FAST Application Software

Technology module

Electrical Shaft Velocity _____________________

Reference Manual EN

13531724

Lenze

Contents

1 About this documentation

This documentation ...

- contains detailed information on the functionalities of the "Electrical Shaft Velocity" 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 Controller (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« (parameter setting, configuration, diagnostics) • »VisiWinNET® Smart« (visualisation) • »Backup & Restore« (data backup, recovery, update)

More technical documentation for Lenze components

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

Planning / 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
Parameter setting / 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 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.

1.1 Document history

Version			Description
3.2	05/2017	TD17	• Content structure has been changed. • General revisions New: ▶ Torque-controlled drive as master (📖 12) ▶ Use of setpoints or actual values (📖 12)
3.1	04/2016	TD17	General revisions
3.0	10/2015	TD17	• Corrections and additions • New: L_TT1P_scAP_ElectricalShaftVel[Base/State/High] (📖 24) • Content structure has been changed.
2.1	05/2015	TD17	General revisions
2.0	01/2015	TD17	• General editorial revision • Modularisation of the contents for the »PLC Designer« online help
1.0	04/2014	TD00	First edition

1.2 Conventions used

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

Type of information	Highlighting	Examples/notes
Spelling of numbers		
Decimal separator	Point	The decimal point is always used. For example: 1234.56
Text		
Program name	» «	»PLC Designer« ...
Variable names	*italics*	By setting *bEnable* 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;`
		`...`

Icons		
Page reference	(📖 6)	Reference to further information: Page number in PDF file.

Variable names

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.

1.3 Definition of the notes used

The following signal words and symbols are used in this documentation to indicate dangers and important information:

Safety instructions

Layout of the safety instructions:

> ## Pictograph and signal word!
>
> (characterise the type and severity of danger)
>
> **Note**
>
> (describes the danger and gives information about how to prevent dangerous situations)

Pictograph	Signal word	Meaning
	Danger!	**Danger of personal injury through dangerous electrical voltage** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	Danger!	**Danger of personal injury through a general source of danger** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
STOP	**Stop!**	**Danger of property damage** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph	Signal word	Meaning
	Note!	Important note to ensure trouble-free operation
	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.

Stop!

Damage or destruction of machine parts

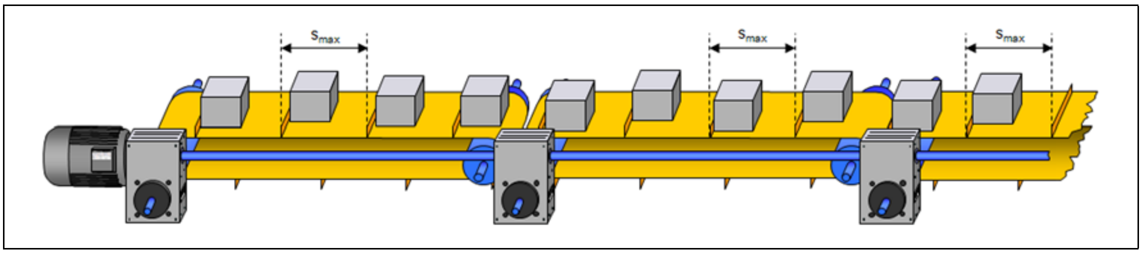
Damage or destruction of machine parts can be caused by ...

- 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 Functional description of "Electrical Shaft Velocity"



[3-1] Typical mechanics of the technology module

- In the "Base" version, the synchronism and the setting of an offset are activated with a velocity jump.
- In the "State" version it is additionally possible to clutch-in jump-free. For this purpose, a velocity-dependent clutch is used. Moreover, an offset can be set between master and slave axis by trimming by analogy with the manual jog function. The absolute-acting offset is immediately accepted with a velocity jump.
- In addition to the State version, the "High" version provides a synchronism with basic velocity and a jump-free connection of the position offset using a profile generator.

▸ Overview of the functions (📖 11)

3.1 Overview of the functions

In addition to the basic functions for operating the **L_MC1P_AxisBasicControl** function block, the **Stop function** and the **Holding function**, the technology module offers the following functionalities that are assigned to the "Base", "State", and "High" versions:

Functionality	Versions		
	Base	State	High
Manual jog (jogging) (🕮 25)	●	●	●
Synchronism (SyncVel) (🕮 26)	●	●	●
Velocity offset during synchronism (🕮 28)	●	●	●
Synchronism with clutch-in/declutch mechanism (🕮 29)		●	●
Position trimming (🕮 30)		●	●
Velocity offset with profile generator (🕮 31)			●
Synchronism with basic velocity (🕮 32)			●

»PLC Designer« Online help

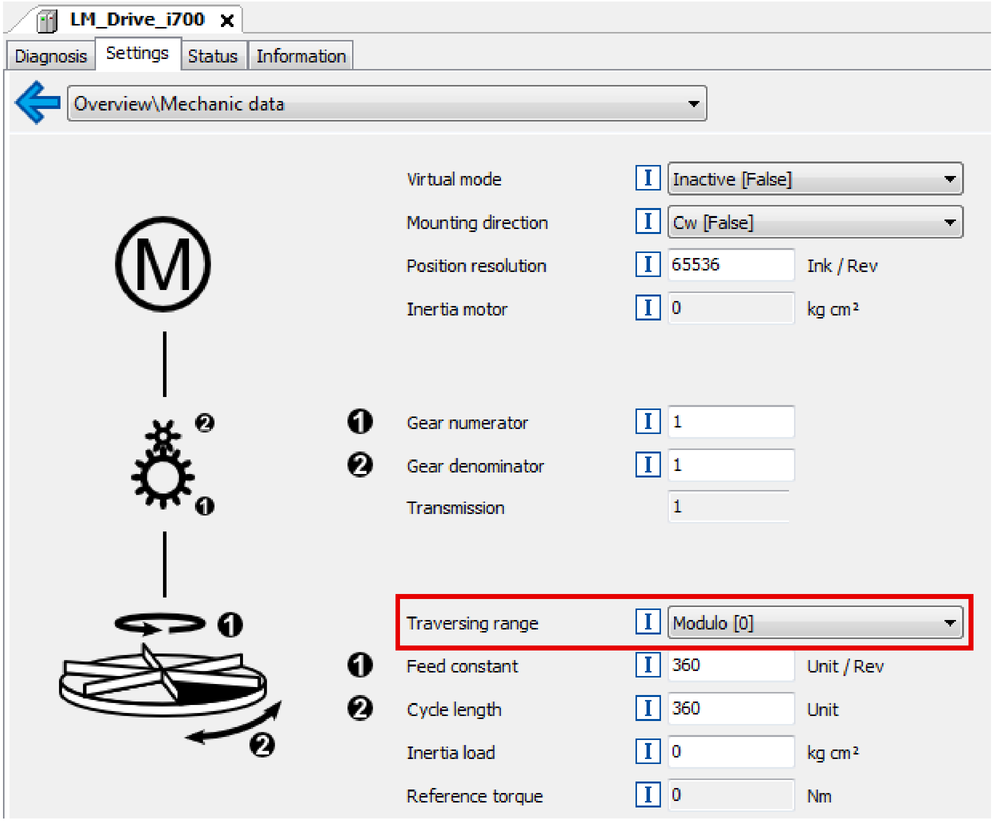
Here you will find detailed information on the **L_MC1P_AxisBasicControl** function block, the **stop function** and the **holding function**.

3.2 Important notes on how to operate the technology module

The "Electrical Shaft Position" technology module only supports rotary axes:

- The master axis has to be a rotary axis and
- the slave axis has to be a rotary axis.

Go to the »PLC Designer« and set the "Modulo" machine measuring system for each axis under the **Settings** tab:



Setting of the operating mode

The operating mode for the slave axis has to be set to "cyclically synchronous speed" (csv) because the axis is led via the speed conductivity.

Torque-controlled drive as master

In its function as master, the technology module can also have an axis which runs in the cyclic sync torque mode (cst).

The actual values are written to the setpoints.

Use of setpoints or actual values

The technology module uses the setpoint of the master axis.

The **L_MC1P_AverageFilterSetValue** filter function can be used to influence the setpoints, making it possible for the technology module to switch over to the actual values.

Controlled start of the axes

Motion commands that are set in the inhibited axis state (*xAxisEnabled* = FALSE) after enable (*xRegulatorOn* = TRUE) must be activated again by a FALSE↗TRUE edge.

In this way it is prevented that the drive starts in an uncontrolled manner after controller enable.

Example Manual jog (jogging) (📖 25)**:**

1. In the inhibited axis state (*xAxisEnabled* = FALSE), *xJogPos* is set to TRUE.
   - *xRegulatorOn* = FALSE (axis is inhibited.)
     ==> "READY" state (*xAxisEnabled* = FALSE)
   - *xJogPos* = TRUE (manual jog is to be executed.)
2. Enable axis.
   - *xRegulatorOn* = TRUE
     ==> "READY" state (*xAxisEnabled* = TRUE)
3. Execute manual jog.
   - *xJogPos* = FALSE↗TRUE
     ==> "JOGPOS" state

3.3 Function block L_TT1P_ElectricalShaftVel[Base/State/High]

The figure shows the relation of the inputs and outputs to the "Base", "State" and "High" versions. The additional inputs and outputs of the "State" and "High" versions are shaded.

L_TT1P_ElectricalShaftVel[Base/State/High]

Base			
BOOL	xEnableInternalControl	xInternalControlActive	BOOL
BOOL	xEnable	eTMState	L_TT1P_States
scCtrl_ABC	scCtrlABC	scStatusABC	scStatus_ABC
BOOL	xResetError	xError	BOOL
BOOL	xRegulatorOn	xWarning	BOOL
BOOL	xStop	eErrorID	L_IE1P_Error
BOOL	xHalt	scErrorInfo	L_TT1P_scErrorInfo
L_TT1P_scPar_ElectricalShaftVel[Base/State/High]	scPar	xAxisEnabled	BOOL
AXIS_REF	MasterAxis	scSignalFlow	L_TT1P_scSF_ElectricalShaftVel[Base/State/High]
AXIS_REF	SlaveAxis	xDone	BOOL
L_TT1P_scAP_ElectricalShaftVel[Base/State/High]	scAccessPoints	xBusy	BOOL
BOOL	xJogPos	lrActVel	LREAL
BOOL	xJogNeg	lrActPos	LREAL
BOOL	xSyncVel	lrOffset	LREAL
LREAL	lrSetOffSet		
State			
BOOL	xTrimPos	lrOffsetTrim	LREAL
BOOL	xTrimNeg	lrOffsetTotal	LREAL
		xSynchronised	BOOL
		xAccDecSync	BOOL
High			
LREAL	lrSetGroundVel		

3.3.1 Inputs and outputs

Designator Data type	Description	Available in version		
		Base	State	High
MasterAxis AXIS_REF	Reference to the master axis (master axis)	●	●	●
SlaveAxis AXIS_REF	Reference to the slave axis	●	●	●

3.3.2 Inputs

Designator Data type	Description		Available in version		
			Base	State	High
xEnableInternalControl BOOL	TRUE	In the visualisation, the internal control of the axis can be selected via the "Internal Control" axis.	●	●	●
xEnable BOOL	Execution of the function block		●	●	●
	TRUE	The function block is executed.			
	FALSE	The function block is not executed.			
scCtrlABC scCtrl_ABC	Input structure for the **L_MC1P_AxisBasicControl** function block • scCtrlABC can be used in "Ready" state. • If there is a request, the state changes to "Service". • The state change from "Service" back to "Ready" takes place if there are no more requests.		●	●	●
xResetError BOOL	TRUE	Reset axis error or software error.	●	●	●
xRegulatorOn BOOL	TRUE	Activate controller enable of the axis (via the **MC_Power** function block).	●	●	●
xStop BOOL	TRUE	Cancel the active movement and brake the axis to a standstill with the deceleration defined via the lrStopDec parameter. • The state changes to "Stop". • The technology module remains in the "Stop" state as long as xStop is set to TRUE (or xHalt = TRUE). • The input is also active with "Internal Control".	●	●	●
xHalt BOOL	TRUE	Cancel the active movement and brake the axis to a standstill with the deceleration defined via the lrHaltDec parameter. • The state changes to "Stop". • The technology module remains in the "Stop" state as long as xStop is set to TRUE (or xHalt = TRUE).	●	●	●
scPar L_TT1P_scPar_ElectricalShaftVel[Base/State/High]	The parameter structure contains the parameters of the technology module. The data type depends on the version used (Base/State/High).		●	●	●
scAccessPoints L_TT1P_scAP_ElectricalShaftVel[Base/State/High]	Structure of the access points The data type depends on the version used (Base/State/High).		●	●	●
xJogPos BOOL	TRUE	Traverse axis in positive direction (manual jog). If xJogNeg is also TRUE, the traversing direction selected first remains set.	●	●	●

Designator / Data type	Description		Available in version: Base	State	High
xJogNeg BOOL	TRUE	Traverse axis in negative direction (manual jog). If xJogPos is also TRUE, the traversing direction selected first remains set.	●	●	●
xSyncVel BOOL	Synchronisation of the slave axis to the master axis		●	●	●
	TRUE	Base: Synchronisation without clutch function			
		State/High: Synchronisation with velocity clutch			
lrSetOffsetSlave LREAL	Velocity offset to master axis The position is approached in the "VEL_IS_SYNCHRONISED" state when the value changes • Unit: units/s		●	●	●
	Base/ State	The offset is directly applied.			
	High	The offset is assigned via the profile generator.			
xTrimPos BOOL	TRUE	Trim velocity in positive direction. If xTrimNeg is also TRUE, the traversing direction selected first remains set.		●	●
xTrimNeg BOOL	TRUE	Trim velocity in negative direction. If xTrimPos is also TRUE, the traversing direction selected first remains set.		●	●
lrSetGroundVel LREAL	Basic velocity The velocity specified is transmitted to the axis when the clutch is open. • Unit: units/s				●

3.3.3 Outputs

Designator Data type	Description		Available in version		
			Base	State	High
xInternalControlActive BOOL	TRUE	The internal control of the axis is activated via the visualisation. (xEnableInternalControl input = TRUE)	●	●	●
eTMState L_TT1P_States	Current state of the technology module ▸ State machine (📖 21)		●	●	●
scStatusABC scStatus_ABC	Structure of the status data of the **L_MC1P_AxisBasicControl** function block		●	●	●
xError 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 xError = TRUE or xWarning = TRUE. **"FAST technology modules" reference manual:** Here you can find information on error or warning messages.		●	●	●
scErrorInfo L_TT1P_scErrorInfo	Error information structure for a more detailed analysis of the error cause		●	●	●
scSignalFlow L_TT1P_scSF_ElectricalShaftVel[Base/State/High]	Structure of the signal flow The data type depends on the version used (Base/State/High). ▸ Signal flow diagram (📖 22)		●	●	●
xAxisEnabled BOOL	TRUE	The axis is enabled.	●	●	●
xDone BOOL	TRUE	The request/action has been completed successfully.	●	●	●
xBusy BOOL	TRUE	The request/action is currently being executed.	●	●	●
lrActVel LREAL	Current velocity • Unit: units/s		●	●	●
lrActPos LREAL	Current position • Unit: units		●	●	●
lrOffset LREAL	Set velocity offset from the lrSetOffsetSlave input between the master axis and the slave axis • Unit: units/s		●	●	●
lrOffsetTrim LREAL	Velocity offset from the trimming function between the master axis and the slave axis • Unit: units/s			●	●
lrOffsetTotal LREAL	Total velocity offset between the master axis and the slave axis • Unit: units/s			●	●
xSynchronised BOOL	TRUE	The axis is coupled with reference to the master axis.		●	●
xAccDecSync BOOL	TRUE	The synchronisation function is active. The axis is synchronised or desynchronised (clutch opens or closes).		●	●

3.3.4 Parameters

L_TT1P_scPar_ElectricalShaftVel[Base/State/High]

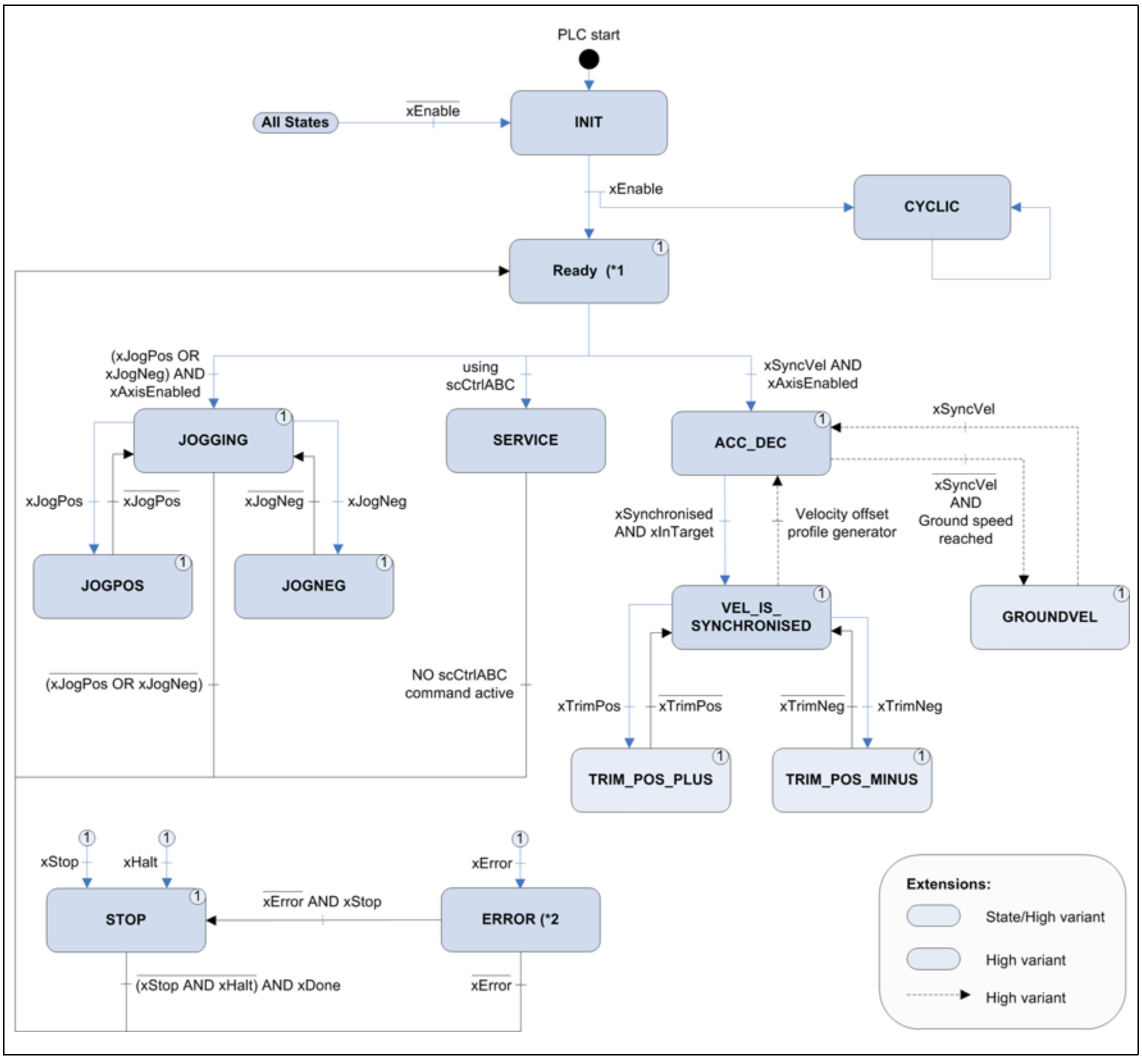
The **L_TT1P_scPar_ElectricalShaftVel[Base/State/High]** structure contains the parameters of the technology module.

Designator / Data type	Description	Available in version: Base	State	High
lrStopDec LREAL	Deceleration for the stop function and when hardware/ software limit switches and the following error monitoring function are triggered • Unit: units/s^2 • Initial value: 10000	●	●	●
lrStopJerk LREAL	Jerk for the stop function and for the triggering of the hardware limit switches, software limit positions, and the following error monitoring function • Unit: units/s^3 • Initial value: 100000	●	●	●
lrHaltDec LREAL	Deceleration for the holding function Specification of the maximum speed variation which is to be used for deceleration to standstill. • Unit: units/s^2 • Initial value: 3600 • Only positive values are permissible.	●	●	●
lrJerk LREAL	Jerk for compensating an offset value, trimming, clutch, or holding function • Unit: units/s^3 • Initial value: 100000	●	●	●
lrJogJerk LREAL	Jerk for manual jog • Unit: units/s^3 • Initial value: 10000	●	●	●
lrJogVel LREAL	Maximum speed to be used for manual jog. • Unit: units/s • Initial value: 10	●	●	●
lrJogAcc LREAL	Acceleration for manual jog Specification of the maximum speed variation which is to be used for acceleration. • Unit: units/s^2 • Initial value: 100	●	●	●
lrJogDec LREAL	Deceleration for manual jog Specification of the maximum speed variation which is to be used for deceleration to standstill. • Unit: units/s^2 • Initial value: 100	●	●	●
dwCouplingMode DWORD	Mode for coupling measuring systems X and Y • Initial value: 1 (coupling over cycle lengths) 0: Unit clutch 1: Coupling via cycle lengths	●	●	●
lrCouplingX LREAL	Coupling factor for the X axis • The setting of the parameter is effective in the "unit coupling" (dwCouplingMode = 0). • Changes of the parameter are accepted in the "Ready" state. • In a clutched-in state, the coupling factor cannot be changed via the parameter. The coupling factor can only be changed via the access points L_TT1P_scAP_ElectricalShaftVel[Base/State/High] (📖 24). • Initial value: 1	●	●	●

<table>
<tr><th rowspan="2">Designator
Data type</th><th rowspan="2">Description</th><th colspan="3">Available in version</th></tr>
<tr><th>Base</th><th>State</th><th>High</th></tr>
<tr><td>lrCouplingY
LREAL</td><td>Coupling factor for the Y axis
• The setting of the parameter is effective in the "unit coupling" (dwCouplingMode = 0).
• Changes of the parameter are accepted in the "Ready" state.
• In a clutched-in state, the coupling factor cannot be changed via the parameter. The coupling factor can only be changed via the access points L_TT1P_scAP_ElectricalShaftVel[Base/State/High] (24).
• Initial value: 1</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>lrTrimAcc
LREAL</td><td>Acceleration for trimming
Selection of the velocity change relative to the master to be used for accelerating. The acceleration acting on the drive is the sum of master and slave acceleration.
• Unit: units/s^2
• Initial value: 100</td><td></td><td>●</td><td>●</td></tr>
<tr><td>lrTrimDec
LREAL</td><td>Deceleration for trimming
Selection of the velocity change relative to the master to be used for decelerating. The deceleration acting on the drive is the sum of master and slave deceleration.
• Unit: units/s^2
• Initial value: 100</td><td></td><td>●</td><td>●</td></tr>
<tr><td>lrTrimVel
LREAL</td><td>Velocity for trimming
Selection of the velocity used for trimming.
• Unit: units/s
• Initial value: 50</td><td></td><td>●</td><td>●</td></tr>
<tr><td rowspan="2">lrSyncOutAcc
LREAL</td><td>Acceleration for declutching
• Base/State:
Deceleration ramp for travelling to a standstill
• High:
Synchronisation to the lrSetGroundVel basic velocity</td><td rowspan="2"></td><td rowspan="2">●</td><td rowspan="2">●</td></tr>
<tr><td>• Unit: units/s^2
• Initial value: 100
• Value 0.0 units/s^2: Maximum acceleration (the difference in velocity is reached in one cycle.)</td></tr>
<tr><td>lrSyncInAcc
LREAL</td><td>Acceleration for clutching-in
• Acceleration ramp for synchronising the master velocity.
• Value 0.0 units/s^2: Maximum acceleration (the difference in velocity is reached in one cycle.)
• Unit: units/s^2
• Initial value: 100</td><td></td><td>●</td><td>●</td></tr>
<tr><td>lrSyncJerk
LREAL</td><td>Jerk for clutch-in and declutch function
• Unit: units/s^3
• Initial value: 10000</td><td></td><td>●</td><td>●</td></tr>
<tr><td>lrOffsetAcc
LREAL</td><td>Acceleration for ramp generation
• Value 0.0 units/s^2: Maximum acceleration (the difference in velocity is reached in one cycle.)
• Unit: units/s^2
• Initial value: 100</td><td></td><td></td><td>●</td></tr>
</table>

Designator Data type	Description	Available in version		
		Base	State	High
lrOffsetDec LREAL	Deceleration for ramp generation • Value 0.0 units/s^2: Maximum deceleration (the difference in velocity is reached in one cycle.) • Unit: units/s^2 • Initial value: 100			●
lrOffsetJerk LREAL	Jerk for ramp generation • Value 0 units/s^3: Jerk limitation deactivated (Use of linear acceleration ramps) • Unit: units/s^3 • Initial value: 10000			●

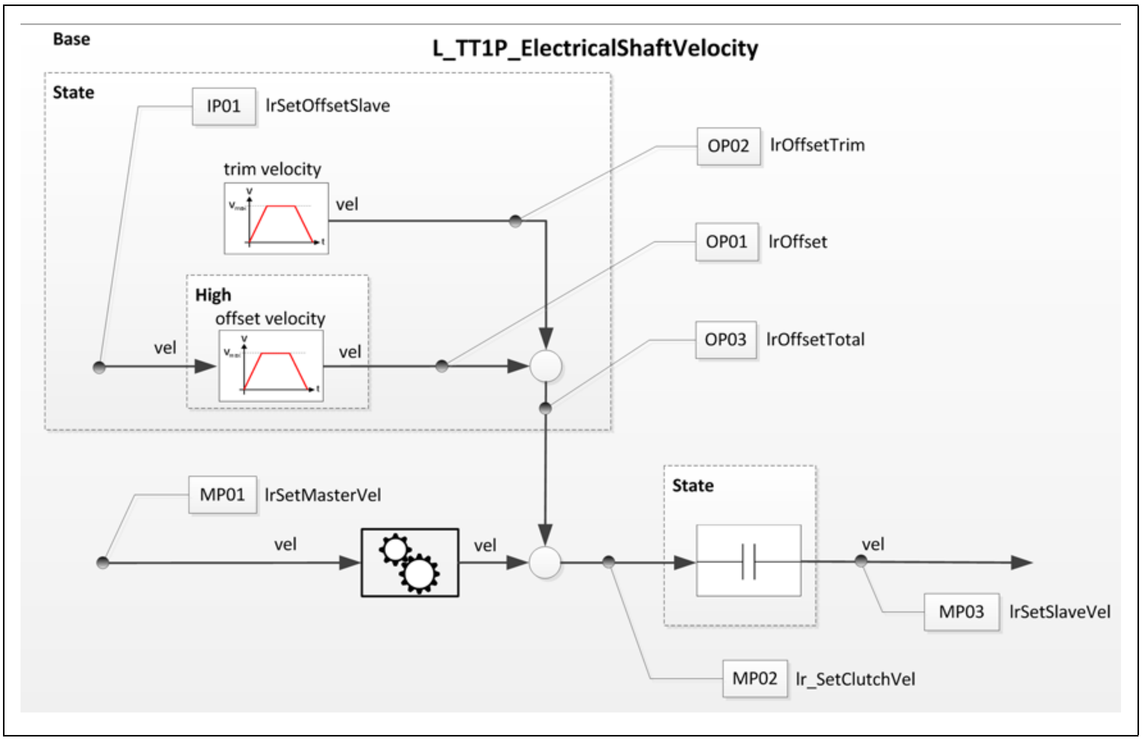
3.4 State machine



[3-2] State machine of the technology module

(*1 In the "Ready" state, xRegulatorOn has to be set to TRUE.
(*2 In the "ERROR" state, xResetError has to be set to TRUE in order to acknowledge and reset the errors.

3.5 Signal flow diagram



[3-3] Signal flow diagram

The illustration [3.5] shows the main signal flow of the implemented functions.

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

3.5.1 Structure of the signal flow

L_TT1P_scSF_ElectricalShaftVel[Base/State/High]

The contents of the **L_TT1P_scSF_ElectricalShaftVel[Base/State/High]** structure are read-only and offer a practical diagnostics option within the signal flow (Signal flow diagram (22)).

Designator / Data type	Description		Available in version: Base	State	High
IP01_lrSetOffsetSlave LREAL	Velocity offset to master axis The position is approached in the "VEL_IS_SYNCHRONISED" state when the value changes • Unit: units/s		●	●	●
	Base/ State	The offset is directly applied.			
	High	The offset is assigned via the profile generator.			
MP01_lrSetMasterVel LREAL	Setpoint velocity of the master axis • Unit: units/s		●	●	●
MP02_lrSetClutchVel LREAL	Master velocity for the clutch • Unit: units/s		●	●	●
MP03_lrSetSlaveVel LREAL	Setpoint velocity of the slave axis • Unit: units/s		●	●	●
OP01_lrOffset LREAL	Set velocity offset from the lrSetOffsetSlave input between the master axis and the slave axis • Unit: units/s		●	●	●
OP02_lrOffsetTrim LREAL	Velocity offset from the trimming function between the master axis and the slave axis • Unit: units/s			●	●
OP03_lrOffsetTotal LREAL	Total velocity offset between the master axis and the slave axis • Unit: units/s			●	●

3.5.2 Structure of the access points

L_TT1P_scAP_ElectricalShaftVel[Base/State/High]

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.

<table>
<tr><th rowspan="2">Designator
Data type</th><th rowspan="2" colspan="2">Description</th><th colspan="3">Available in version</th></tr>
<tr><th>Base</th><th>State</th><th>High</th></tr>
<tr><td rowspan="2">AP01_xCouplingX
BOOL</td><td colspan="2">Enable of the AP01_xCouplingX access point</td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3">●</td></tr>
<tr><td>TRUE</td><td>The access point overwrites the values at the access point in the signal flow.
The coupling factor in the lrCouplingX parameter becomes ineffective.</td></tr>
<tr><td>AP01_lrCouplingX
LREAL</td><td colspan="2">Active coupling factor for the X axis
• The setting of the parameter is effective in the "unit coupling" (dwCouplingMode = 0).
• The coupling factor can also be changed cyclically in a clutched-in state.</td></tr>
<tr><td rowspan="2">AP02_xCouplingY
BOOL</td><td colspan="2">Enable of the AP01_xCouplingY access point</td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3">●</td></tr>
<tr><td>TRUE</td><td>The access point overwrites the values at the access point in the signal flow.
The coupling factor in the lrCouplingY parameter becomes ineffective.</td></tr>
<tr><td>AP02_lrCouplingY
LREAL</td><td colspan="2">Active coupling factor for the Y axis
• The setting of the parameter is effective in the "unit coupling" (dwCouplingMode = 0).
• The coupling factor can also be changed cyclically in a clutched-in state.</td></tr>
</table>

3.6 Manual jog (jogging)

Precondition

- The technology module is in the "Ready" state.
- The slave axis is enabled (*xRegulatorOn* = TRUE).

Execution

For manual jog of the axis, the manual jog speed *lrJogVel* is used.

If the *xJogPos* input is TRUE, the axis is traversed in positive direction and if the *xJogNeg* input is TRUE, the axis is traversed in negative direction. The axis is executed for as long as the input remains set to TRUE.

The current travel command cannot be replaced by another jog command. Only if both inputs have been reset, the State machine (📖 21) changes to the "Ready" state again.

Parameters to be set

The parameters for the manual jog are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (📖 18) parameter structure.

```
lrJogVel : LREAL := 10;     // Velocity [units/s]
lrJogAcc : LREAL := 100;     // Acceleration [units/s^2]
lrJogDec : LREAL := 100;     // Deceleration [units/s^2]
lrJogJerk : LREAL := 10000;  // Jerk [units/s^3]
```

The parameter values can be changed during operation. They are accepted when the *xJogPos* or *xJogNeg* input is set to TRUE again.

3.7 Synchronism (SyncVel)

Note!

A coupling procedure requires the master axis and slave axis to be at standstill. Running axes cause a velocity jump.

Execution

For synchronising the slave axis and master axis, the slave velocity is directly coupled to the master velocity by means of the coupling factor.

The coupling factor can either be defined by unit coupling or set cycle lengths.

- Coupling factor = *lrCouplingY* / *lrCouplingX*
- Coupling factor = cycle length of the slave axis / cycle length of the master axis

The coupling mode is set via the *dwCouplingMode* parameter.

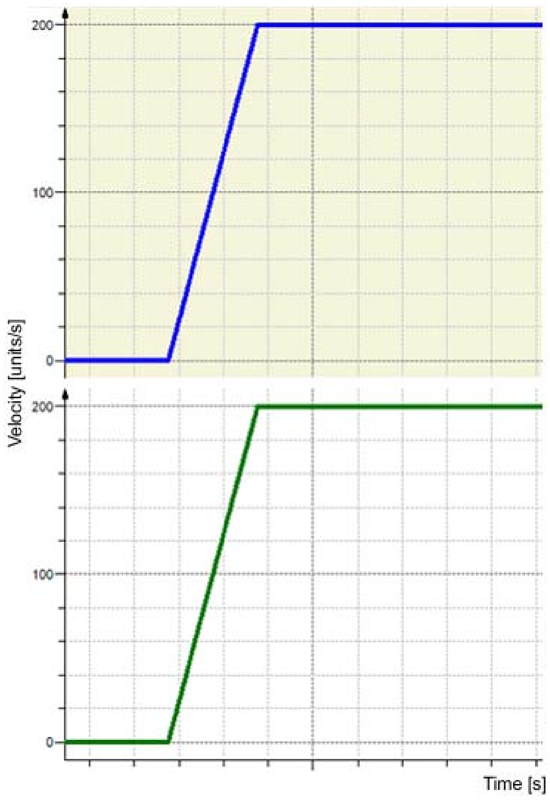
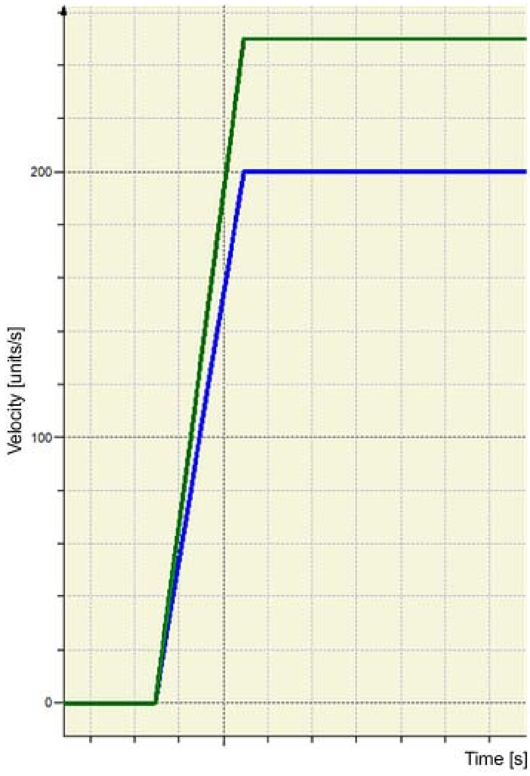
The cycle lengths are set in the axes.

Parameters to be set

The parameters for coupling are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (📖 18) parameter structure.

```
dwCouplingMode : DWORD := 1;  // 0: Unit coupling, 1: Coupling via cycle lengths
lrCouplingX : LREAL := 1;
lrCouplingY : LREAL := 1;
```

Examples

Synchronism with identical cycle (360/360)	Synchronism with different cycle (360/450)
	

3.8 Velocity offset during synchronism

Note!

A velocity offset is set with a velocity jump.

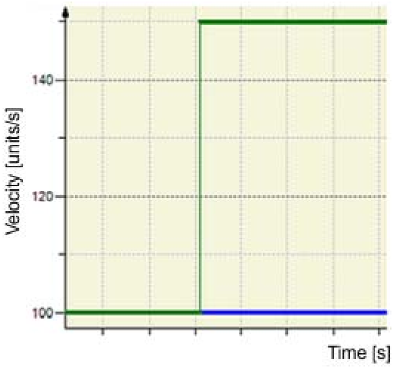
Precondition

Setting a velocity offset is only possible in the "VEL_IS_SYNCHRONISED" state.

Execution

A variable velocity offset between master and slave is defined with the *IrSetOffsetSlave* input. In the "VEL_IS_SYNCHRONISED" state and with a changed value, the offset is abruptly connected to the setpoint velocity of the axis.

Example



[3-4] Velocity offset IrSetOffsetSlave = 50

3.9 Synchronism with clutch-in/declutch mechanism

Execution

The synchronism of slave axis and master axis is extended by a clutch function. The clutch function synchronises the velocity of the slave axis to the master velocity of the master axis. Here, positioning takes place jump-free.

Clutch-in starts at any position when *xSyncVel* = TRUE.

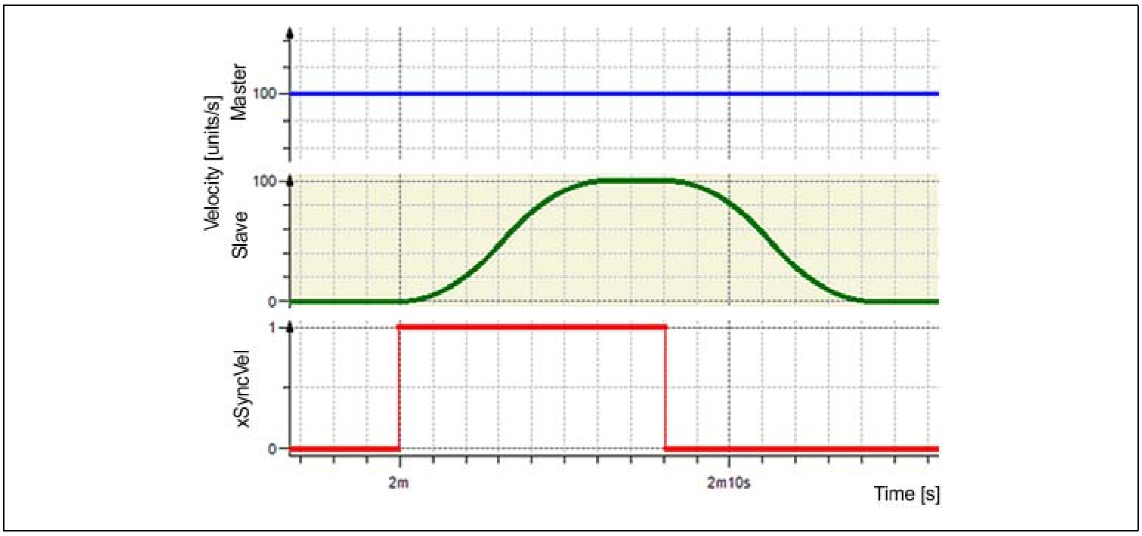
When declutching with *xSyncVel* = FALSE, the drive is braked to standstill at the *lrSyncOutAcc* deceleration and changed to the "Ready" state.

Parameters to be set

The parameters for the clutch function are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (🕮 18) parameter structure.

```
lrSyncOutAcc : LREAL := 10.0;
lrSyncInAcc : LREAL := 10.0;
lrSyncOutInstantAcc : LREAL := 100.0;
lrSyncJerk : LREAL := 10000;
```

Example



[3-5] Clutch-in/declutch process

[3-5] shows the clutch-in/declutch process from standstill to the velocity of 100.0 units/s and back again to standstill.

3.10 Position trimming

Precondition

The position trimming is only possible in the "VEL_IS_SYCHRONISED" state.

Execution

Position trimming enables the position of the slave axis to be adjusted towards the master axis by "tipping" - by analogy with Manual jog (jogging) (📖 25).

Position trimming is started by setting the input *xTrimPos* or *xTrimNeg* to TRUE. The "VEL_IS_SYCHRONISED" state then changes to "TRIM_POS_PLUS" or "TRIM_POS_MINUS", depending on the direction, and only leaves it when the respective input *xTrimPos* or *xTrimNeg* is reset to FALSE.

Offsets adjusted by trimming can be detected via the *lrOffsetTrim* output. The value of *lrOffsetTrim* can only be reset to zero by switching of the technology module.

Parameters to be set

The parameters for position trimming are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (📖 18) parameter structure.

```
lrJerk    : LREAL := 10000;
lrTrimAcc : LREAL := 100;
lrTrimDec : LREAL := 100;
lrTrimVel : LREAL := 50;
```

The acceleration and velocity of the trimming superimpose the ones of the master axis. Hence, the results for the axis to be trimmed are as follows:

- Resulting velocity of: $\mathbf{v_{AxisRes} = v_{MasterAxis} + lrTrimVel}$
- Resulting acceleration of: $\mathbf{a_{AxisRes} = a_{MasterAxis} + lrTrimAcc}$

3.11 Velocity offset with profile generator

Precondition

Setting a velocity offset is only possible in the "VEL_IS_SYNCHRONISED" state.

Execution

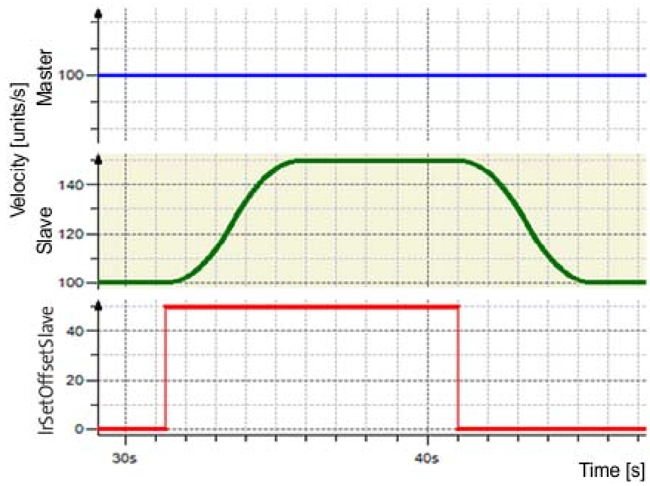
The velocity offsets transferred to the axis via a profile generator without position jumps. The offset is selected using the *lrSetOffsetSlave* input. The velocity offset is driven by means of S-rounding.

Parameters to be set

The parameters for the S-rounding are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (📖 18) parameter structure.

```
lrOffsetAcc : LREAL := 100.0;
lrOffsetDec : LREAL := 100.0;
lrOffsetJerk : LREAL := 10000;
```

Example



[3-6] Velocity offset (lrSetOffsetSlave = 50) by means of S-rounding (lrOffsetJerk = 10)

3.12 Synchronism with basic velocity

Execution

The basic velocity is active as soon as a non-zero value is set in the *lrSetGroundVel* input. Immediately after the function block has been activated, the drive travels to the basic velocity by means of S-rounding and then changes to the "GROUNDVEL" state.

Based on this state, the slave axis velocity can be synchronised to the master velocity of the master axis via the clutch function – as in case of Synchronism with clutch-in/declutch mechanism (📖 29). Clutching-in starts at any position when *xSyncVel* = TRUE. When declutching by means of *xSyncVel* = FALSE, the drive travels back to basic velocity with the *lrSyncOutAcc* deceleration.

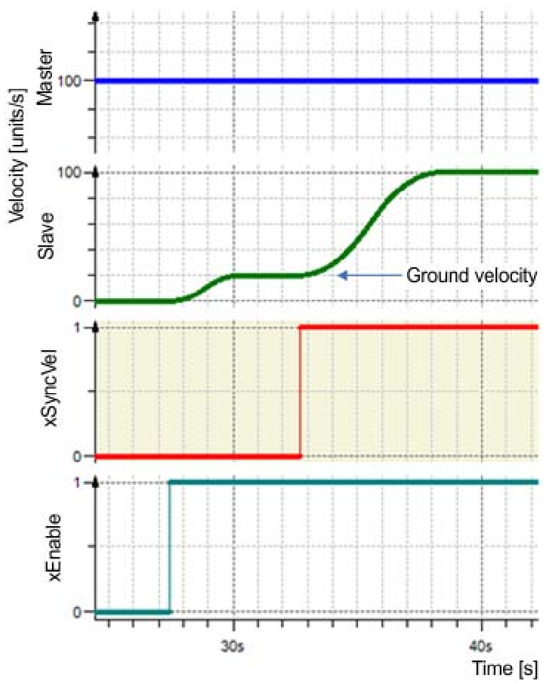
Parameters to be set

The parameters for the S-rounding and the clutch function are located in the L_TT1P_scPar_ElectricalShaftVel[Base/State/High] (📖 18) parameter structure.

```
// Parameters for S-rounding
lrOffsetAcc : LREAL := 100.0;
lrOffsetDec : LREAL := 100.0;
lrOffsetJerk : LREAL := 10000;

// Parameters for the clutch function
lrSyncOutAcc : LREAL := 10.0;
lrSyncInAcc : LREAL := 10.0;
lrSyncOutInstantAcc : LREAL := 100.0;
lrSyncJerk : LREAL := 10000;
```

Example



[3-7] Clutch-in process (xSyncVel = TRUE) with basic velocity (lrSetGroundVel = 20)

3.13 CPU utilisation (example Controller 3231 C)

The following table shows the CPU utilisation in microseconds using the example of the 3231 C controller (ATOM™ processor, 1.6 GHz).

Versions	Interconnection of the technology module	CPU utilisation	
		Average	Maximum peak

Base	xEnable := TRUE;
	xRegulatorOn := TRUE;
	xSyncVel := TRUE;
		40 µs	72 µs

State	xEnable := TRUE;
	xRegulatorOn := TRUE;
	xSyncVel := TRUE;
		50 µs	83 µs

High	xEnable := TRUE;
	xRegulatorOn := TRUE;
	xSyncVel := TRUE;
		60 µs	91 µs

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FEEDBACK

Your opinion is important to us

These instructions were created to the best of our knowledge and belief to give you the best possible support for handling 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.

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