle	FALSE↗TRUE	A cam is executed with the following settings: xCamCyclic := FALSE // cam executed once If there is a rising edge at the xSyncln input, the slave axis is clutched in to the y axis within one PLC cycle. In doing so, the slave position jumps to the y position. The y position is calculated from the cam. The xAccDecSync output is set for one PLC cycle.
2	TRUE	TRUE↘FALSE	FALSE	TRUE↘FALSE	The cam reaches the end of the defined range. The xEndOfProfile status is set for one PLC cycle.

9.5.4 Clutching-in with "Instant relative" coupling mode

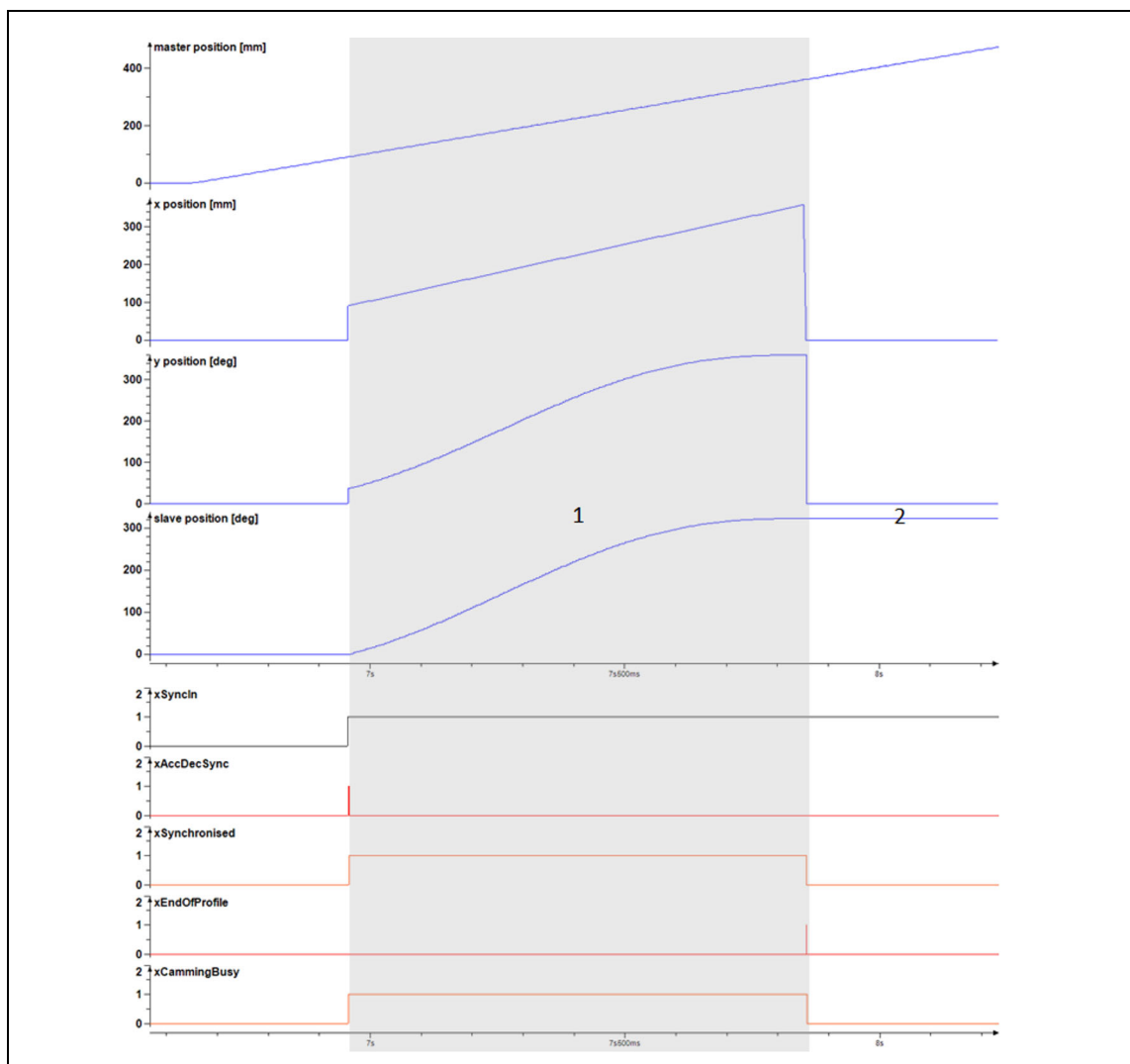
The position, speed, and acceleration of the slave axis are set directly to the resulting y position of the cam.

In contrast to the "Instant absolute" mode, the slave axis does not have to be located at the resulting y position of the cam. This results in an offset between the position of the slave axis and the resulting y position of the cam. In order to avoid irregularities in the drive movement, the master axis must remain at standstill during the clutch-in process.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.eSyncMode*, data type: *L_TS2P_SyncModeFlexCam*, initial value: "Profile generator absolute"



[9-6] Clutching in to the cam via the "Instant relative" mode

No	xSyncln	xCammingBusy	xAccDecSync	xSynchronised	Info
1	FALSE↗TRUE	FALSE↗TRUE	TRUE for 1 PLC clock cycle	FALSE↗TRUE	A cam is executed with the following settings: xCamCyclic := FALSE // cam executed once If there is a rising edge at the xSyncln input, the slave axis is clutched in to the y axis within one PLC cycle. In doing so, the slave position is maintained. The internal offset is set between the y position and the slave position. The y position is calculated from the cam. The xAccDecSync output is set for one PLC cycle.
2	TRUE	TRUE↘FALSE	FALSE	TRUE↘FALSE	The cam reaches the end of the defined range. The xEndOfProfile status is set for one PLC cycle.

9.6 Declutching from the cam

If the *xSyncIn* input is set to FALSE, the slave axis declutches from the current cam position.

The coupling mode for the declutch process can be specified via the *eSyncMode* parameter of the [L_TS2P_scPar_FlexCamState](#) (□ 20):

Coupling mode <i>eSyncMode</i>	Further information
0 (profile generator absolute)	The slave axis is declutched to the <i>lrSlaveSyncOutPos</i> target position via the profile generator with the modified acceleration trapezoid. ▶ Declutching in "Profile generator absolute" coupling mode (□ 67)
4 (CAM absolute)	The slave axis is declutched to the <i>lrSlaveSyncOutPos</i> target position via a cam with a 5th grade polynomial. ▶ Declutching in "CAM absolute" coupling mode (□ 69)
10 (Instant absolute)	If there is a falling edge at <i>xSyncIn</i> , the slave axis is stopped without smoothing (within one PLC cycle). The speed is set to 0. ▶ Declutching in the "Instant absolute"/"Instant relative" coupling mode (□ 71)
11 (Instant relative)	

9.6.1 Declutching in "Profile generator absolute" coupling mode

The slave axis declutches from the current y position of the cam in a profile-controlled manner.

In doing so, the slave axis is brought to a standstill with the parameters *lrSyncVel*, *lrSyncAcc*, *lrSyncDec* and *lrSyncJerk*.

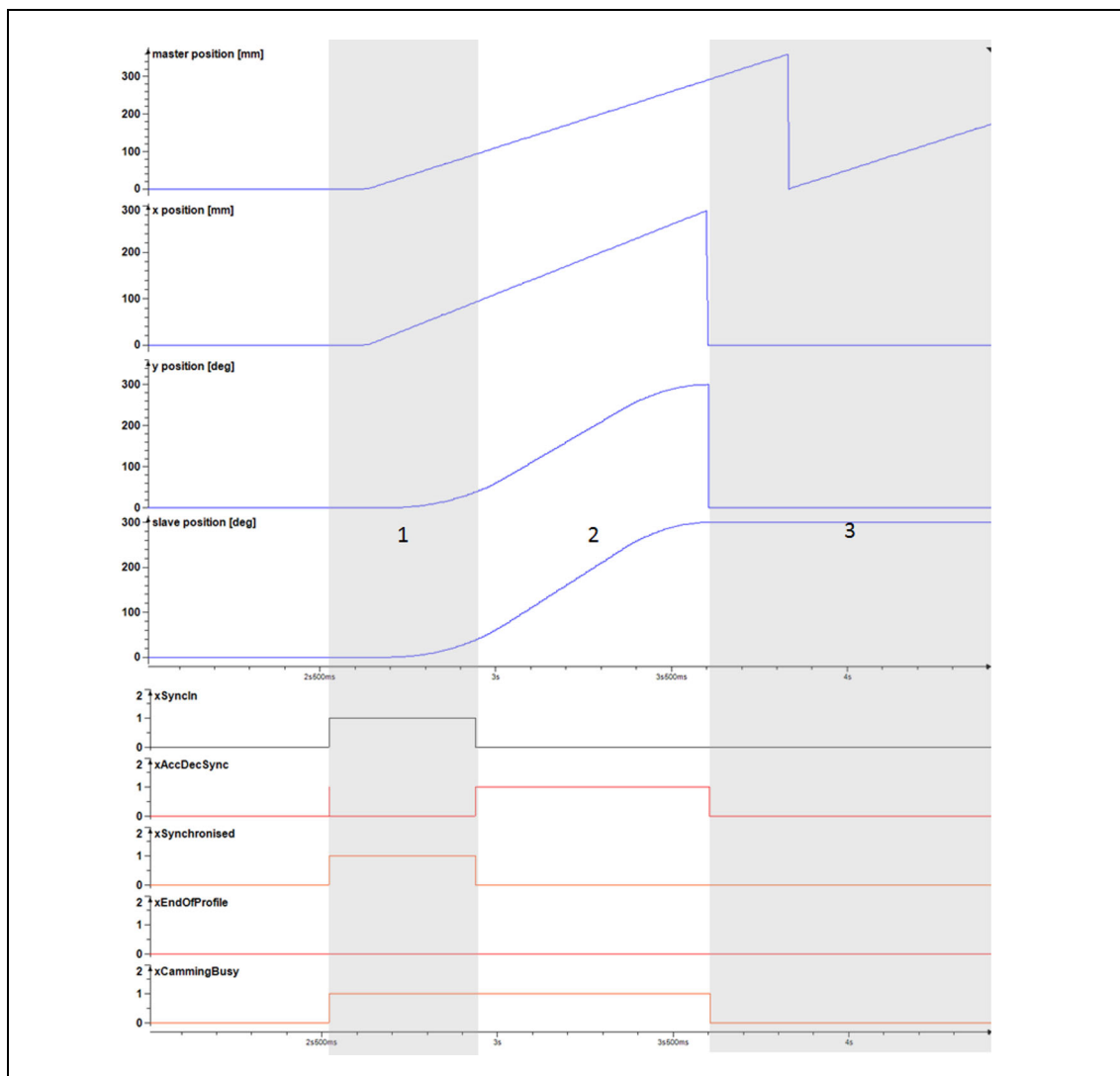
The *lrSlaveSyncOutPos* parameter defines the position from which the slave axis is to be at standstill.

This coupling mode is irrespective of the movement of the master axis.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (□ 20) structure.

- *scPar.eSyncMode*, data type: L_TS2P_SyncModeFlexCam, initial value: "Profile generator absolute"
- *scPar.lrSlaveSyncOutPos*, data type: LREAL, initial value: 0
- *scPar.lrSyncVel*, data type: LREAL, initial value: 100
- *scPar.lrSyncAcc*, data type: LREAL, initial value: 1 000
- *scPar.lrSyncDec*, data type: LREAL, initial value: 1 000
- *scPar.lrSyncJerk*, data type: LREAL, initial value: 1 000 000



[9-7] Declutching from the cam to a target position via the "Profile generator absolute" mode

No	xSyncIn	xCammingBusy	xAccDecSync	xSynchronised	Info
1	TRUE	TRUE	FALSE	TRUE	The cam is executed.
2	TRUE⇒FALSE	TRUE	TRUE	FALSE	If there is a falling edge at <i>xSyncIn</i> , the declutch process is executed. In doing so, the slave axis is brought to a standstill at the <i>IrSlaveSyncOutPos</i> declutch position via the profile generator.
3	FALSE	FALSE	FALSE	FALSE	The slave axis has been brought to a standstill in the declutch position. This completes the declutch process.

9.6.2 Declutching in "CAM absolute" coupling mode

The slave axis declutches in a position-controlled manner using a 5th grade polynomial.

In this mode, declutching can only be executed whilst the master axis is running. The declutch process can take several cycles.

By means of the *lrMasterSyncOutDist* parameter, the braking distance of the master axis is defined, producing the position in which the slave axis releases from the cam.

The *lrSlaveSyncOutPos* parameter defines the position from which the slave axis is to be at standstill.

Parameters to be set

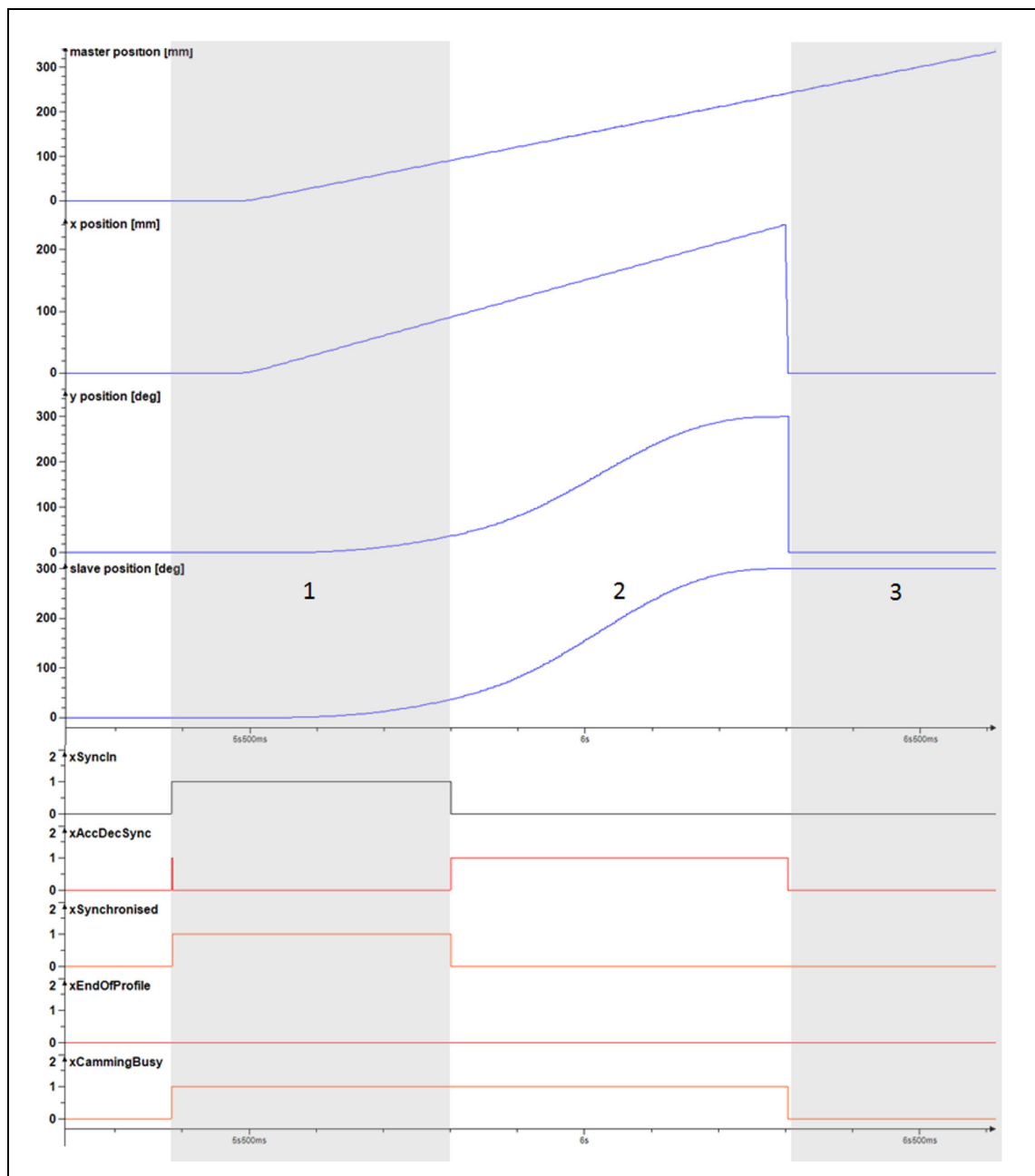
The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.eSyncMode*, data type: L_TS2P_SyncModeFlexCam, initial value: "Profile generator absolute"
- *scPar.lrMasterSyncOutDist*, data type: LREAL, initial value: 100
- *scPar.lrSlaveSyncOutPos*, data type: LREAL, initial value: 0

NOTICE

Path-based clutch-in of the slave axis with or without reversing:

If the *eAllowedDirection* parameter is set to 0 (both), the slave axis is allowed to reverse (movement against the master axis) during the clutch-in process. If reversing during the clutch-in process should be inhibited, the *eAllowedDirection* parameter must be set to 1 (positive) or the *eAllowedDirection* parameter must be set to -1 (negative).



[9-8] Declutching from the cam to a target position via the "CAM absolute" mode

No	xSyncIn	xCammingBusy	xAccDecSync	xSynchronised	Info
1	TRUE	TRUE	FALSE	TRUE	The cam is executed.
2	TRUE→FALSE	TRUE	TRUE	FALSE	If there is a falling edge at xSyncIn, the declutch process is executed. In doing so, the slave axis is brought to a standstill at the <i>IrSlaveSyncOutPos</i> declutch position via the cam with a 5th grade polynomial. The xAccDecSync output is set to TRUE.
3	FALSE	FALSE	FALSE	FALSE	The slave axis has been brought to a standstill in the declutch position. This completes the declutch process.

9.6.3 Declutching in the "Instant absolute"/"Instant relative" coupling mode

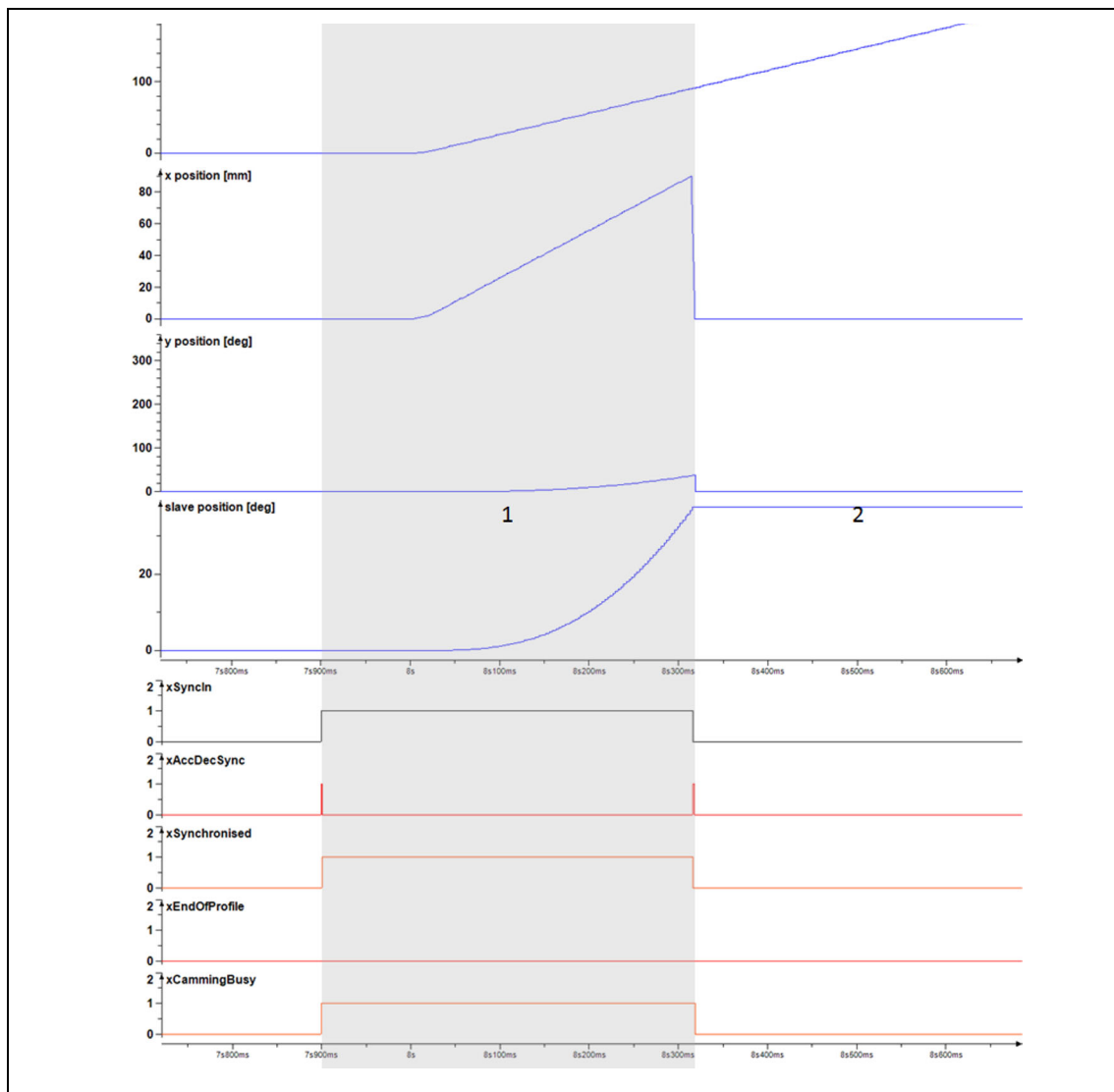
The slave axis declutches immediately from the master axis. The position of the slave axis is "frozen"; the slave speed is set to 0.

In order to avoid step changes, the y position of the cam or the master axis/x axis has to be at a standstill (e.g. over a resting phase in the curve progression).

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- *scPar.eSyncMode*, data type: L_TS2P_SyncModeFlexCam, initial value: "Profile generator absolute"



[9-9] Declutching from the cam to a target position via the "Instant absolute" or "Instant relative" mode

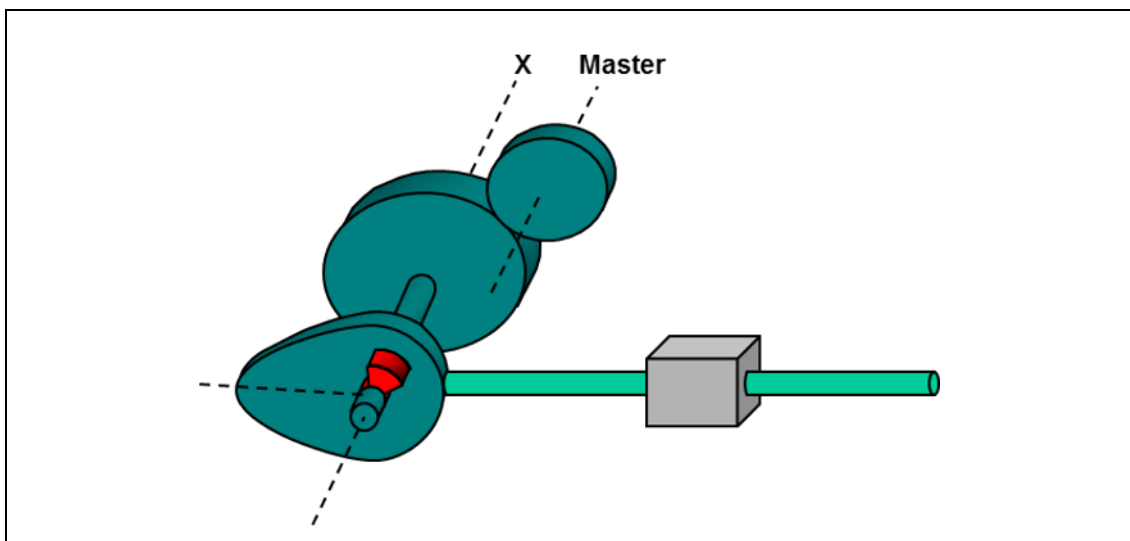
No	xSyncIn	xCammingBusy	xAccDecSync	xSynchronised	Info
1	TRUE	TRUE	FALSE	TRUE	The cam is executed.
2	TRUE⇒FALSE	TRUE⇒FALSE	TRUE for 1 PLC clock cycle	TRUE⇒FALSE	If there is a falling edge at xSyncIn, the declutch process is executed. In doing so, the slave axis is stopped without smoothing. The slave position is frozen. The xAccDecSync status is set to TRUE for one PLC cycle.

9.7 Scaling the cam

A cam can be scaled using factors at the *IrSetScalingX* or *IrSetScalingY* input. The scaling factors do not influence the length/cycle length of the cams and the axes.

IrSetScalingX <> 1

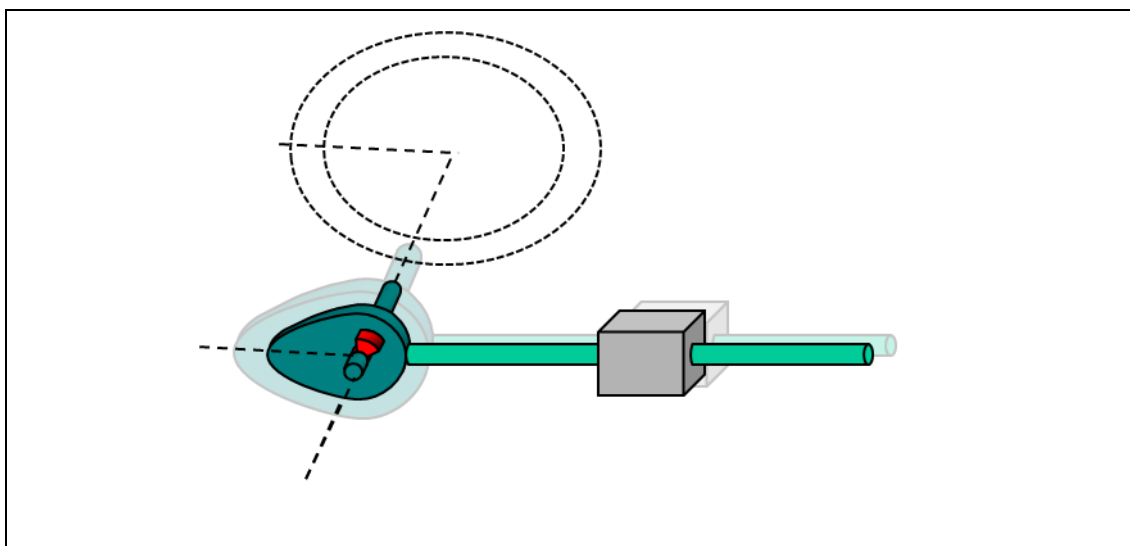
The x axis is extended or compressed in relation to the master axis (comparable to a gearbox between the master axis and the x axis).



[9-10] Mechanical cam - scaling of the master value - MasterScaling

IrSetScalingY <> 1

The slave axis is extended or compressed in relation to the y axis (as though the mechanical cam were enlarged or reduced).



[9-11] Mechanical cam - scaling of the tool - SlaveScaling

The mode for accepting the scaling factors for the master axis is set via the *eScalingModeX* parameter, and for the slave axis via the *eScalingModeY* parameter.

Setting mode: • eScalingModeX • eScalingModeY	Description
0 (x_zero)	Standard setting: The scaling factors are accepted in the "zero crossing" of the cam. The "zero crossing" is defined as a starting point of a cam if the direction of rotation of the master is positive, or as an end point of a cam if the direction of rotation of the master is negative.
1 (Instant absolute)	Absolute scaling of the position The scaling factors are accepted immediately after they have been selected or changed. A direct selection or change of the scaling factors causes a step change of the setpoint position even if the axes are at standstill.
2 (Instant relative)	Relative scaling of the position, absolute scaling of the speed. The scaling factors are accepted immediately after they have been selected or changed. A direct selection or change of the scaling factors causes a step change of the setpoint position even if the axes are at standstill.
3 (profile generator absolute)	Absolute Scaling the position via the ramp generator (74) with the parameters: • <i>lrSetOffsetScalingXVel</i>, <i>lrSetOffsetScalingYVel</i> • <i>lrSetOffsetScalingXAcc</i>, <i>lrSetOffsetScalingYAcc</i> • <i>lrSetOffsetScalingXDec</i>, <i>lrSetOffsetScalingYDec</i> • <i>lrSetOffsetScalingXJerk</i>, <i>lrSetOffsetScalingYJerk</i>
4 (profile generator relative)	Relative Scaling the position via the ramp generator (74) with the parameters: • <i>lrSetOffsetScalingXVel</i>, <i>lrSetOffsetScalingYVel</i> • <i>lrSetOffsetScalingXAcc</i>, <i>lrSetOffsetScalingYAcc</i> • <i>lrSetOffsetScalingXDec</i>, <i>lrSetOffsetScalingYDec</i> • <i>lrSetOffsetScalingXJerk</i>, <i>lrSetOffsetScalingYJerk</i>

9.7.1 Scaling the position via the ramp generator

In order to be able to internally change the scaling factors continuously in spite of an erratic change in value at the inputs *IrSetScalingX* or *IrSetScalingY*, ramp generators can be used: ramp modes "3 (profile generator absolute)" and "4 (profile generator relative)" in the *eScalingModeX* or *eScalingModeY* parameter.

A ramp generator executes a compensating movement via a ramp function between the last and the new scaling factor. If the scaling factor is changed again during the compensating movement of the ramp generator, the ramp generator executes a new compensating movement with the current value.

If the ramp generators are active and the cam has been changed, the ramp generators are not deactivated. The compensating movement is executed in its entirety until it is finished.

WARNING!

Injury to persons

Risk of injury is caused by unpredictable motor movements (especially by reversing direction of rotation)

Possible consequences

Death or severe injuries

Protective measures

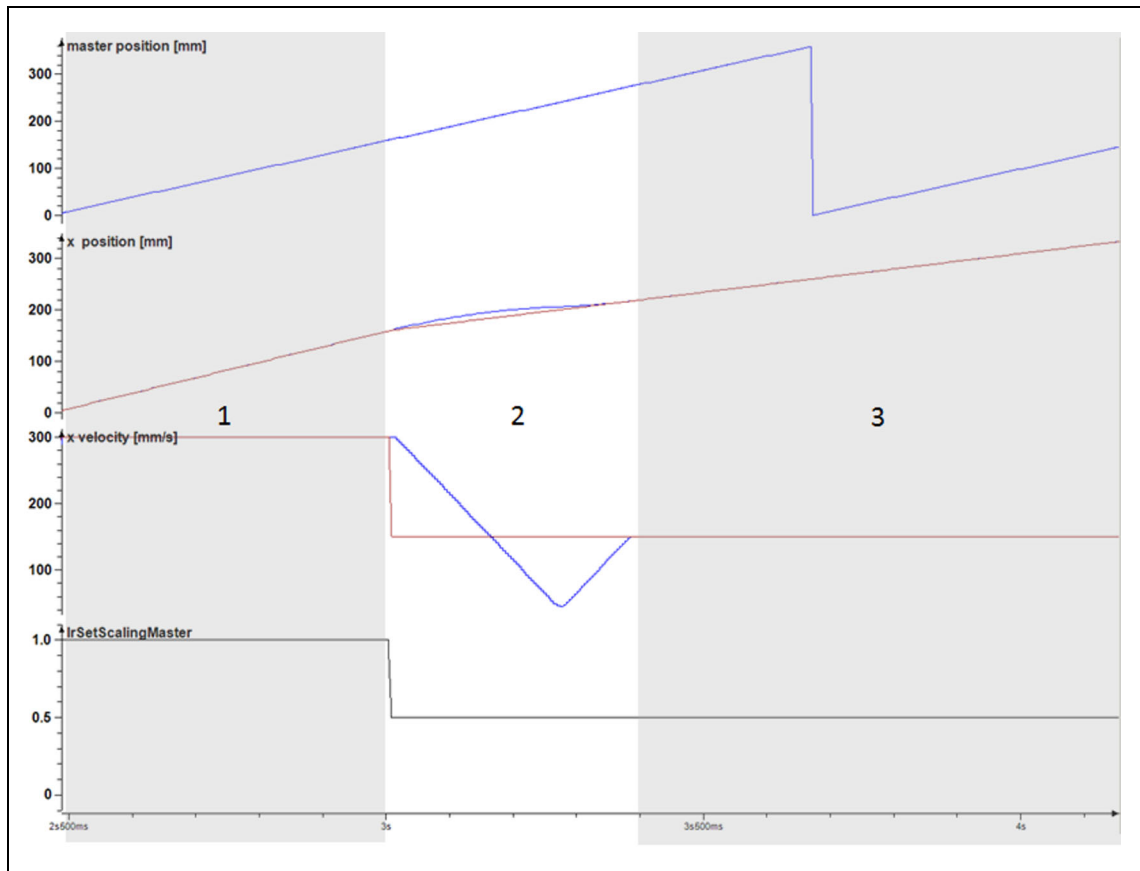
- Reversing is allowed during the compensating movement if the *eAllowedDirection* parameter is set to 0 (both).
- If reversing during the compensating movement should be inhibited, the *eAllowedDirection* parameter must be set to 1 (positive) or the *eAllowedDirection* parameter must be set to 2 (negative).

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (□ 20) structure.

- *scPar.eScalingModeX*, data type: L_TS2P_ScalingMode, initial value: "x_zero"
- *scPar.IrSetOffsetScalingXVel*, data type: LREAL, initial value: 100
- *scPar.IrSetOffsetScalingXAcc*, data type: LREAL, initial value: 1 000
- *scPar.IrSetOffsetScalingXDec*, data type: LREAL, initial value: 1 000
- *scPar.IrSetOffsetScalingXJerk*, data type: LREAL, initial value: 1 000 000
- *scPar.eScalingModeY*, data type: L_TS2P_ScalingMode, initial value: "x_zero"
- *scPar.IrSetOffsetScalingYVel*, data type: LREAL, initial value: 100
- *scPar.IrSetOffsetScalingYAcc*, data type: LREAL, initial value: 1 000
- *scPar.IrSetOffsetScalingYDec*, data type: LREAL, initial value: 1 000
- *scPar.IrSetOffsetScalingYJerk*, data type: LREAL, initial value: 1 000 000

9.7.2 Relative extension and compression factor of the master axis



[9-12] Connection of the scaling factor $IrSetScalingX < 0$ to the master axis during runtime in the master cycle

- **Upper blue curve:** master axis
In the master cycle, the $IrSetScalingX$ input = 0.5 (range 2).
- **Red curve:** x axis with the $eScalingModeX$ mode = 2 (instant relative)
The $IrSetScalingX$ scaling factor has an immediate effect on the course of the x speed. This keeps the position of the x axis steady and the x speed gets a step change.
Resulting speed of the x axis: $x_vel = Master_vel * IrSetScalingX$
- **Blue curve:** x axis with the $eScalingModeX$ mode = 4 (profile generator relative)
As in mode 2 (instant relative), the $IrSetScalingX$ scaling factor only has an effect on the speed. However, the difference is that the step change in the x speed is blended via the ramp generator.

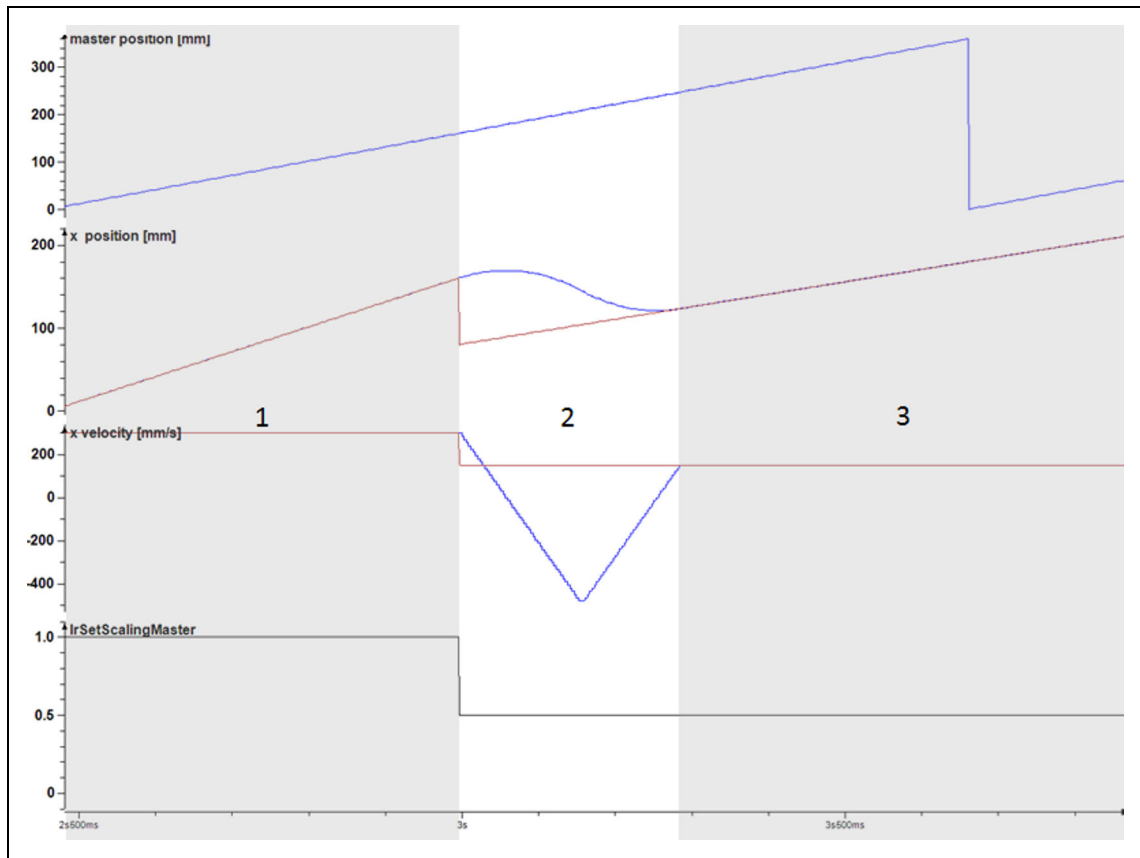
Parameters to be set

The parameters to be set are located in the [L TS2P_scPar_FlexCamState](#) (20) structure.

- $scPar.eScalingModeX$, data type: L_TS2P_ScalingMode, initial value: "x_zero"
- $scPar.IrSetOffsetScalingXVel$, data type: LREAL, initial value: 100
- $scPar.IrSetOffsetScalingXAcc$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingXDec$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingXJerk$, data type: LREAL, initial value: 1 000 000

9.7.3

Absolute extension and compression factor of the master axis



[9-13] Connection of the scaling factor $IrSetScalingX < 0$ to the master axis during runtime in the master cycle

- **Upper blue curve:** master axis
In the master cycle, the $IrSetScalingX$ input = 0.5 (range 2).
- **Red curve:** x axis with the $eScalingModeX$ mode = 1 (instant absolute)
The $IrSetScalingX$ scaling factor has an immediate effect on the course of the x position and the x speed. The position and the speed of the x axis jump. The factor is multiplied in the calculation.

$$x_pos = Master_pos * IrSetScalingX$$

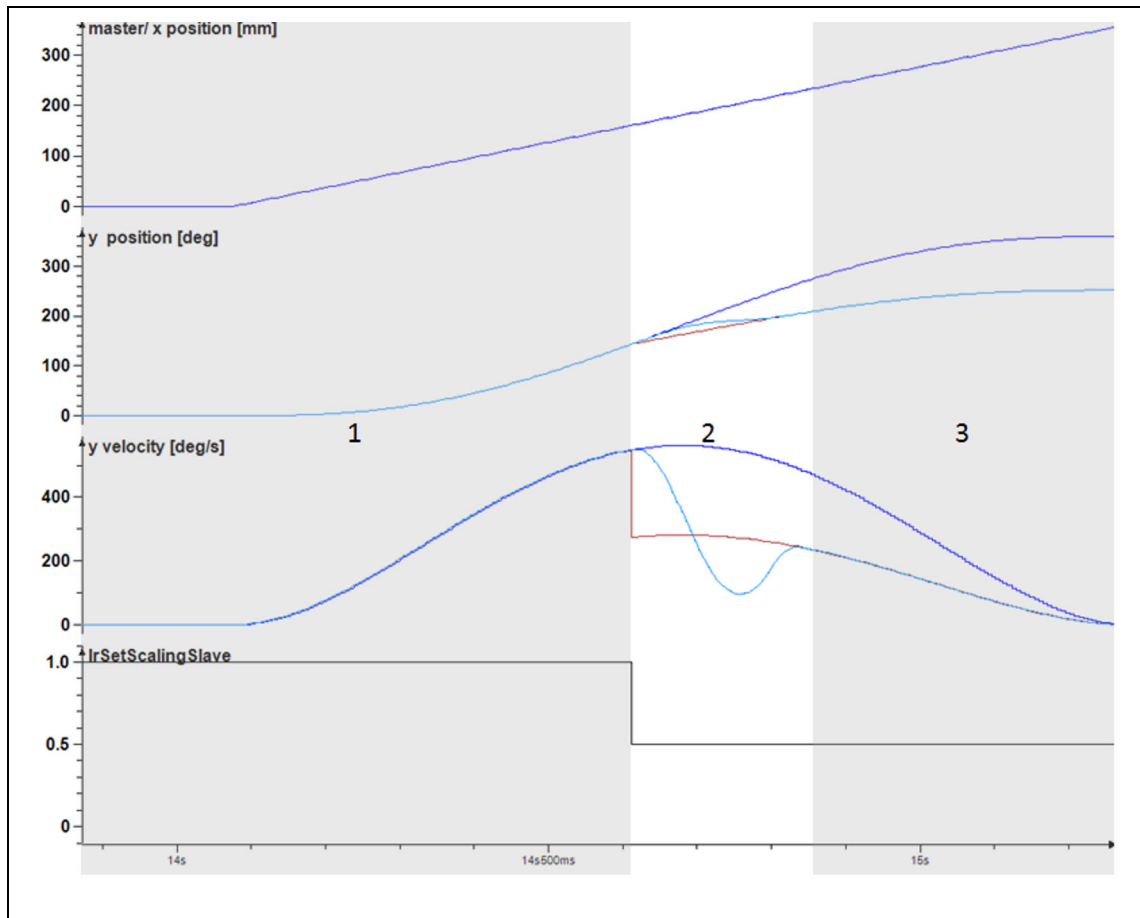
$$x_vel = Master_vel * IrSetScalingX$$
- **Lower blue curve:** x axis with the $eScalingModeX$ mode = 3 (profile generator absolute)
The $IrSetScalingX$ scaling factor also has a multiplicative effect on the position and the speed of the x axis. However, the difference is that the step change in the x position and in the x speed is extended via the ramp generator.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- $scPar.eScalingModeX$, data type: L_TS2P_ScalingMode, initial value: "x_zero"
- $scPar.IrSetOffsetScalingXVel$, data type: LREAL, initial value: 100
- $scPar.IrSetOffsetScalingXAcc$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingXDec$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingXJerk$, data type: LREAL, initial value: 1 000 000

9.7.4 Relative extension and compression factor of the slave axis



[9-14] Connection of the scaling factor $IrSetScalingY > 0$ to the slave axis during runtime in the y cycle

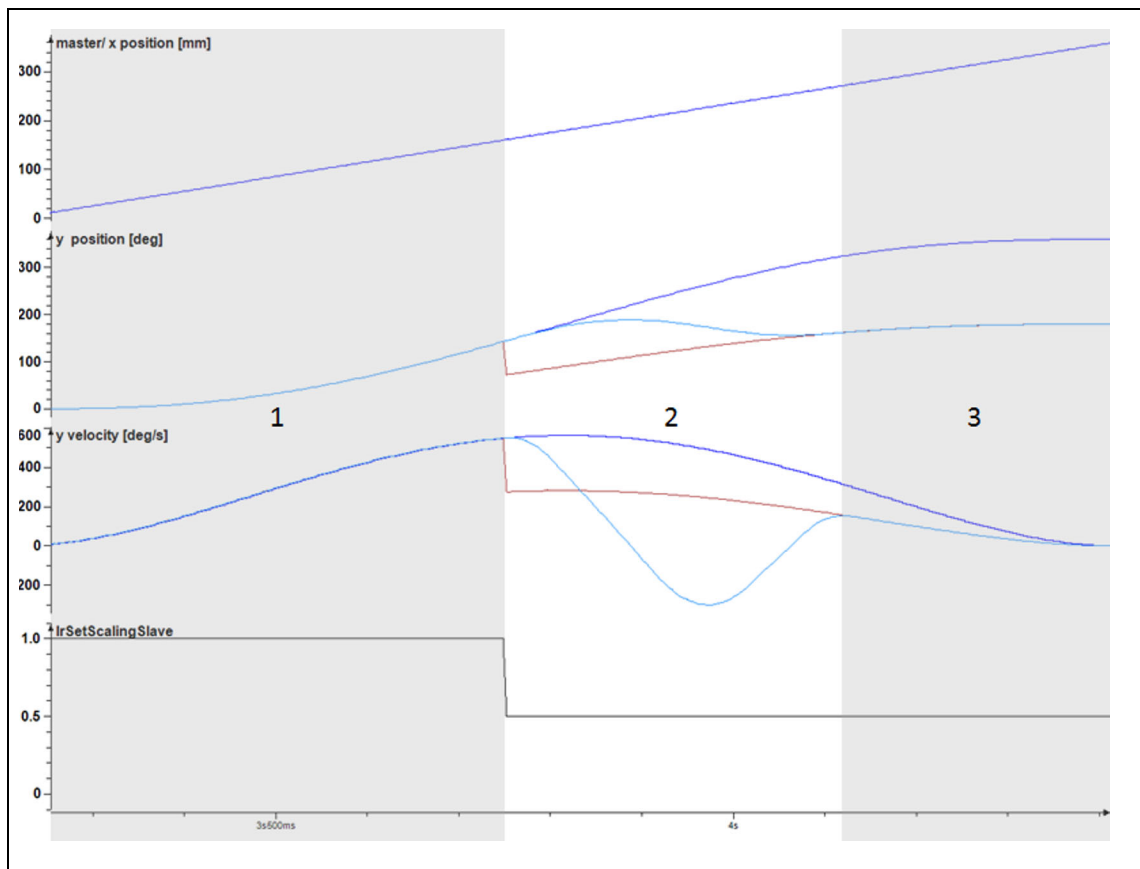
- **Upper blue curve:** y axis
In the y cycle, the $IrSetScalingY$ input = 0.5 (range 2).
- **Red curve:** slave axis with the $eScalingModeX$ mode = 2 (instant relative)
The $IrSetScalingY$ scaling factor has an immediate effect on the course of the slave speed. This keeps the position of the slave axis steady and the y speed gets a step change.
Resulting speed of the slave axis: $Slave_vel = y_vel * IrSetScalingY$
- **Lower blue curve:** slave axis with the $eScalingModeY$ mode = 4 (profile generator relative)
As in mode 2 (relative), the $IrSetScalingY$ scaling factor only has an effect on the speed. However, the difference is that the step change in the slave speed is blended via the ramp generator.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- $scPar.eScalingModeY$, data type: $L_TS2P_ScalingMode$, initial value: "x_zero"
- $scPar.IrSetOffsetScalingYVel$, data type: LREAL, initial value: 100
- $scPar.IrSetOffsetScalingYAcc$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingYDec$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingYJerk$, data type: LREAL, initial value: 1 000 000

9.7.5 Absolute extension and compression factor of the slave axis



[9-15] Connection of the scaling factor $IrSetScalingY < 0$ to the slave axis during runtime in the y cycle

- **Upper blue curve: y axis**
In the y cycle, the $IrSetScalingY$ input = 0.5 (range 2).
- **Red curve: slave axis with the $eScalingModeY$ mode = 1 (instant absolute)**
The $IrSetScalingY$ scaling factor has an immediate effect on the course of the slave position and the slave speed; both jump. The factor is multiplied in the calculation.

$$Slave_pos = y_pos * IrSetScalingY$$

$$Slave_vel = y_vel * IrSetScalingY$$
- **Lower blue curve: slave axis with the $IrSetScalingY$ mode = 3 (profile generator absolute)**
The $IrSetScalingY$ scaling factor also has a multiplicative effect on the position and the speed of the slave axis. However, the difference is that the step change in the slave position and in the slave speed is compensated via the ramp generator.

Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (20) structure.

- $scPar.eScalingModeY$, data type: L_TS2P_ScalingMode, initial value: "x_zero"
- $scPar.IrSetOffsetScalingYVel$, data type: LREAL, initial value: 100
- $scPar.IrSetOffsetScalingYAcc$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingYDec$, data type: LREAL, initial value: 1 000
- $scPar.IrSetOffsetScalingYJerk$, data type: LREAL, initial value: 1 000 000

9.8 Offset for the master and slave axis

An offset for the master and slave axis can be specified via the inputs *lrSetOffsetPosX* or *lrSetOffsetPosY*.

The selection mode for accepting the offset values is specified via the parameters *eOffsetModeX* and *eOffsetModeY*.

The selection of the mode for accepting offset values for the master axis is set via the parameter *eOffsetModeX*, and for the slave axis via the parameter *eOffsetModeY*.

► [L_TS2P_scPar_FlexCamState](#) (□ 20)

Setting mode: • <i>eOffsetModeX</i> • <i>eOffsetModeY</i>	Description
0 (x_zero)	Standard setting: The offset values are accepted in the "zero crossing" of the cam. The "zero crossing" is defined as the starting point of a cam if the direction of rotation of the master is positive, or as the end point of a cam if the direction of rotation of the master is negative.
1 (Instant absolute)	The offset values are accepted immediately after they have been specified or changed. Direct specification or change of the offset values causes a step change of the setpoint position even if the axes are at standstill.
2 (profile generator absolute)	The ramp generator brings the current offset to the setpoint offset via the following profile parameters: • <i>lrSetOffsetScalingXVel</i>, <i>lrSetOffsetScalingYVel</i> • <i>lrSetOffsetScalingXAcc</i>, <i>lrSetOffsetScalingYAcc</i> • <i>lrSetOffsetScalingXDec</i>, <i>lrSetOffsetScalingYDec</i> • <i>lrSetOffsetScalingXJerk</i>, <i>lrSetOffsetScalingYJerk</i> The <i>lrJerk</i> parameter limits the maximum jerk. Generally, the jerk is set to 100 times the acceleration.

If ramp generators are active and the cam has been changed, the ramp generators are not deactivated. The compensating movement is executed in its entirety until it is finished.

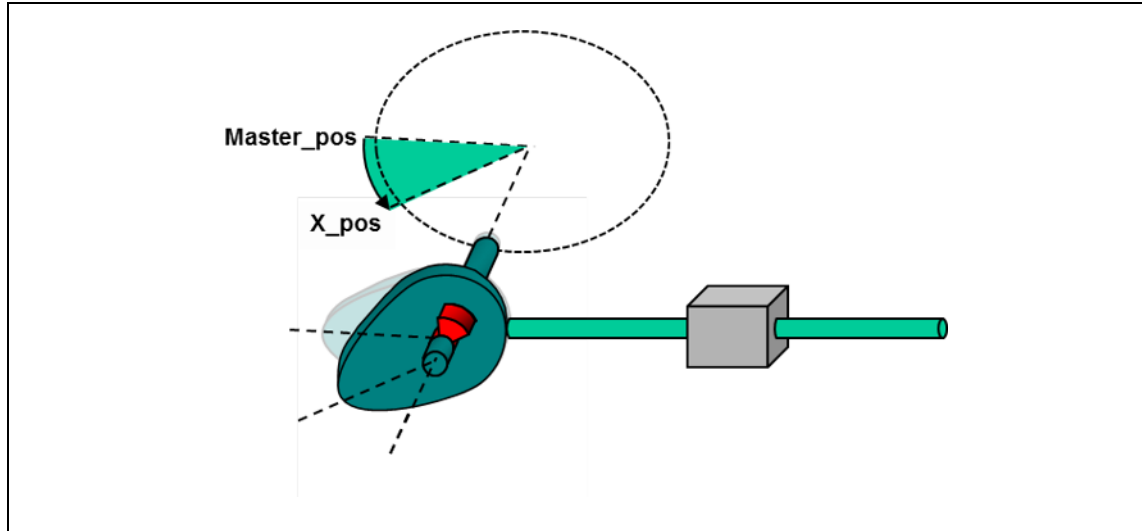
Parameters to be set

The parameters to be set are located in the [L_TS2P_scPar_FlexCamState](#) (□ 20) structure.

- *scPar.eOffsetModeX*, data type: *L_TS2P_OffsetMode*, initial value: "x_zero"
- *scPar.lrSetOffsetScalingXVel*, data type: *LREAL*, initial value: 100
- *scPar.lrSetOffsetScalingXAcc*, data type: *LREAL*, initial value: 1 000
- *scPar.lrSetOffsetScalingXDec*, data type: *LREAL*, initial value: 1 000
- *scPar.lrSetOffsetScalingXJerk*, data type: *LREAL*, initial value: 1 000 000
- *scPar.eOffsetModeY*, data type: *L_TS2P_OffsetMode*, initial value: "x_zero"
- *scPar.lrSetOffsetScalingYVel*, data type: *LREAL*, initial value: 100
- *scPar.lrSetOffsetScalingYAcc*, data type: *LREAL*, initial value: 1 000
- *scPar.lrSetOffsetScalingYDec*, data type: *LREAL*, initial value: 1 000
- *scPar.lrSetOffsetScalingYJerk*, data type: *LREAL*, initial value: 1 000 000

9.8.1 Specify master offset

With a mechanical cam, the master offset corresponds to the torsion of the x shaft around an angle in relation to the master shaft.



[9-16] Master offset with a mechanical cam

The x position (input position for the curve function) results from the sum of the master axis position (Master_Pos) and the *IrSetOffsetPosX* offset.

⚠ WARNING!

Injury to persons

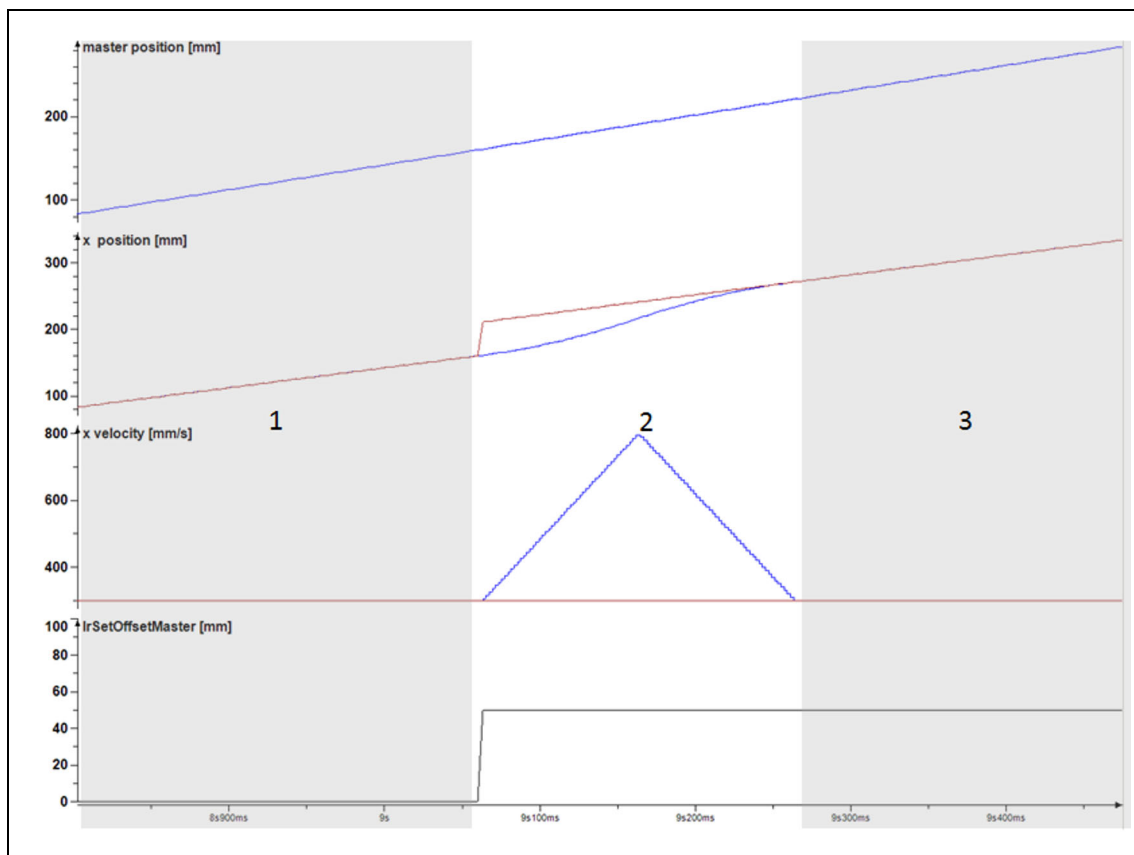
Risk of injury is caused by unpredictable motor movements (especially by reversing direction of rotation)

Possible consequences

Death or severe injuries

Protective measures

- Reversing is allowed during the compensating movement if the *eAllowedDirection* parameter is set to 0 (both).
- If reversing during the compensating movement should be inhibited, the *eAllowedDirection* parameter must be set to 1 (positive) or the *eAllowedDirection* parameter must be set to 2 (negative).

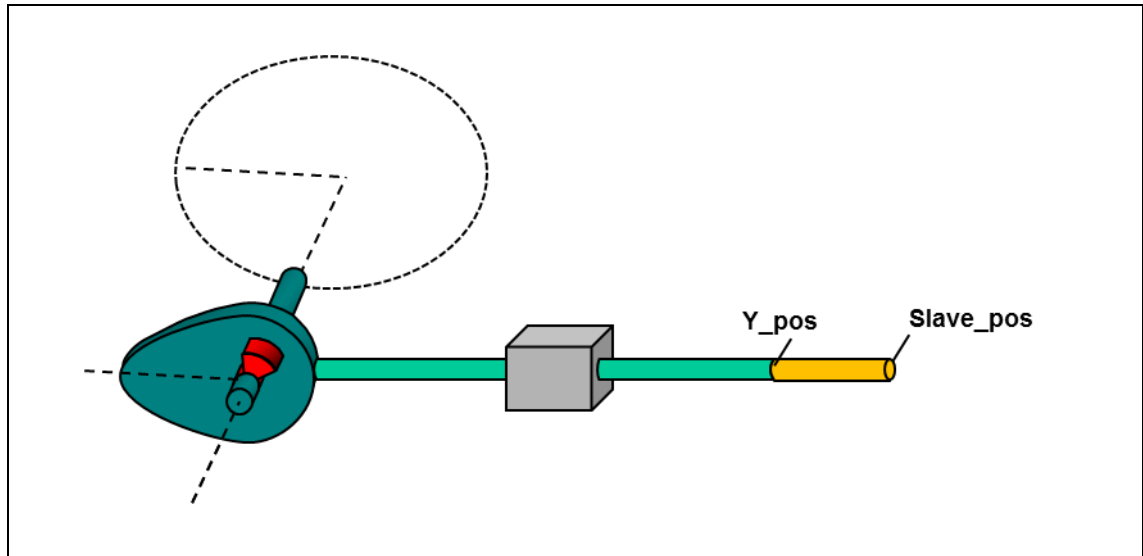


[9-17] Signal characteristic

Range	IrSetOffsetPosX	Description
1	0	The cam is executed.
2	50	Red curve: If <i>eOffsetModeX</i> is set to 1 (instant absolute), the offset is also immediately connected to the x position. Blue curves: If <i>eOffsetModeX</i> is set to 2 (profile generator absolute), the offset is also connected to the x position via the ramp generator.
3	50	The x axis follows the master axis with the position offset.

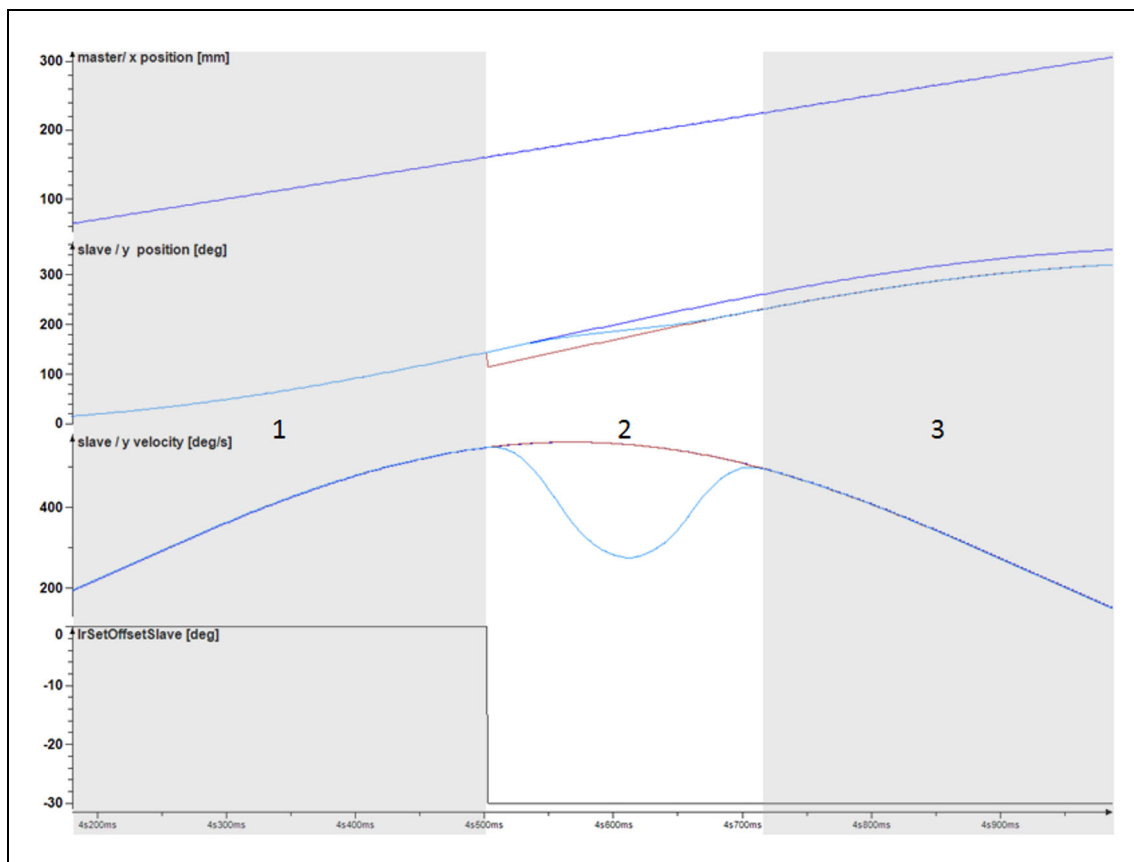
9.8.2 Specify slave offset

With a mechanical cam, the slave offset can be compared with a length change of the lifting rod (in yellow in the illustration).



[9-18] Slave offset with a mechanical cam

The slave position results from the sum of the (optionally scaled) y position of the cam and the *IrSetOffsetPosY* offset.



[9-19] Signal characteristic

Range	IrSetOffsetPosY	Description
1	0	The cam is executed.
2	-30	Red curve: If <i>eOffsetModeY</i> is set to 1 (instant absolute), the offset is also immediately connected to the slave position. Blue curves: If <i>eOffsetModeY</i> is set to 2 (profile generator absolute), the offset is also connected to the slave position via the ramp generator.
3	-30	The x axis follows the y axis with the position offset.

9.9 Specify the switching sequence for cams

A switching sequence makes it possible to execute several cams in succession.

The switching sequence is activated with the input *xCamSequencer* = TRUE. The output *xCamSequencerActive* returns the status, showing whether the switching sequence is executed.

With the parameter *eCamSequenceMode* ([L TS2P_scPar FlexCamState](#) (20)) the following switching sequences can be selected:

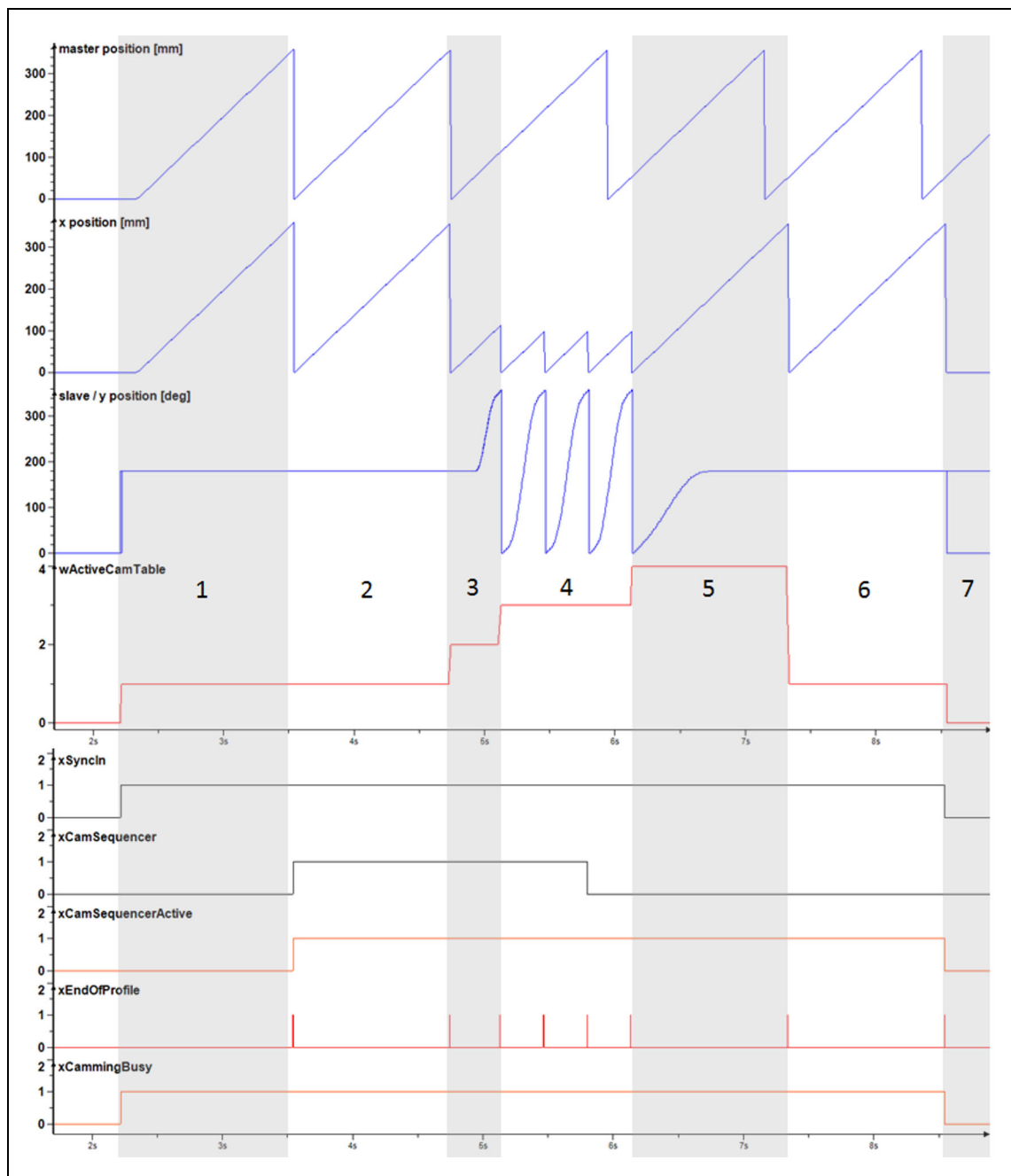
Setting in		Description
<i>eCamSequenceMode</i>	<i>xCamSequencer</i>	
0	TRUE	Cam 1 is executed cyclically.
1	TRUE	Cam 3 is executed cyclically.
2	TRUE	Cam 1 is executed once; then cam 3 is executed cyclically.
	TRUE⇒FALSE	After cam 3, cam 1 is executed once.
3	TRUE	Cams 1 and 2 are executed once in succession; then cam 3 is executed cyclically.
	TRUE⇒FALSE	After cam 3, cam 4 is executed once; then cam 1 is executed cyclically.

The *wActiveCamTable* output names the active cam in each case.

If the switching sequence is off (*xCamSequencer* = FALSE), the *wSetCamTable* input can be used to switch the cam between CamTable1 (*wSetCamTable* = 1), CamTable2 (*wSetCamTable* = 2), CamTable3 (*wSetCamTable* = 3) and CamTable4 (*wSetCamTable* = 4).

If a cam is selected via the *wSetCamTable* input, the cam is automatically changed after *xEndOfProfile*.

If there is a rising edge at the *xCamChangeInstant* input, there can be a changeover to the cam selected via the *wSetCamTable* input.



[9-20] Switching sequence for cams (*eCamSequenceMode* = 3)

No	xSyncln	xCamSequencer	xCamSequencerActive	xCammingBusy	Info
1	TRUE	TRUE	FALSE	TRUE	The slave axis is clutched in to the cam via <i>xSyncln</i>. 4 cam tables are connected: CamTable1: StandstillCAM: The y position is kept at 180° CamTable2: StartCam: The y position is brought from 180° to synchronous speed with the x axis CamTable3: SyncCam: The y position covers a distance of 360° while the x axis only moves 100 mm. CamTable4: StopCam: The y position is taken out of synchronous travel with the x axis and brought to a standstill at position y = 180°. As long as no switching sequence is activated, CamTable1 is executed cyclically.
2	TRUE	TRUE	TRUE	TRUE	The switching sequence for the cams is activated. The <i>scPar.eCamSequenceMode</i> mode is set to 3. CamTable1 is completed.

No	xSyncIn	xCamSequencer	xCamSequencerActive	xCammingBusy	Info
3	TRUE	TRUE	TRUE	TRUE	After CamTable1, CamTable2 is automatically activated.
4	TRUE	TRUE→FALSE	TRUE	TRUE	CamTable2 is completed once and CamTable3 is activated. CamTable3 is executed cyclically.
5	TRUE	FALSE	TRUE	TRUE	If the switching sequence is deactivated, CamTable3 is completed. Then CamTable4 is activated.
6	TRUE	FALSE	TRUE	TRUE	After CamTable4, CamTable1 is once again executed cyclically.
7	FALSE	FALSE	FALSE	FALSE	If xSyncIn = FALSE, the slave axis is declutched from the cam.

Symbols

"CAM absolute" coupling mode [61](#), [69](#)
"Flex Cam State" TM parameters [20](#)
"Flex Cam" - functional description [11](#)
"Instant absolute" coupling mode [63](#), [71](#)
"Instant relative" coupling mode [65](#), [71](#)
"Profile generator absolute" coupling mode [59](#), [67](#)

A

Aborting a positioning process [47](#)
Absolute positioning [39](#)
Access points [30](#)
Application notes [8](#)

C

Cam formats (cam handling) [51](#)
Changing the cam [57](#)
Clutching in to the cam [58](#)
Competing a positioning process [47](#)
Continuous travel with a defined velocity [44](#)
Conventions used [7](#)

D

Declutching from the cam [67](#)
Document history [6](#)

E

E-mail to Lenze [88](#)
eTMState [26](#)
Executing the axes and cam [52](#)
Executing the cam cyclically [52](#)
Executing the cam once [54](#)
Executing the master axis [55](#)
Executing the slave axis [56](#)

F

Feedback to Lenze [88](#)
Flex Cam (functional description) [11](#)
Flex Cam motion profiles [51](#)

H

Halt, [38](#)
Homing [34](#)

I

inputs [16](#)

L

L_TB2P_States [26](#)
L_TF2P_scPar_FlexCamState parameter structure [20](#)
L_TS2P_FlexCamState [15](#)
L_TS2P_FlexCamState function block [15](#)
L_TS2P_scAP_FlexCamState [30](#)
L_TS2P_scPar_FlexCamState [20](#)

L_TS2P_scSF_FlexCamState [28](#)
Layout of the safety instructions [8](#)

M

Manual jog (jogging) [32](#)
Master axis - Absolute extension and compression factor [76](#)
Master axis - Relative extension and compression factor [75](#)

N

Notes on how to operate the technology module [13](#)

O

Offset for the master and slave axis [79](#)
Operating mode [13](#)
outputs [18](#)
Override for speed [49](#)

Q

QSP application [37](#)

R

Relative positioning [41](#)

S

Safety instructions [9](#)
Scaling the cam [72](#)
Scaling via the ramp generator [74](#)
Signal flow diagrams [27](#)
Signal flow of the "Flex Cam" technology module [27](#)
Slave axis - Absolute extension and compression factor [78](#)
Slave axis - Relative extension and compression factor [77](#)
Specify master offset [80](#)
Specify slave offset [82](#)
Speed override [49](#)
Start of the axes [13](#)
State machine [25](#)
States [25](#)
States of the eTMState output [26](#)
Structure of the access points [30](#)
Structure of the signal flow [28](#)
Switching sequence for cams [84](#)

T

Target group [5](#)
Technology module functions (overview) [12](#)

V

Variable identifiers [7](#)



Your opinion is important to us

We have compiled these instructions to the best of our knowledge with the objective of supporting you optimally when you handle our product.

Perhaps we have not succeeded in achieving this objective in every respect. If you have suggestions for improvement, please e-mail us to:

feedback-docu@lenze.com

Thank you very much for your support.

Your Lenze documentation team

