FAST Application Software

Technology module

Table Positioning_____

Reference Manual EN

13531744

Lenze

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1 About this documentation

This documentation ...

- contains detailed information on the functionalities of the "Table Positioning" 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
3.3	05/2017	TD17	• Content structure has been changed. • General revisions
3.2	11/2016	TD29	• General revisions • Interconnection examples supplemented: Touch probe positioning (📖 34)
3.1	04/2016	TD17	General revisions
3.0	10/2015	TD17	• Corrections and additions • Content structure has been changed.
2.0	05/2015	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!**	**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 "Table Positioning"

The technology module provides functions for positioning in the limited travel range and unlimited travel range (modulo measuring system).

The travel profile data required for the positioning process are managed and transferred by a profile data management function (see General information regarding the positioning process (📖 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:

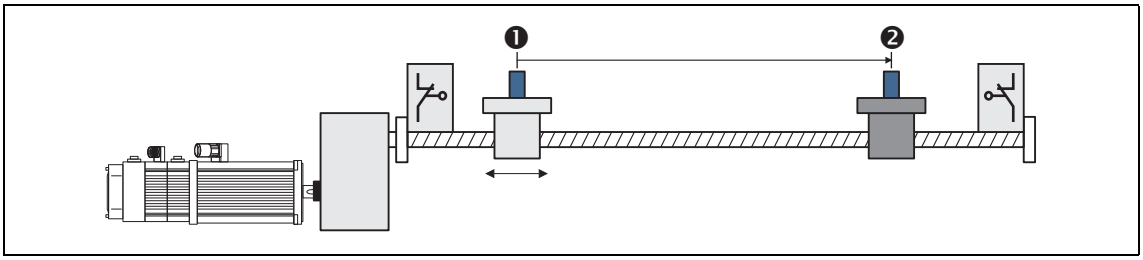
- Manual jog (jogging) (📖 26)
- Homing (📖 27)
- Profile data mManagement (profile parameters) (📖 28)
- Positioning modes (📖 31)
- Execute positioning (📖 33)
- Interrupt positioning and complete it later (📖 33)
- Touch probe positioning (📖 34)
- Override (velocity, acceleration, jerk limitation) (📖 37)
- Following error monitoring (📖 38)

»PLC Designer« Online help

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

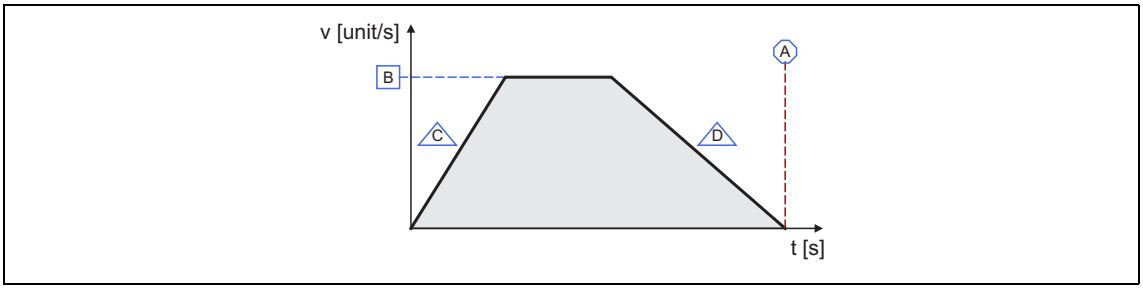
3.2 General information regarding the positioning process

Positioning means to move a workpiece/tool or material to a defined target (❷) from a starting position (❶):



[3-1] Example: Positioning in case of a spindle drive (linear axis)

For this purpose, a travel profile has to be stored in the inverter which at least requires the following profile parameters:



[3-2] Examples for a travel profile

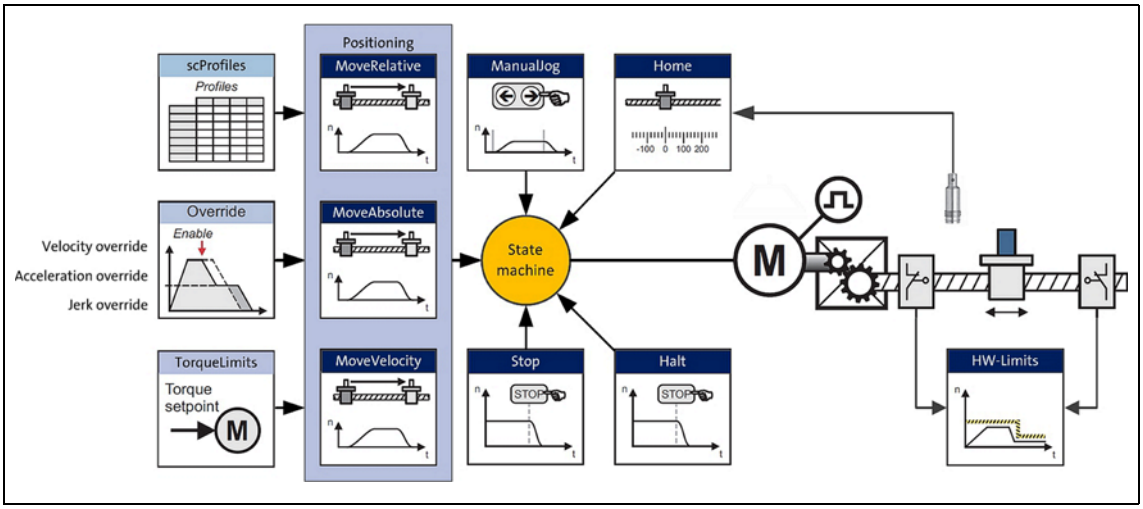
Symbol	Profile parameters
A	**Position** Target position or distance to be travelled.
B	**Velocity** Maximum velocity during the positioning process.
C	**Acceleration** Maximum acceleration during the positioning process.
D	**Deceleration** Maximum deceleration during the positioning process.

- A travel profile describes a motion task that converts a rotary motion of the motor shaft.
- Positioning may consist of several travel profiles that are executed in a defined sequence.

3.2.1 Profile data management

The functional core of the "table positioning" is the profile data management that manages and transmits the required travel profile data for positioning.

The real sequence control is executed through a master control (PLC, master).



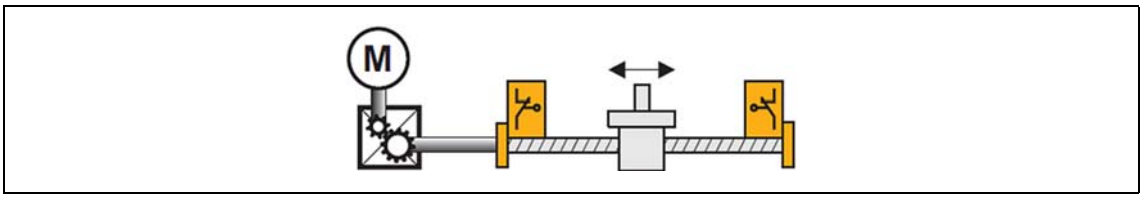
[3-3] Schematic diagram of the "table positioning"

3.2.2 Travel range

The machine type/measuring system is defined by setting the travel range.

Limited travel range

A limited travel range is provided, for instance, in case of a spindle drive (linear axis).

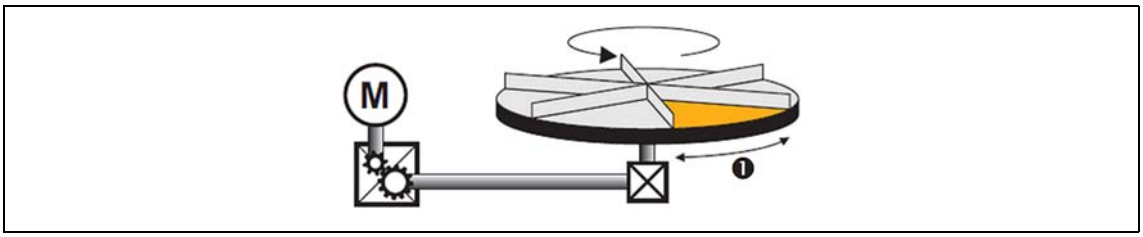


[3-4] Limited travel range

- For positioning, the home position must be known.
  Execute ▸ Homing (📖 27).
- After the workpiece/tool or material has reached the travel range limit switch (hardware limit switch), the drive must rotate in the opposite direction.
- Generally, the maximum value range ($\pm 2^{31}$ increments) is monitored internally. Otherwise, an override of the value range would cause a loss of the home position.
- Moreover, the user can set and activate software limit positions to limit the travel range.

Unlimited travel range (Modulo measuring system)

The Modulo measuring system is also called "rotary table application".



[3-5] Unlimited travel range (Modulo measuring system)

- For positioning, the home position must be known.
  Execute ▸ Homing (📖 27).
- The measuring system is repeated.
- When the set cycle length (❶) is exceeded, a defined override takes place.
  In a rotary system, the cycle length typically corresponds to one rotation or one tool distance.
- Software limit positions are not effective.
- Absolute targets can be approached over the shortest possible path by exceeding the measuring system limit, e.g. from 10° over 0° to 350° (angular degree).

3.3 Important notes on how to operate the technology module

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.

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.

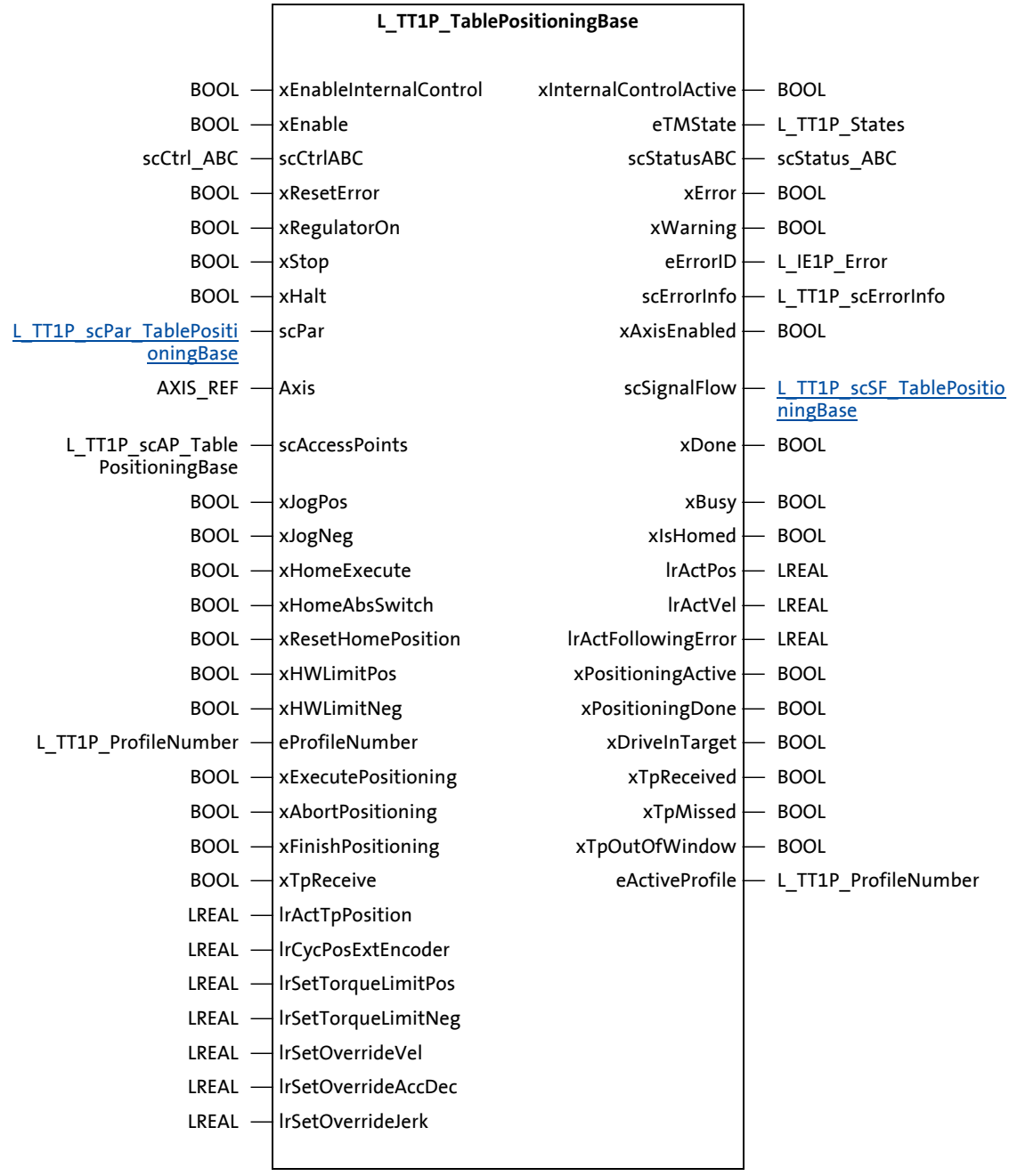
Example Manual jog (jogging) (📖 26)**:**

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

3.4 Function block L_TT1P_TablePositioningBase

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

The base version offers the full functionality of the technology module.



3.4.1 Inputs and outputs

Designator Data type	Description
Axis AXIS_REF	Axis for table positioning

3.4.2 Inputs

Designator Data type		Description
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 IrStopDec 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 IrHaltDec 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_TablePositioningBase	The parameter structure contains the parameters of the technology module. The data type depends on the version used (Base).	
scAccessPoints L_TT1P_scAP_TablePositioningBase	Structure of the access points The data type depends on the version used (Base).	
xJogPos BOOL	TRUE	Traverse axis in positive direction (manual jog). If xJogNeg is also TRUE, the traversing direction selected first remains set.
xJogNeg BOOL	TRUE	Traverse axis in negative direction (manual jog). If xJogPos is also TRUE, the traversing direction selected first remains set.
xHomeExecute BOOL	The input is edge-controlled and evaluates the rising edge.	
	FALSE↗ TRUE	Start homing. The function is aborted via the xStop input.
xHomeAbsSwitch BOOL	TRUE	Connection for reference switch: For homing modes with a reference switch, connect this input to the digital signal which maps the state of the reference switch.

Designator Data type	Description	
xResetHomePosition BOOL	TRUE	Reset "Home position known" status information.
xHWLimitPos BOOL	Positive hardware limit switch Connect this input to the corresponding digital input that is connected to the limit switch.	
	TRUE	The positive hardware limit switch has been reached or approached. • The xHwLimitSwitchPos output is also set to TRUE. • The axis is brought to a standstill with the deceleration in the dlrStopDec parameter. • The state changes to "ERROR" with the error message '20500' (HWLimitPos).
xHWLimitNeg BOOL	Negative hardware limit switch Connect this input to the corresponding digital input that is connected to the limit switch.	
	TRUE	The negative hardware limit switch has been reached or approached. • The xHwLimitSwitchNeg output is also set to TRUE. • The axis is brought to a standstill with the deceleration in the dlrStopDec parameter. • The state changes to "ERROR" with the error message '20501' (HWLimitNeg).
eProfileNumber L_TT1P_ProfileNumber	Selection of the active travel profile • Initial value: 1 (profile 1)	
	0	No profile
	1	Profile 1
	...	...
	16	Profile 16
xExecutePositioning BOOL	The input is edge-controlled and evaluates the rising edge.	
	FALSE↗TRUE	The travel profile selected in the eProfileNumber input is executed.
	FALSE↗TRUE	Restart by a renewed FALSE↗TRUE edge: • During a running positioning process, another profile can be selected via the scProfiles profile data structure (see (📖 21)L_TT1P_scPar_TablePositioningBase parameter structure) that will be executed after a restart. • Distances for relative positioning are not considered.
xAbortPositioning BOOL	Abort or interruption of the positioning	
	FALSE↗TRUE	The current travel profile is interrupted and the axis is brought to a standstill with the deceleration defined in the profile data.
	TRUE	A restart via the xExecutePositioning input or the resumption of an interrupted positioning via the xFinishPositioning input is prevented.
	FALSE	A restart via the xExecutePositioning input or the resumption of an interrupted positioning via the xFinishPositioning input is enabled. If the restart signal is set via xFinishPositioning during a deceleration phase, the positioning process is continued immediately.
xFinishPositioning BOOL	Continuation of an interrupted positioning	
	FALSE↗TRUE	Restart: • A positioning process previously interrupted via xAbortPositioning will be completed. • Distances of a relative positioning already covered are taken into account.
xTpReceive BOOL	TRUE	A touch probe mark has been detected in the connected touch probe sensor.
lrActTpPosition LREAL	Current position of the touch probe mark with regard to the axis reference used. • Unit: units	

Designator Data type	Description
lrCycPosExtEncoder LREAL	Cyclic position of the external encoder in case the touch probe from the encoder axis is used. (eTpMode parameter = 2: External encoder) • Unit: units
lrSetTorqueLimitPos LREAL	Positive torque limitation from the gearbox output This input is activated when the xLoadTorqueLimits parameter = TRUE. • Unit: Nm
lrSetTorqueLimitNeg LREAL	Negative torque limitation from the gearbox output This input is activated when the xLoadTorqueLimits parameter = TRUE. • Unit: Nm
lrSetOverrideVelocity LREAL	Value for the velocity override • Value range: 0.0 ... 1.0 (0 ... 100 %) • Initial value: 1.0 (100 %) Values < '0.0' are set internally to '0.0' and the axis is brought to a standstill.
lrSetOverrideAccDec LREAL	Value for the acceleration/deceleration override • Value range: 0.1 ... 1.0 (10 ... 100 %) • Initial value: 1.0 (100.0 %)
lrSetOverrideJerk LREAL	Value for the jerk override • Value range: 0.1 ... 1.0 (10 ... 100 %) • Initial value: 1.0 (100 %)

3.4.3 Outputs

Designator Data type	Description	
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 (📖 23)	
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_TablePositioningBase	Structure of the signal flow The data type depends on the version used (Base/State). ▸ Signal flow diagram (📖 24)	
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.
xIsHomed BOOL	TRUE	The axis has been referenced (reference known).
lrActPos LREAL	Current position • Unit: units	
lrActVel LREAL	Current velocity • Unit: units/s	
lrActFollowingError LREAL	Current following error • Unit: units	
xPositioningActive BOOL	TRUE	Positioning is executed (axis is moving).
xPositioningDone BOOL	TRUE	Positioning has been executed. The travel profile has been executed; no sequence profile defined.
xDriveInTarget BOOL	Status signal "Drive in target position"	
	FALSE↗ TRUE	The target position has been reached after the travel profile has been executed within the tolerance window (lrTargetWindow parameter). In case of positioning with sequence profiles, xDriveInTarget is set= TRUE after the last travel profile has been executed.
	TRUE↘ FALSE	After a positioning has been completed, the current actual position has left the tolerance window (lrTargetWindow parameter) again.
xTpReceived BOOL	TRUE	A touch probe mark has been detected.
xTpMissed BOOL	TRUE	No touch probe mark has been detected within the touch probe window.

Designator Data type	Description	
xTpOutOfWindow BOOL	TRUE	A touch probe mark has been detected outside of the touch probe window.
eActiveProfile L_TT1P_ProfileNumber	Profile number of the current travel profile	

3.4.4 Parameters

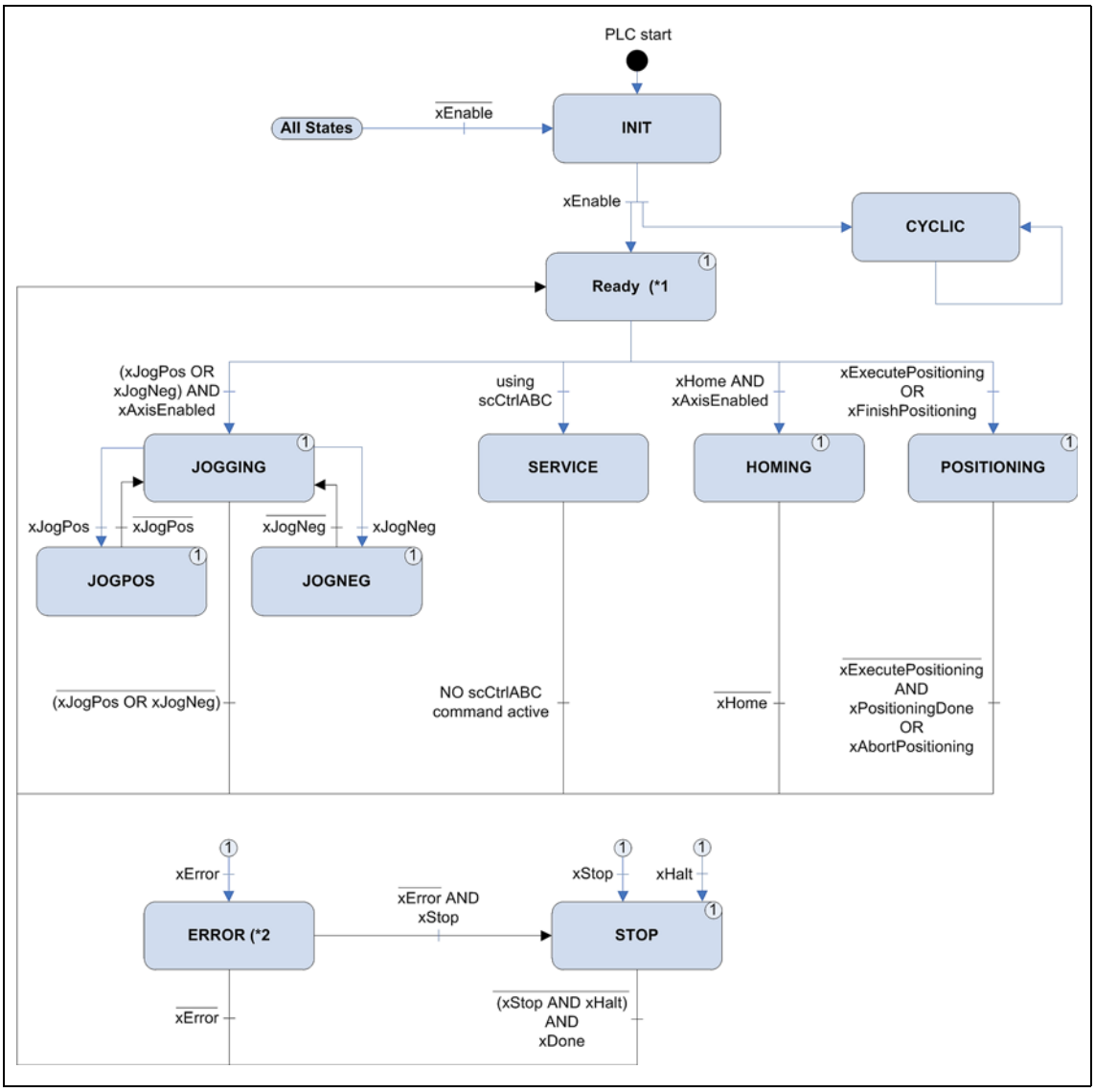
L_TT1P_scPar_TablePositioningBase

The **L_TT1P_scPar_BasicPositioningBase** structure contains the parameters of the technology module.

Designator Data type	Description	
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	
lrHomePosition LREAL	Home position for a reference run (homing) • Unit: units • Initial value: 0	
xUseHomeExtParameter BOOL	Selection of the homing parameters to be used • Initial value: FALSE	
	FALSE	The homing parameters defined in the axis data are used.
	TRUE	The **scHomeExtParameter** homing parameters from the application are used.
scHomeExtParameter L_MC1P_HomeParameter	Homing parameters from the application • Only relevant if xUseHomeExtParameter = TRUE.	
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.	

Designator Data type	Description	
eTPMode L_TT1P_TpModeSingleAxis	Touch probe source	
	0	Axis for table positioning
	1	External encoder
lrCycleLengthExtEncoder LREAL	Cycle length of the external encoder • Unit: units • Initial value: 360	
scProfiles L_TT1P_Profiles	Travel profile data for positioning This data structure contains all data for generating the positioning profiles 1 ... 16.	
xContinuousUpdate BOOL	TRUE	The travel profile parameters are checked with regard to changes and are accepted continuously. • Initial value: FALSE
xAbsoluteModuloCycle BOOL	TRUE	Execute Modulo cycles completely. • Initial value: FALSE
xLoadTorqueLimits BOOL	TRUE	The torque limitations at the inputs lrSetTorqueLimitPos and lrSetTorqueLimitNeg are active. The values are updated continuously. • Initial value: FALSE
lrTargetWindow LREAL	Tolerance window for the status signal "Drive in target position" (xDriveInTarget output) After positioning has been executed, xDriveInTarget remains set = TRUE until the current actual position of the axis exits the tolerance window again. (Target position ± (lrTargetWindow / 2)) In case of positioning with sequence profiles, xDriveInTarget is set= TRUE after the last travel profile has been executed. • Unit: units • Initial value: 0	

3.5 State machine

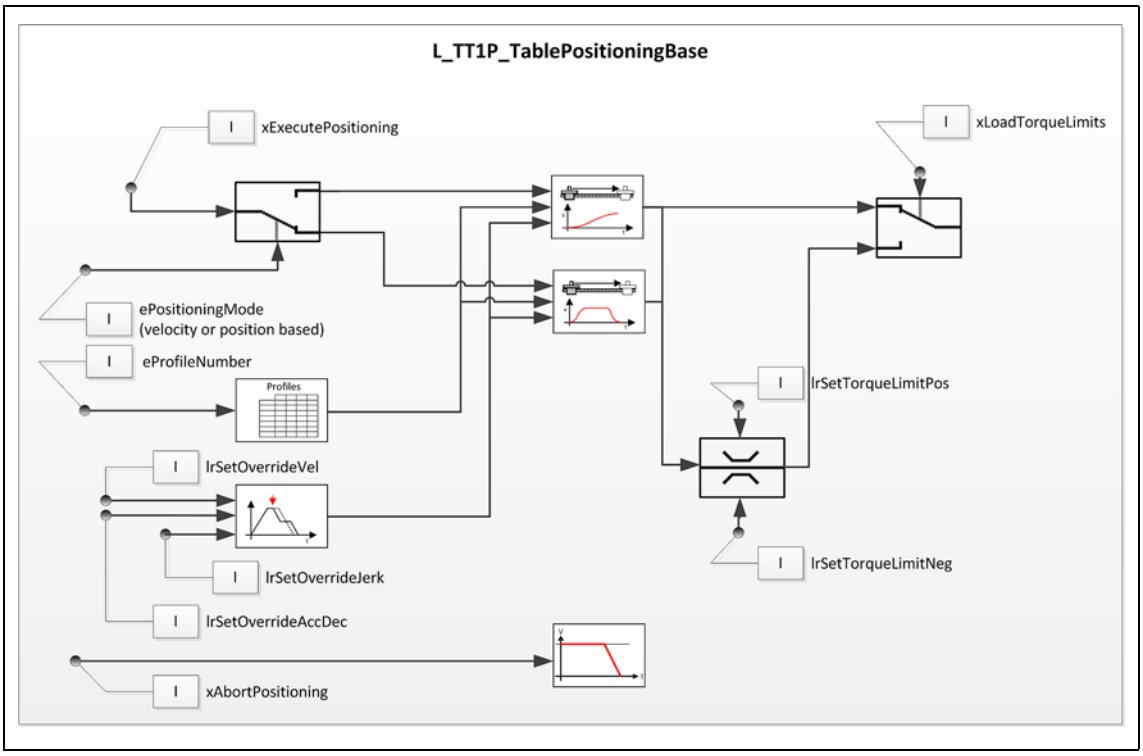


[3-6] State machine of the technology module

(*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.

3.6 Signal flow diagram



[3-7] Signal flow diagram

The illustration [3.6] shows the main signal flow of the implemented functions.

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

3.6.1 Structure of the signal flow

L_TT1P_scSF_TablePositioningBase

The contents of the **L_TT1P_scSF_TablePositioningBase** structure are read-only and offer a practical diagnostics option within the signal flow (Signal flow diagram (📖 24)).

Designator Data type	Description	
ePositioningMode ENUM	Positioning mode	
	0	Velocity-based
	1	Position-based
xExecutePositioning BOOL	The input is edge-controlled and evaluates the rising edge.	
	FALSE↗TRUE	The travel profile selected in the eProfileNumber input is executed.
	FALSE↗TRUE	Restart by a renewed FALSE↗TRUE edge: • During a running positioning process, another profile can be selected via the scProfiles profile data structure (see (📖 21)L_TT1P_scPar_TablePositioningBase parameter structure) that will be executed after a restart. • Distances for relative positioning are not considered.
eProfileNumber L_TT1P_ProfileNumber	Selection of the active travel profile • Initial value: 1 (profile 1)	
	0	No profile
	1	Profile 1
	...	...
	16	Profile 16
lrSetOverrideVelocity LREAL	Value for the velocity override • Value range: 0.0 ... 1.0 (0 ... 100 %) • Initial value: 1.0 (100 %) Values < '0.0' are set internally to '0.0' and the axis is brought to a standstill.	
lrSetOverrideAccDec LREAL	Value for the acceleration/deceleration override • Value range: 0.1 ... 1.0 (10 ... 100 %) • Initial value: 1.0 (100.0 %)	
lrSetOverrideJerk LREAL	Value for the jerk override • Value range: 0.1 ... 1.0 (10 ... 100 %) • Initial value: 1.0 (100 %)	
xLoadTorqueLimits BOOL	TRUE	The torque limitations at the inputs lrSetTorqueLimitPos and lrSetTorqueLimitNeg are active. The values are updated continuously.
lrSetTorqueLimitPos LREAL	Positive torque limitation from the gearbox output This input is activated when the xLoadTorqueLimits parameter = TRUE. • Unit: Nm	
lrSetTorqueLimitNeg LREAL	Negative torque limitation from the gearbox output This input is activated when the xLoadTorqueLimits parameter = TRUE. • Unit: Nm	
xAbortPositioning BOOL	Abort or interruption of the positioning	
	FALSE↗TRUE	The current travel profile is interrupted and the axis is brought to a standstill with the deceleration defined in the profile data.
	TRUE	A restart via the xExecutePositioning input or the resumption of an interrupted positioning via the xFinishPositioning input is prevented.
	FALSE	A restart via the xExecutePositioning input or the resumption of an interrupted positioning via the xFinishPositioning input is enabled. If the restart signal is set via xFinishPositioning during a deceleration phase, the positioning process is continued immediately.

3.7 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 (📖 23) changes to the "Ready" state again.

Parameters to be set

The parameters for the manual jog are located in the L_TT1P_scPar_TablePositioningBase (📖 21) parameter structure.

```
lrJogVel : LREAL := 10;      // Velocity [units/s]
lrJogAcc : LREAL := 100;     // Acceleration [units/s^2]
lrJogDec : LREAL := 100;     // Deceleration [units/s^2]
lrJogJerk : LREAL := 100000; // 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.

3.8 Homing

Precondition

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

Execution

Homing is started with a rising edge (FALSE↗TRUE) at the *xHomeExecute* input. The axis will be travelling until the home position is reached. After successful homing, the State machine (📖 23) changes back again to the "Ready" state.

The homing process is not interrupted if the *xHomeExecute* input is set to FALSE too early. The function is aborted via the *xStop* input.

Parameters to be set

The parameters for homing are located in the L_TT1P_scPar_TablePositioningBase (📖 21) parameter structure.

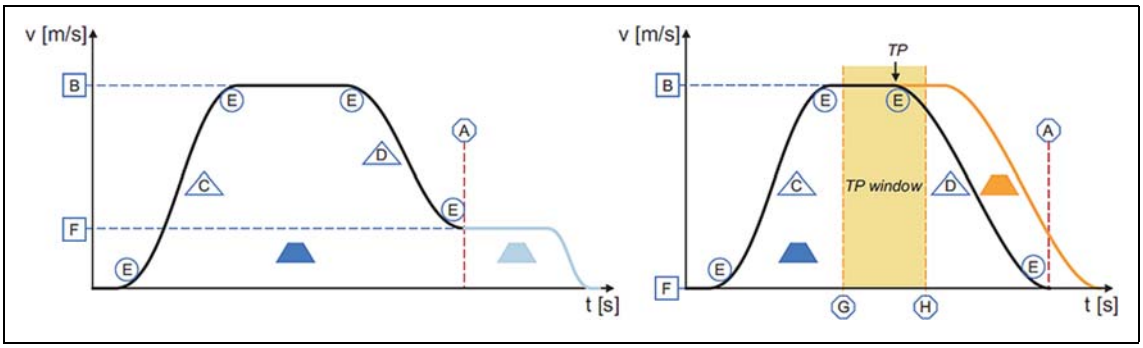
```
xUseHomeExtParameter : BOOL := FALSE;
lrHomePosition : LREAL := 0.0;
scHomeExtParameter : L_MC1P_HomeParameter;
scHomeExtTP : MC_TRIGGER_REF;
```

3.9 Profile data mManagement (profile parameters)

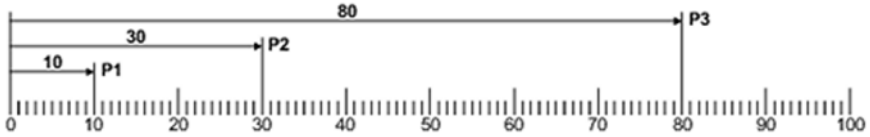
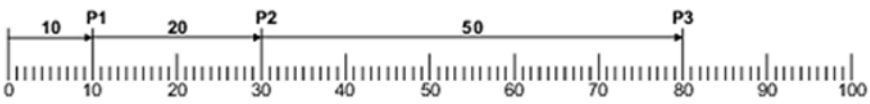
The profile data management manages the parameters of up to 16 travel profiles.

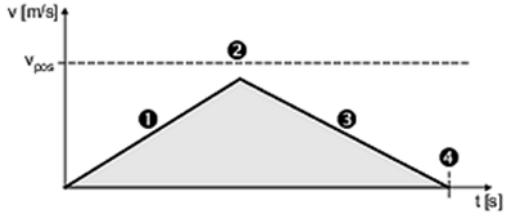
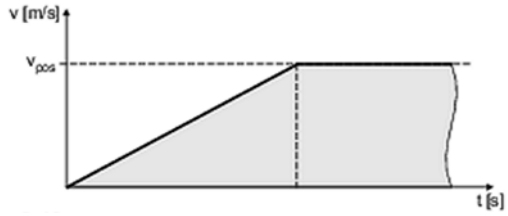
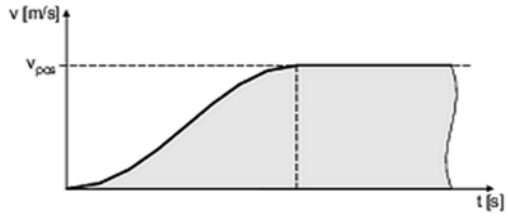
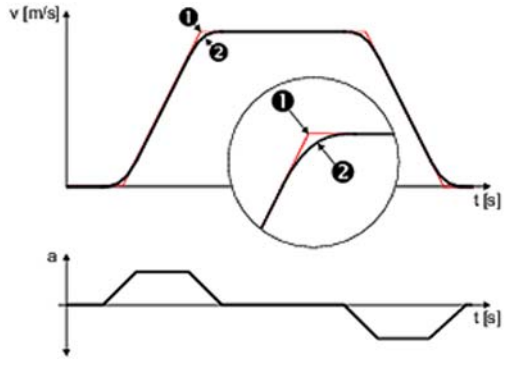
A travel profile describes a motion task for the General information regarding the positioning process (📖 11) that is converted into a rotary motion of the motor shaft.

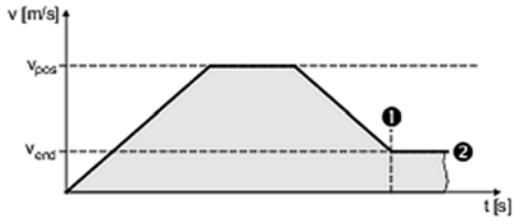
The travel profile is described by the following parameters:



[3-8] Travel profile parameters

Symbol	Profile parameters
	ePositioningMode Selection of the positioning mode (see Positioning modes (📖 31))
	**Profile no.** Number of the profile data set (1 ... 16), in which the travel profile data are contained.
	eTpProfile (L_TT1P_ProfileNumber) Number of the profile data set (1 ... 16) that is to be executed after a detected touch probe. • When "0" is set, no travel profile is executed after a touch probe has been detected.
	**eSequenceProfile (L_TT1P_ProfileNumber)** Number of the profile data set (1 ... 16) that is to be executed after the current travel profile. • When "0" is set, no further travel profile will be executed. • The travel profile will only be executed if no touch probe has been detected within the touch probe window.
A	**lrPosition** Target position or distance to be travelled lrPosition is either given "absolutely" or "relatively". • The absolute position describes the distance between the zero position and the target position. (absolute position = target position) • The home position for the absolute position is the zero position.  • The relative position takes the current actual position at the starting time of the travel command into consideration. (Relative position = target position - actual position) • The home position for the starting point of the distance is the target position of the travel profile executed previously. 

Symbol	Profile parameters
B	**lrVelocity** Maximum velocity used for approaching the target position. • Depending on the target position (lrPosition), acceleration (lrAcceleration) and deceleration (lrDeceleration). • It is possible that the drive does not reach the maximum velocity. In this case, the graph is shown as a triangle instead of a trapezium.
	 ❶ Acceleration ❷ Max. velocity (not reached in this case) ❸ Deceleration ❹ Target position
C	**lrAcceleration** Acceleration to reach the maximum velocity (lrVelocity). The following acceleration types are distinguished:
	• Linearly increasing acceleration 
	• Acceleration increasing in S-shape 
D	**lrDeceleration** Deceleration to brake from the maximum velocity (lrVelocity) to a standstill.
E	**lrJerk** Jerk limitation for acceleration (lrAcceleration) and deceleration (lrDeceleration) If a jerk limitation is given for a travel profile, acceleration and deceleration are executed more smoothly via S-shaped ramps. • This prevents, for instance, sensitive machine parts from damages. • The S-shaped acceleration and deceleration extend the duration of positioning compared to linear acceleration and deceleration.
	 ❶ Profile without jerk limitation ❷ Profile with jerk limitation

Symbol	Profile parameters
F	**lrFinalVelocity** Final speed the drive uses to execute the next travel profile after reaching the target position. • When the target position has been reached, the next travel profile is executed immediately without braking the drive to a standstill at the target position. • The final speed can be used to execute a velocity changeover.
	 ❶ Target position ❷ Final velocity
G	**lrTpWindowNeg** Lower limit value for the touch probe window in which a touch probe can be detected. ▸ Touch probe positioning (📖 34)
H	**lrTpWindowPos** Upper limit value for the touch probe window in which a touch probe can be detected. ▸ Touch probe positioning (📖 34)

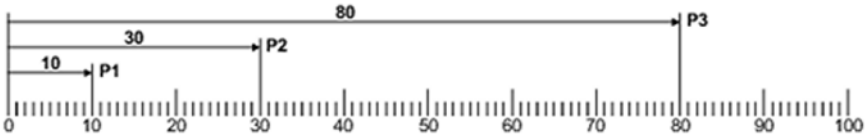
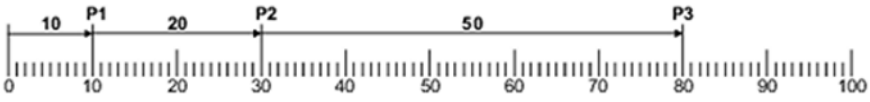
3.10 Positioning modes

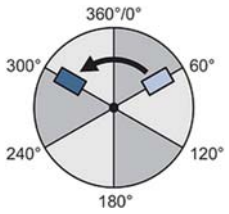
The selection of the positioning mode depends on the travel range or the application.

Note!

For an absolute positioning – positioning modes 0, 1 and 6 ... 11 –, a home position must be known!

- Execute Homing (📖 27).
- If no home position is known, the error "20696: AxisNotHomed" occurs and the program flow has to be reset.
- If the error occurs in a sequence profile, the drive is brought to a standstill via the *lrStopDec* parameter.

Positioning mode	Description
0	**Absolute** The axis travels to an absolute position. • Cannot be used for Modulo measuring system (rotary table application). • The absolute position describes the distance between the zero position and the target position. (absolute position = target position) • The home position for the absolute position is the zero position.  • The home position must be known (Homing (📖 27)).
1	**Absolute TP** Like mode "0", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)
2	**Relative** The axis travels a defined distance. • The relative position considers the distance to the starting position. (relative position = target position - starting position) • The home position for the starting point of the distance is the target position of the travel profile executed previously. 
3	**Relative TP** Like mode "2", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)
4	**Velocity** Continuous constant travel/motion. • This mode does not need a predefined position but follows the profile parameters. • Acceleration and deceleration are based on the profile parameters lrAcceleration and lrDeceleration. • The travel direction is defined by the sign of the travelling speed (+: CW / -: CCW) • The travel/motion is stopped when the xHalt input = TRUE.
5	**Velocity TP** Like mode "4", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)

Positioning mode	Description
6	**Absolute CW** The axis travels to an absolute position in CW direction. • Can only be used for Modulo measuring system (rotary table application). • The home position for the absolute position is the zero position. • The home position must be known (Homing (📖 27)). • In CW direction, the zero position of the axis can be overtravelled.
7	**Absolute CW TP** Like mode "6", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)
8	**Absolute CCW** The axis travels to an absolute position in CCW direction. • Can only be used for Modulo measuring system (rotary table application). • The home position for the absolute position is the zero position. • The home position must be known (Homing (📖 27)). • In CCW direction, the zero position of the axis can be overtravelled.
9	**Absolute CCW TP** Like mode "8", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)
10	**Absolute Shortest Way** The axis travels to an absolute position over the shortest possible way (in the shortest possible time). • Can only be used for Modulo measuring system (rotary table application). • The home position for the absolute position is the zero position. • The home position must be known (Homing (📖 27)). • Basically, the rotary table positioning is an absolute positioning with target positions between 0 ... 360° (angular degree). In this mode, the zero position can be overtravelled if located on the shortest way to the target position: 
11	**Absolute Shortest Way TP** Like mode "10", only with profile change if a touch probe has been detected. ▸ Touch probe positioning (📖 34)

3.11 Execute positioning

In order to execute a positioning, a valid travel profile has to be defined in the profile data (see Profile data mManagement (profile parameters) (📖 28)).

First, a travel profile has to be selected via the *eProfileNumber* input.

A FALSE↗TRUE edge at the *xExecutePositioning* input serves to execute the selected profile for at least one cycle.

3.12 Interrupt positioning and complete it later

When the *xAbortProfile* input = TRUE, a travelling profile can be interrupted.

- The axis is brought to a standstill with the deceleration in the *lrStopDec* parameter (see L_TT1P_scPar_TablePositioningBase (📖 21) parameter structure).
- During the interruption of the positioning process, an override is not active.

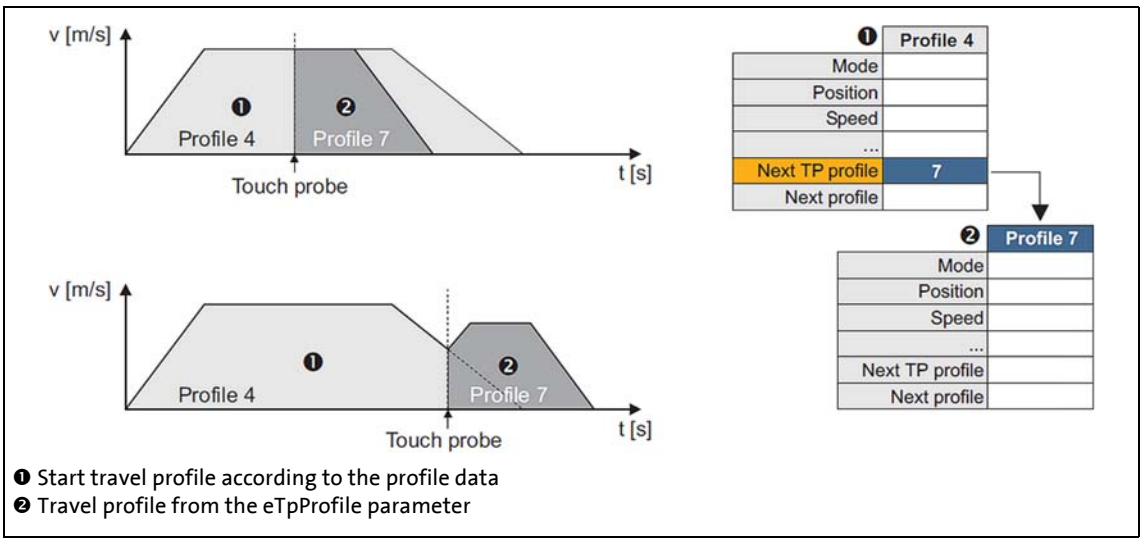
A FALSE↗TRUE edge at the *xFinishPositioning* input serves to execute the previously interrupted profile again and completes it.

3.13 Touch probe positioning

In the touch probe positioning modes, first the travel profile is executed according to the profile data (see Profile data mManagement (profile parameters) (📖 28)).

If a touch probe is detected during the positioning process, it is automatically changed to the profile defined in the *eTpProfile* profile parameter.

The current position is saved at the time when the touch probe is detected by a sensor. Directly at this position the travel profile is now executed from the *eTpProfile* profile parameter.



❶ Start travel profile according to the profile data
❷ Travel profile from the eTpProfile parameter

[3-9] Example: Diagrams for profile change after a touch probe

The profile parameters *lrTpWindowNeg* and *lrTpWindowPos* limit the area (touch probe window) in which a touch probe can be detected. If both parameters have the value '0', the touch probe detection is activated for the entire travel profile or travel range.

If no touch probe is detected and the travel profile has been executed completely, the profile set in the *eSequenceProfile* profile parameter is executed.

Note!

If the touch probe positioning starts while a profile is executed with maximum velocity, the target position is overtravelled when the residual path still to be travelled is too short for the set deceleration ramp.

Normally, a reversing motion takes place.

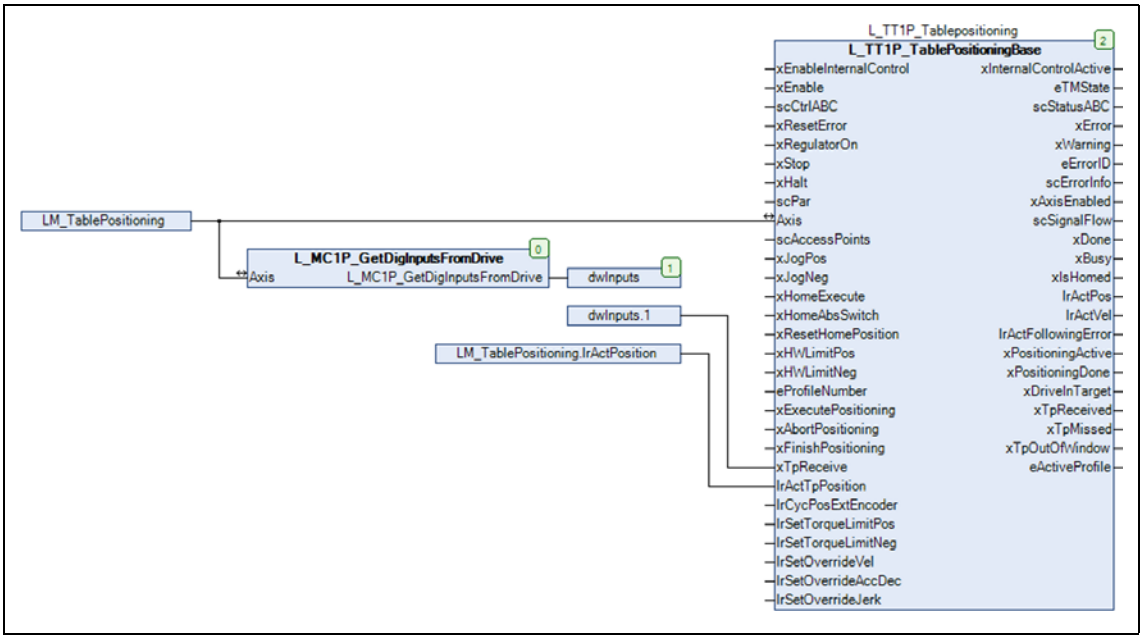
However, constellations with linking of travel profiles are possible that make it impossible to reverse and reach the target position. Thus, for instance, a reversing CCW motion of the axis can be prevented by a safety module.

Sensor connection

For detecting the touch probe position, the product sensor must be connected logically to the technology module.

Interconnection example 1: Digital input of the positioning axis without touch probe

Can be used if no touch probe accuracy is required (position error is detected with the accuracy of the used task cycle time).



Inputs:

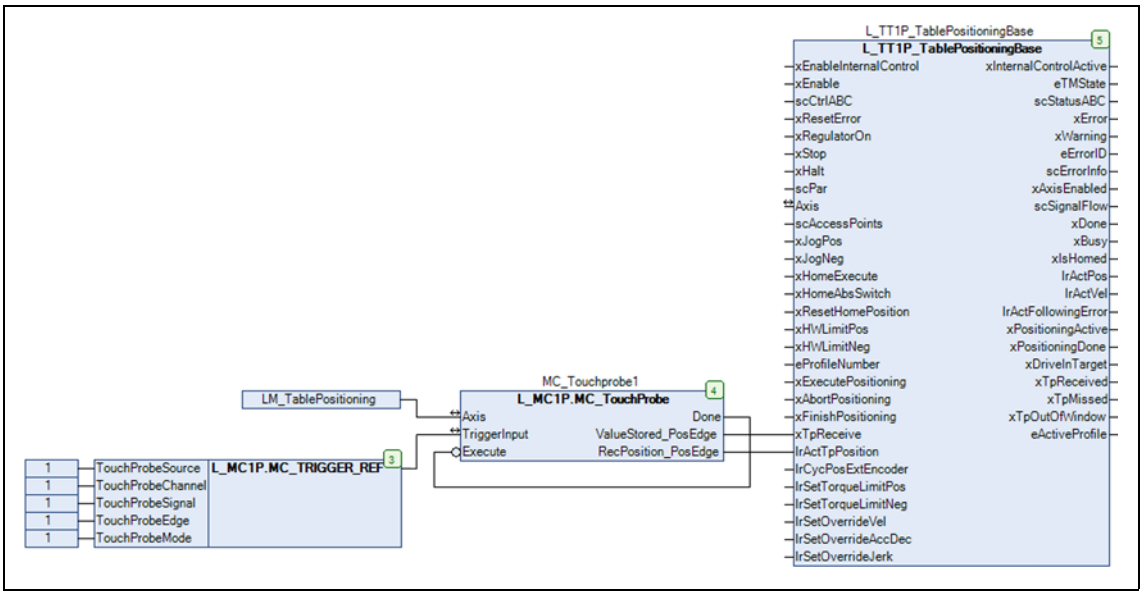
```
xTpReceive = digital input to which the sensor is connected.
lrActTpPosition = Axis.lrActPosition
```

Parameters to be set:

```
eTpMode := L_TT1P_TpModeSingleAxis.TpFromTmAxis;
```

Interconnection example 2: Touch probe of the technology module axis:

Can be used if a touch probe accuracy is required.



Inputs:

```
xTpReceive = MC_Touchprobe.ValueStored_PosEdge
lrActTpPosition = RegPosition_PosEdge
```

Parameters to be set:

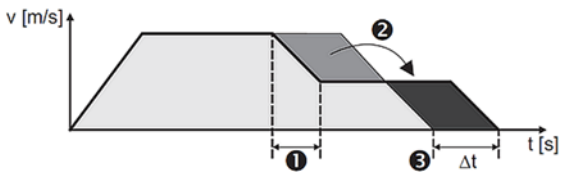
```
eTpMode := L_TT1P_TpModeSingleAxis.TpFromTmAxis;
```

3.14 Override (velocity, acceleration, jerk limitation)

"Override" is the change and the acceptance of profile parameters during a positioning process.

The velocity, acceleration and jerk limitation can be adapted for the travel profile. Here, it is ensured that the defined target position is reached exactly.

The setting is made via the inputs *lrSetOverrideVelocity*, *lrSetOverrideAccDec* and *lrSetOverrideJerk*.



❶ The velocity decreases during the positioning process.
❷ In order to reach the defined target position, the missing area has to be added.
❸ As a result, more time (Δt) is required for the positioning.

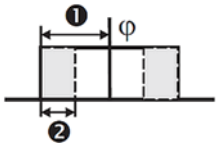
[3-10] v/t diagram at a decreasing velocity

3.15 Following error monitoring

In the Lenze standard setting, a 2-stage following error monitoring is active.

- If the first adjustable warning threshold is exceeded, a corresponding warning appears.
- If the second higher error threshold is exceeded, the set response is triggered.

The parameter values for following error monitoring are imported from the referenced axis (input/output *Axis* [AXIS_REF]).



❶ Monitoring thresholds
❷ Hysteresis

[3-11] Diagram for following error monitoring

3.16 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).

Interconnection of the technology module	CPU utilisation	
	Average	Maximum peak

xEnable := TRUE;
xRegulatorOn := TRUE;
xExecutePositioning := TRUE;
	55 µs	118 µs

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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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