

Technology module



Pick & Place -----

Reference Manual

EN



13565794

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1 About this documentation

This documentation ...

- contains detailed information on the functionalities of the "Pick & Place" 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 About this documentation

1.1 Document history

1.1 Document history

Version			Description
5.0	06/2019	TD29	General revisions
4.3	07/2018	TD29	General revisions
4.2	05/2017	TD17	• Content structure has been changed. • General revisions
4.1	04/2016	TD17	General revisions
4.0	10/2015	TD17	• Corrections and additions • New: xInPosition output • New: Parameters xPosInWindow, lrPosInWindow, lrTimePosInWindow • Content structure has been changed.
3.0	05/2015	TD17	• General revisions • New: parameters for orientation axes A, B, C • New: Information on the "High" technology module version
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 About this documentation

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	<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; ...
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

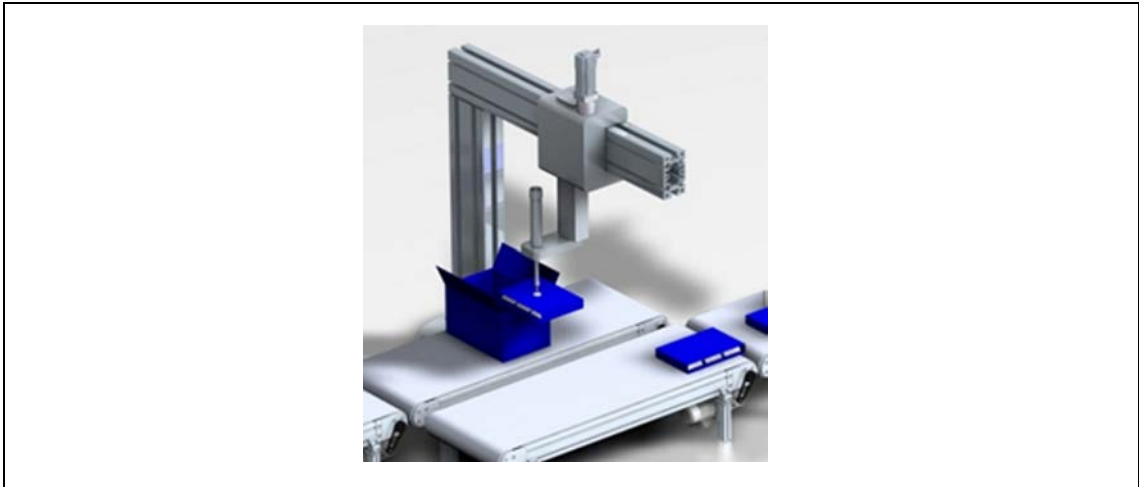
Damage or destruction of machine parts can be caused by ...

- 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 "Pick & Place"



[3-1] Typical mechanics of the technology module

"Pick & Place" mechanics/kinematics are utilised in various industrial sectors. Typical applications can for instance be found in the field of packaging technology. Here, workpieces are picked up with a gripper and are placed to other positions.

In addition to simple point-to-point positioning processes, it is also possible to execute whole paths with several interpolation points. This, for example, serves to bypass obstacles.

There are three versions of the "Pick & Place" technology module:

- **In the "Base" version**, simple travel profiles can be executed. By means of only a few parameters, a target point can be approached from the current actual position of the kinematics. In addition to the rounding parameter, only the starting height and final height have to be specified. The movement of an auxiliary axis (Aux1) is always carried out from the start of the first rounding process to the end of the second rounding process. There is only one parameter for the speed and acceleration of the path over the whole travel profile in each case.
- **In the "State" version**, the functional range of the Base version is extended. The travel profile can be written to with 10 interpolation points. The speed, acceleration and rounding can be set individually for each interpolation point. In addition, the movement of the (Aux1) auxiliary axis can be distributed over several interpolation points in the space. Furthermore it is possible to set breakpoints, for instance to wait for enable.
- **In the "High" version**, the functional range of the state version is extended. Several profiles consisting of a maximum of 10 interpolation points can be connected and executed in succession without a stop. A path can be implemented from an infinite number of interpolation points and with a variable target.

The TM can preselect positions for the following axes:

- x/y/z axis
- a/b/c axis
- Aux1 axis (auxiliary axis)

► [Overview of the functions](#) (□ 11)

3.1 Overview of the functions

In addition to the basic functions for operating the **L_MC4P_AxesGroupBasicControl** function block and the **Holding function**, the technology module offers the following functionalities that are assigned to the "Base", "State", and "High" versions:

Functionality	Variant		
	Base	State	High
Manual jog (jogging) (📖 38)	●	●	●
Homing (📖 40)	●	●	●
Specifying a travel profile (📖 41)	●	●	●
Calculation of the profile points with $lrBlendingRadius = 0$ (📖 42)	●	●	●
Calculation of the profile points with $lrBlendingRadius > 0$ (📖 44)	●	●	●
Limitations (maximum values) for the axes on the travel profile (📖 46)	●	●	●
Starting the travel profile (xExecutePickAndPlace) (📖 48)	●	●	●
Stop/holding function (xPathStop, xStopALL, xPathHalt) (📖 49)	●	●	●
Interrupting the travel profile/path (xPathInterrupt) (📖 50)	●	●	●
Gripper control (📖 51)	●	●	●
Speed override (📖 52)	●	●	●
Defining a travel profile with up to 10 interpolation points (📖 53)		●	●
Movement of the orientation axes and the auxiliary axis across several interpolation points (📖 55)		●	●
Defining optional breakpoints on the travel profile (📖 56)		●	●
Adding more travel profiles (📖 57)			●



»PLC Designer« Online help

Here you'll find some detailed information with regard to the **L_MC4P_AxesGroupBasicControl** function block and the **holding function**.

3.2

Important notes on how to operate the technology module

Setting of the operating mode

The operating mode for the real axes A1 ... A6 has to be set to "cyclically synchronous position" (csp) because the axes are lead via the master position value.

Controlled start of the axes

Motion commands that are set in the inhibited axis state ($xAxesEnabled = FALSE$) after enable ($xRegulatorOnALL = TRUE$) must be activated again by a $FALSE \rightarrow TRUE$ edge.

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

**Example [Manual jog \(jogging\)](#) (38):**

1. In the inhibited axis state ($xAxesEnabled = FALSE$), $xJogPos$ is set to TRUE.
 - $xRegulatorOnALL = FALSE$ (axis is inhibited.)
==> "READY" state ($xAxesEnabled = FALSE$)
 - Select the axis for the manual jog function via the $eSelectAxis$ input.
 - $xJogPos = TRUE$ (manual jog is to be executed.)
2. Enable axis.
 - $xRegulatorOnALL = TRUE$
==> "READY" state ($xAxesEnabled = TRUE$)
3. Execute manual jog.
 - $xJogPos = FALSE \rightarrow TRUE$
==> "JOGPOS" state

3 Functional description of "Pick & Place"

3.3 Interconnection of the technology module with the axis group

3.3 Interconnection of the technology module with the axis group

The "Pick & Place" technology module has no direct axis connections. The axes are transferred as group via the *AxesGroup* input of the technology module. An axis group is a combination of axes which can additionally contain kinematic transformations.

Communication between the technology module and the axis group is established via a direct connection.

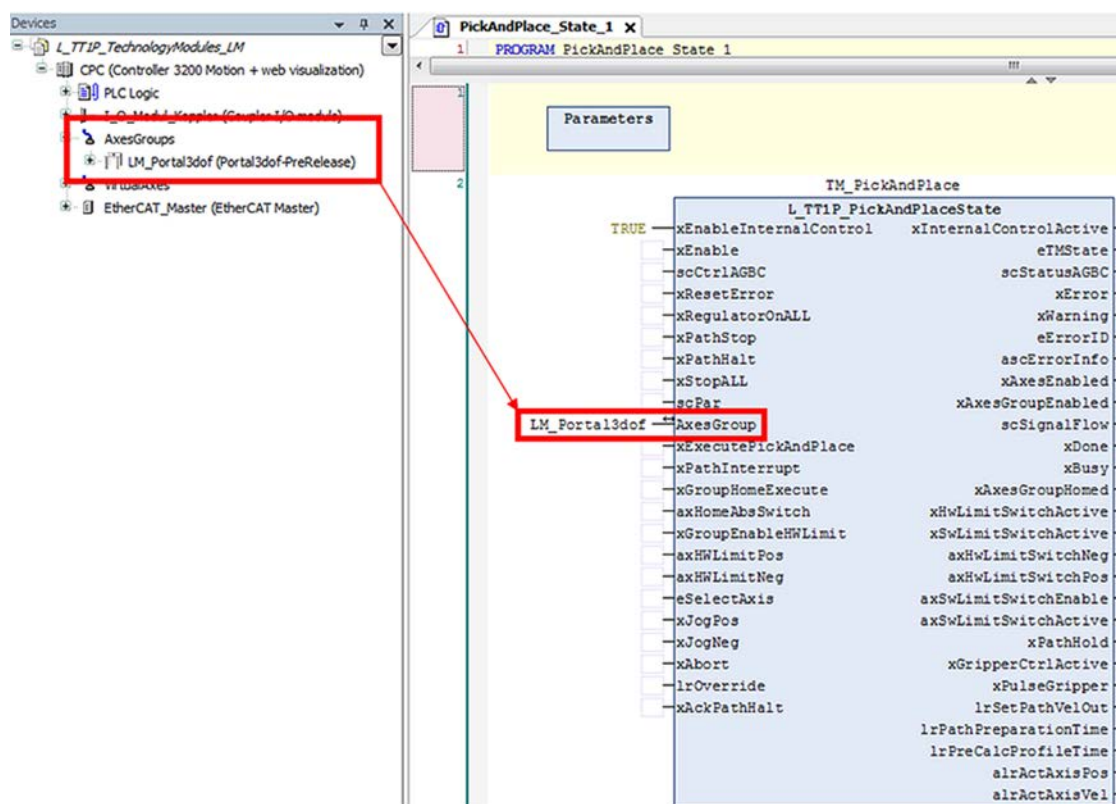
The axis group must be inserted in the device tree. Via the designation, the axis group is connected to the *AxesGroup* input of the technology module.

The setpoint generation for the axes and control of the functions (such as manual jog) are executed in the technology module. The technology module reaches each axis via the axis group. It is the axis group's task to cyclically calculate the kinematic reference between the real and virtual axes.

Example of the Delta3 transformation

An LM_Delta3dof axis group manages the real axes A1 ... A6 and virtual axes X, Y and Z. In a movement of the real axes A1 ... A6, the virtual axes X, Y and Z are controlled along with the direct kinematics. When a movement of the virtual axes X, Y and Z is carried out, the real axes A1 ... A6 are automatically controlled along with the inverse kinematics. Thus, the reference between the real axes and the virtual axes (coordinates of the "Tool Center Point", tool zero point) is always given.

All functional parameters and the parameters for the setpoint generation are only set in one central position via the [L_TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (□ 26) parameter structure at the *scPar* input of the technology module. The kinematic parameters and the limitations of the individual axes must be set in the axis group.

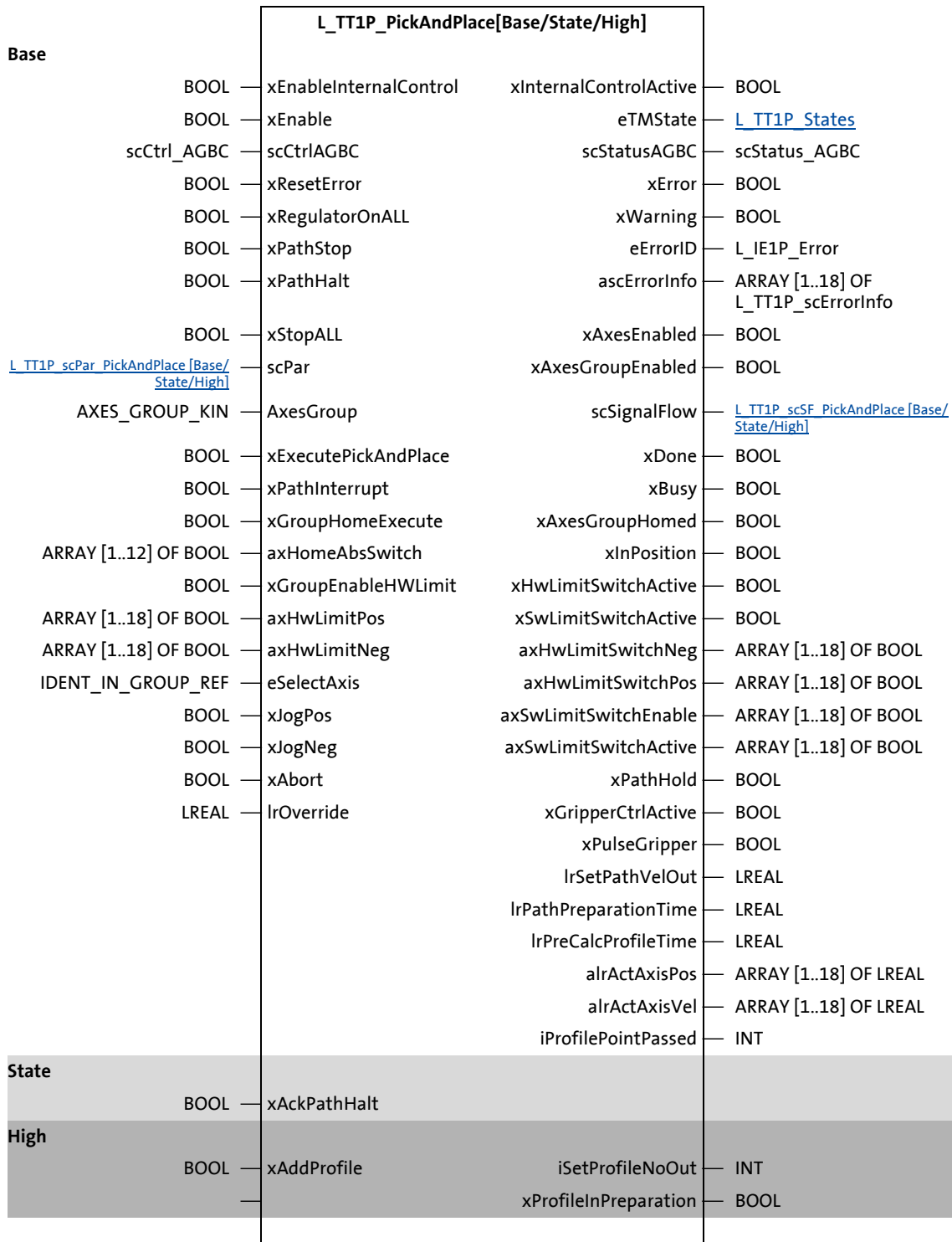


[3-2] Example: Interconnection of the technology module and the transformation Delta3 in the »PLC Designer«

3.4

L_TT1P_PickAndPlace[Base/State/High] function block

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.



3.4.1 Inputs and outputs

Designator Data type	Description	Available in version		
		Base	State	High
AxesGroup AXES_GROUP_KIN	Reference to the axis group ► Interconnection of the technology module with the axis group (□ 13)	●	●	●

3.4.2 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.			
scCtrlAGBC scCtrl_AGBC	Input structure for the L_MC4P_AxesGroupBasicControl function block - scCtrlAGBC can be used in the "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 error in all axes or software error.	●	●	●
xRegulatorOnALL BOOL	TRUE Activate controller enable for all axes (via the MC_Power function block).	●	●	●
xPathStop BOOL	TRUE The "STOP" status is set, i.e. movements are cancelled and the axes are brought to a standstill <u>accurate to the path</u> (following the travel profile) with the deceleration defined via the lPathStopDec parameter. - The technology module remains in the "STOP" state as long as xPathStop, xStopALL or xPathHalt is set to TRUE. - The xStopALL input is also active with "Internal Control". ► Stop/holding function (xPathStop, xStopALL, xPathHalt) (□ 49)	●	●	●
	FALSE If the axes are at a standstill and xPathHalt, xPathStop and xStopALL are set to FALSE, the "Ready" status is set.			

Designator	Data type	Description		Available in version		
				Base	State	High
xPathHalt	BOOL	TRUE	The "STOP" status is set, i.e. movements are cancelled and the axes are brought to a standstill <u>accurate to the path</u> (following the travel profile) with the deceleration defined via the <code>lrPathHaltDec</code> parameter. - The technology module remains in the "STOP" state as long as <code>xPathStop</code>, <code>xStopALL</code> or <code>xPathHalt</code> is set to TRUE. - The <code>xStopALL</code> input is also active with "Internal Control". ► Stop/holding function (xPathStop, xStopALL, xPathHalt) (□ 49)	●	●	●
		FALSE	If the axes are at a standstill and <code>xPathHalt</code>, <code>xPathStop</code> and <code>xStopALL</code> are set to FALSE, the "Ready" status is set.			
xStopALL	BOOL	TRUE	Bring <u>all</u> axes to a standstill individually, irrespectively of the path. Note: Executing this function during synchronised movements of the axis group may cause errors. - The individual axes are brought to a standstill independently of each other with the deceleration of the <code>alrStopDec</code> parameter. - The state changes to "Stop". - If the stop is executed from the technology module's movement, the reference to the path is cancelled. - The technology module remains in the "STOP" state as long as <code>xPathStop</code>, <code>xStopALL</code> or <code>xPathHalt</code> is set to TRUE. - The "READY" state is set automatically when the axes are at standstill and <code>xPathHalt</code>, <code>xPathStop</code> and <code>xStopALL</code> are set to FALSE. - The input is also active with "Internal Control". ► Stop/holding function (xPathStop, xStopALL, xPathHalt) (□ 49)	●	●	●
scPar L_TT1P_scPar_PickAndPlace[Base/State/High]		The parameter structure contains the parameters of the technology module. The data type depends on the version used (Base/State/High).		●	●	●
xExecutePickAndPlace	BOOL	The input is edge-controlled and evaluates the rising edge.		●	●	●
		FALSE	Path preparation is started (change to the "PREPARING_PATH" state).			
		TRUE	Then the path is executed or the path interpolation that has been stopped is continued (change to the "MOVE_PP" state).			

Designator	Data type	Description	Available in version		
			Base	State	High
xPathInterrupt	BOOL	Stop movement of the path accurate to the path (following the travel profile). - This function can only be activated in the "MOVE_PP" state. - The path is decelerated in compliance with the segment from the profile calculation (in contrast to xPathHalt or xPathStop, where the deceleration is defined in the parameter setting).	●	●	●
		TRUE - All axes are brought to a standstill at a maximum with the deceleration of the path so that they are <u>accurate to the path</u> (following the travel profile). - The technology module changes to the "PATH INTERRUPT" state.			
		FALSE - The path is continued at its breakpoint. - The technology module changes to the "MOVE_PP" state.			
xGroupHomeExecute	BOOL	The input is edge-controlled and evaluates the rising edge.	●	●	●
		FALSE → TRUE - Start of the reference run (homing) for the real axes A1 ... A6 and Aux1 - Homing depends on the connected axis group. - The axes are only referenced in the order that is given via the aeHomingOrder parameter. - The parameters for homing are included in the L_TT1P_scPar_PickAndPlace[Base/State/High] (26) parameter structure. - Initial value: the axis positions are set to the position in the alrHomePos parameter.			
axHomeAbsSwitch	ARRAY [1..12] OF BOOL	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. axHomeAbsSwitch[axis] : connection of reference switch [Axis] = 1 : axis 'A1' [Axis] = 2 : axis 'A2' [Axis] = 3 : axis 'A3' [Axis] = 4 : axis 'A4' [Axis] = 5 : axis 'A5' [Axis] = 6 : axis 'A6' [Axis] = 7 : axis 'Aux1'	●	●	●
xGroupEnableHWLimit	BOOL	TRUE Activation for evaluating the travel range limit switch (Hardware limit positions)	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
axHwLimitPos ARRAY [1..18] OF BOOL		Positive hardware limit switch Connect this input to the corresponding digital input that is connected to the limit switch. axHwLimitPos[axis] : connection of pos. hardware limit switch • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●
		TRUE The positive hardware limit switch has been reached or approached. • The axHwLimitSwitchPos output is also set to TRUE. • The axis is brought to a standstill with the deceleration in the alrStopDec parameter. • The state changes to "ERROR" with the error message '20500' (HwLimitPos).			
axHwLimitNeg ARRAY [1..18] OF BOOL		Negative hardware limit switch Connect this input to the corresponding digital input that is connected to the limit switch. axHwLimitNeg[axis] : connection of neg. hardware limit switch • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●
		TRUE The negative hardware limit switch has been reached or approached. • The axHwLimitSwitchNeg output is also set to TRUE. • The axis is brought to a standstill with the deceleration in the alrStopDec parameter. • The state changes to "ERROR" with the error message '20501' (HwLimitNeg).			

Designator	Data type	Description		Available in version		
				Base	State	High
eSelectAxis	IDENT_IN_GROUP_REF	Selection of the axis for the manual jog function Note: With Manual jog (jogging) , always only one axis can be traversed, not several axes at the same time. • Initial value: 0		●	●	●
		0	No axis			
		1	X axis			
		2	Y axis			
		3	Z axis			
		4	A axis			
		5	B axis			
		6	C axis			
		7	Axis 'A1'			
		8	Axis 'A2'			
		9	Axis 'A3'			
		10	Axis 'A4'			
		11	Axis 'A5'			
		12	Axis 'A6'			
		13	Axis 'Aux1'			
xJogPos	BOOL	TRUE	Traverse the axis selected at the eSelectAxis input in positive direction (manual jog). If xJogNeg is also TRUE, the traversing direction selected first remains set.	●	●	●
xJogNeg	BOOL	TRUE	Traverse the axis selected at the eSelectAxis input in negative direction (manual jog). If xJogPos is also TRUE, the traversing direction selected first remains set.	●	●	●
xAbort	BOOL		The input is edge-controlled and evaluates the rising edge.	●	●	●
		FALSE TRUE	If the path has come to a standstill (by xPathStop, xPathHalt, xPathInterrupt or a breakpoint in the profile), continuation of the path can be cancelled using this input. Then it is no longer possible to continue or complete the path.			
IrOverride	BOOL	Override • Initial value: 1.0 • Value range: 0.0 ... 1.0 (0 ... 100%) • The value '0.5' halves the speed, the acceleration and the jerk. Note: For values not equalling '1.0', the internal gripper control does not work. Only use this input for commissioning purposes.		●	●	●
xAckPathHalt	BOOL	TRUE	A breakpoint is acknowledged on the path. Breakpoints can be acknowledged anytime, irrespective of whether the path has reached a breakpoint or not.		●	●

Designator	Data type	Description		Available in version		
				Base	State	High
xAddProfile	BOOL	The input is edge-controlled and evaluates the rising edge.				●
		FALSE	The profile from the scPar.ascProfilePar parameter is added to the profile in the "Pick & Place" technology module. Preconditions for loading the profile: • The technology module is in the "MOVE_PP" state. • The resources of the technology module for path planning are enabled for the next profile (output xProfileInPreparation = FALSE).			

3.4.3 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 (□ 34)		●	●	●
scStatusAGBC scStatus_AGBC	Status data structure of the L_MC4P_AxesGroupBasicControl function block		●	●	●
xError BOOL	TRUE	An error is pending in the technology module. For more information about the error, see the eErrorID output.	●	●	●
xWarning BOOL	TRUE	A warning is pending in the technology module. For more information about the warning, see the eErrorID output.	●	●	●
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.		●	●	●
ascErrorInfo ARRAY [1..18] OF L_TT1P_scErrorInfo	Error information structure for a more detailed analysis of the error cause at the axes ascErrorInfo[axis]: • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'		●	●	●
xAxesEnabled BOOL	TRUE	All axes are enabled/switched on.	●	●	●
xAxesGroupEnabled BOOL	TRUE	Axes group enabled/switched on.	●	●	●
scSignalFlow L_TT1P_scSF_PickAndPlace [Base/State/High]	Structure of the signal flow; the content of the structure offers a practical diagnostics option within the signal flow. ► Signal flow diagram (□ 36)		●	●	●
xDone BOOL	TRUE	The request/action has been completed successfully.	●	●	●
xBusy BOOL	TRUE	The request/action is currently being executed.	●	●	●
xAxesGroupHommed BOOL	TRUE	All axes have been referenced (reference known).	●	●	●

Designator	Data type	Description		Available in version		
				Base	State	High
xInPosition	BOOL	TRUE	The defined position of the "Tool Center Point" has been reached. With the parameter xPosInWindow = TRUE from the L_TT1P_scPar_PickAndPlace[Base/State/High] structure (26), monitoring of the "Tool Center Point" (TCP) takes place within the tolerance window for following error monitoring.	●	●	●
xHwLimitSwitchActive	BOOL	TRUE	At least one axis has reached or approached a hardware limit switch. - The xHwLimitPos input is also set to TRUE. - The drive is braked to a standstill with the deceleration set in the alrStopDec parameter. - The state changes to "ERROR" with error message '20500' (HwLimitPos) or '20501' (HwLimitNeg).	●	●	●
xSwLimitSwitchActive	BOOL	TRUE	At least one axis has reached or exceeded a software limit position. - The drive is brought to a standstill with the deceleration set in the lrStopDec parameter. - The state changes to "ERROR" with error message '20306' (SWLimitPos) or '20307' (SWLimitNeg).	●	●	●
axHwLimitSwitchNeg ARRAY [1..18] OF BOOL		TRUE	The negative hardware limit switch has been reached or approached. - The axHwLimitNeg input has to be connected to the digital input that is connected to the limit switch. - The axHwLimitNeg input is also set to TRUE. - The axis is brought to a standstill with the deceleration in the alrStopDec parameter. - The state changes to "ERROR" with the error message '20501' (HwLimitNeg). axHwLimitSwitchNeg[axis]: [Axis] = 1 : X axis [Axis] = 2 : Y axis [Axis] = 3 : Z axis [Axis] = 4 : A axis [Axis] = 5 : B axis [Axis] = 6 : C axis [Axis] = 7 : axis 'A1' [Axis] = 8 : axis 'A2' [Axis] = 9 : axis 'A3' [Axis] = 10 : axis 'A4' [Axis] = 11 : axis 'A5' [Axis] = 12 : axis 'A6' [Axis] = 13 : axis 'Aux1'	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
axHwLimitSwitchPos ARRAY [1..18] OF BOOL	TRUE	The positive hardware limit switch has been reached or approached. • The axHwLimitPos input has to be connected to the digital input that is connected to the limit switch. • The axHwLimitPos input is also set to TRUE. • The axis is brought to a standstill with the deceleration in the alrStopDec parameter. • The state changes to "ERROR" with the error message '20500' (HwLimitPos). axHwLimitSwitchPos[axis]: • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●
axSwLimitEnabled ARRAY [1..18] OF BOOL	TRUE	Activate the monitoring function of the software limit positions for the axis. axSwLimitEnabled[axis]: • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●
axSwLimitSwitchActive ARRAY [1..18] OF BOOL	TRUE	The axis has reached or exceeded the software limit position. axSwLimitSwitchActive[axis]: • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●

Designator	Data type	Description		Available in version		
				Base	State	High
xPathHold	BOOL	TRUE	The path interpolation has been stopped ... • by "Stop" and can be continued with the input xExecutePickAndPlace = TRUE; • with the input xPathInterrupt = TRUE and can be continued with xPathInterrupt = FALSE; • at a defined path point and can be continued by acknowledgement with the input xAckPathHalt = TRUE.	●	●	●
xGripperCtrlActive	BOOL	TRUE	Activate gripper control. If the path is interrupted by "Stop", the gripper control is deactivated (xGripperCtrlActive = FALSE).	●	●	●
xPulseGripper	BOOL	Control output for automatic gripper control • The output is only active for one cycle. • If the path is interrupted by a stop, gripper control is deactivated (xGripperCtrlActive = FALSE).		●	●	●
lrSetPathVelOut	LREAL	Display of the current setpoint path speed • Unit: units/s		●	●	●
lrPathPreparationTime	LREAL	Time required for the calculation of the path preparation • Unit: s		●	●	●
lrPreCalcProfileTime	LREAL	Time calculated for the travel process of the profile to be executed • Unit: s		●	●	●
alrActPos	ARRAY [1..18] OF LREAL	Current position of the axes • Unit: units		●	●	●
		1 X axis				
		2 Y axis				
		3 Z axis				
		4 A axis				
		5 B axis				
		6 C axis				
		7 Axis 'A1'				
		8 Axis 'A2'				
		9 Axis 'A3'				
		10 Axis 'A4'				
		11 Axis 'A5'				
		12 Axis 'A6'				
		13 Axis 'Aux1'				

Designator	Data type	Description		Available in version		
				Base	State	High
alrActVel ARRAY [1..18] OF LREAL		Current speed of the axes • Unit: units/s		●	●	●
		1	X axis			
		2	Y axis			
		3	Z axis			
		4	A axis			
		5	B axis			
		6	C axis			
		7	Axis 'A1'			
		8	Axis 'A2'			
		9	Axis 'A3'			
		10	Axis 'A4'			
		11	Axis 'A5'			
		12	Axis 'A6'			
		13	Axis 'Aux1'			
iProfilePointPassed	INT	Output of the number of the point that has been reached in the current profile.		●	●	●
iSetProfileNoOut	INT	Output of the number of the current profile. = 0: no profile is executed > 0: profile is executed				●
xProfileInPreparation	BOOL	TRUE	The technology module is preparing the profile.			●
		FALSE	The resources for the preparation of a profile have been enabled. A new profile can be appended via the xAddProfile input.			

3.4.4 Parameter

L_TT1P_scPar_PickAndPlace [Base/State/High]

The L_TT1P_scPar_PickAndPlace[Base/State/High] structure contains the parameters of the technology module.

Designator	Data type	Description	Available in version		
			Base	State	High
lrPathStopDec	LREAL	Deceleration of the path for the input xPathStop = TRUE In order to prevent overtravelling of the programmed target position, this parameter is only taken into consideration for Cartesian movements if the values specified are higher than those of the path that is currently interpolated. • Unit: units/s ² • Initial value: 10000	●	●	●
lrPathStopJerk	LREAL	Jerk of the path for the input xPathStop = TRUE In order to prevent overtravelling of the programmed target position, this parameter is only taken into consideration for Cartesian movements if the values specified are higher than those of the path that is currently interpolated. • Unit: units/s ³ • Initial value: 100000	●	●	●
lrPathHaltDec	LREAL	Deceleration of the path for the input xPathHalt = TRUE In order to prevent overtravelling of the programmed target position, this parameter is only taken into consideration for Cartesian movements if the values specified are higher than those of the path that is currently interpolated. • Unit: units/s ² • Initial value: 100	●	●	●
lrPathJerk	LREAL	Jerk of the path for the input xPathHalt = TRUE and the path interpolation • Unit: units/s ³ • Initial value: 100000	●	●	●
alrStopDec ARRAY [1..18] OF LREAL		Deceleration of the individual axes for the input xStopALL = TRUE, or when the hardware limit switches, software limit positions, and following error monitoring are triggered • Unit: units/s ² • Initial value: 10000 alrStopDec[axis]: • [Axis] = 1 : X axis • [Axis] = 2 : Y axis • [Axis] = 3 : Z axis • [Axis] = 4 : A axis • [Axis] = 5 : B axis • [Axis] = 6 : C axis • [Axis] = 7 : axis 'A1' • [Axis] = 8 : axis 'A2' • [Axis] = 9 : axis 'A3' • [Axis] = 10 : axis 'A4' • [Axis] = 11 : axis 'A5' • [Axis] = 12 : axis 'A6' • [Axis] = 13 : axis 'Aux1'	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
alrStopJerk ARRAY [1..18] OF LREAL		Jerk of the individual axes for the input xStopALL = TRUE, or when the hardware limit switches, software limit positions, and following error monitoring are triggered - Unit: units/s³ - Initial value: 100000 alrStopJerk[axis]: [Axis] = 1 : X axis [Axis] = 2 : Y axis [Axis] = 3 : Z axis [Axis] = 4 : A axis [Axis] = 5 : B axis [Axis] = 6 : C axis [Axis] = 7 : axis 'A1' [Axis] = 8 : axis 'A2' [Axis] = 9 : axis 'A3' [Axis] = 10 : axis 'A4' [Axis] = 11 : axis 'A5' [Axis] = 12 : axis 'A6' [Axis] = 13 : axis 'Aux1'	●	●	●
lrCartesianJogJerk	LREAL	Jerk for manual jog of the Cartesian axes X, Y and Z - Unit: units/s³ - Initial value: 10000	●	●	●
lrCartesianJogVel	LREAL	Speed for manual jog of the Cartesian axes X, Y and Z - Unit: units/s - Initial value: 10	●	●	●
lrCartesianJogAcc	LREAL	Acceleration for manual jog of the Cartesian axes X, Y and Z - Unit: units/s² - Initial value: 100	●	●	●
lrCartesianJogDec	LREAL	Deceleration for manual jog of the Cartesian axes X, Y and Z - Unit: units/s² - Initial value: 100	●	●	●
lrOrientationJogJerk	LREAL	Jerk for manual jog of orientation axes A, B and C - Unit: units/s³ - Initial value: 10000	●	●	●
lrOrientationJogVel	LREAL	Speed for manual jog of orientation axes A, B and C - Unit: units/s - Initial value: 10	●	●	●
lrOrientationJogAcc	LREAL	Acceleration for manual jog of orientation axes A, B and C - Unit: units/s² - Initial value: 100	●	●	●
lrOrientationJogDec	LREAL	Deceleration for manual jog of orientation axes A, B and C - Unit: units/s² - Initial value: 100	●	●	●
lrRealAxisJogJerk	LREAL	Jerk for manual jog of the real axes A1 ... A6 and Aux1 - Unit: units/s³ - Initial value: 10000	●	●	●
lrRealAxisJogVel	LREAL	Velocity for manual jog of the real axes A1 ... A6 and Aux1 - Unit: units/s - Initial value: 10	●	●	●
lrRealAxisJogAcc	LREAL	Acceleration for manual jog of the real axes A1 ... A6 and Aux1 - Unit: units/s² - Initial value: 100	●	●	●
lrRealAxisJogDec	LREAL	Deceleration for manual jog of the real axes A1 ... A6 and Aux1 - Unit: units/s² - Initial value: 100	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
alrHomePosition ARRAY [1..12] OF LREAL		Home position for the desired axis The reference run (homing) is started with the xGroupHomeExecute input. The axes are only referenced in the order that is given via the aeHomingOrder parameter. - Unit: units - Initial value: 0 alrHomePosition[axis]: [Axis] = 1 : axis 'A1' [Axis] = 2 : axis 'A2' [Axis] = 3 : axis 'A3' [Axis] = 4 : axis 'A4' [Axis] = 5 : axis 'A5' [Axis] = 6 : axis 'A6' [Axis] = 7 : axis 'Aux1'	●	●	●
aeHomingOrder ARRAY [1..12] OF L_MC4P_HomingOrder		Definition of the sequence in which the axes are to be referenced: - NoHoming (standard setting) - First, Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Eleventh, Twelfth aeHomingOrder[axis]: [Axis] = 1 : axis 'A1' [Axis] = 2 : axis 'A2' [Axis] = 3 : axis 'A3' [Axis] = 4 : axis 'A4' [Axis] = 5 : axis 'A5' [Axis] = 6 : axis 'A6' [Axis] = 7 : axis 'Aux1' Example aeHomingOrder[1] := First; aeHomingOrder[2] := First; aeHomingOrder[3] := Second,, aeHomingOrder[7] := NoHoming; Axes A1 and A2 are referenced isochronously, then axis A3. Axis Aux1 is not referenced.	●	●	●
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 ascHomeExtParameter homing parameters from the application are used.			
ascHomeExtTP ARRAY [1..12] OF 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.	●	●	●
ascHomeExtParameter ARRAY [1..12] OF L_MC1P_HomeParameter		Homing parameters from the application for the desired axis - Only relevant if xUseHomeExtParameter = TRUE. ascHomeExtParameter[axis]: [Axis] = 1 : axis 'A1' [Axis] = 2 : axis 'A2' [Axis] = 3 : axis 'A3' [Axis] = 4 : axis 'A4' [Axis] = 5 : axis 'A5' [Axis] = 6 : axis 'A6' [Axis] = 7 : axis 'Aux1'	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
IrXMaxVel	LREAL	Maximum velocity of the Cartesian X axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrYMaxVel	LREAL	Maximum velocity of the Cartesian Y axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrZMaxVel	LREAL	Maximum velocity of the Cartesian Z axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrAMaxVel	LREAL	Maximum velocity for the A axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrBMaxVel	LREAL	Maximum velocity for the B axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrCMaxVel	LREAL	Maximum velocity for the C axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrAux1MaxVel	LREAL	Maximum velocity for the Aux1 axis during the path interpolation • Unit: units/s • Initial value: 10	●	●	●
IrXMaxAccDec	LREAL	Maximum acceleration/deceleration for the Cartesian X axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrYMaxAccDec	LREAL	Maximum acceleration/deceleration for the Cartesian Y axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrZMaxAccDec	LREAL	Maximum acceleration/deceleration for the Cartesian Z axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrAMaxAccDec	LREAL	Maximum acceleration/deceleration for the A axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrBMaxAccDec	LREAL	Maximum acceleration/deceleration for the B axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrCMaxAccDec	LREAL	Maximum acceleration/deceleration for the C axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●
IrAux1MaxAccDec	LREAL	Maximum acceleration/deceleration for the Aux1 axis during the path interpolation • Unit: units/s ² • Initial value: 100	●	●	●

Designator	Data type	Description	Available in version		
			Base	State	High
IrXMaxJerk	LREAL	Maximum jerk for the Cartesian X axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrYMaxJerk	LREAL	Maximum jerk for the Cartesian Y axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrZMaxJerk	LREAL	Maximum jerk for the Cartesian Z axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrAMaxJerk	LREAL	Maximum jerk for the A axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrBMaxJerk	LREAL	Maximum jerk for the B axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrCMaxJerk	LREAL	Maximum jerk for the C axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrAux1MaxJerk	LREAL	Maximum jerk for the Aux1 axis during the path interpolation • Unit: units/s ³ • Initial value: 10000	●	●	●
IrGripperClosingTime	LREAL	Deceleration of the gripper control • Positive values: the gripper is opened before the path profile is completed. • Negative values: the gripper is opened after the path profile has been completed. • Initial value: 0 • Unit: s	●	●	●
xPosInWindow	BOOL	Activation of the tolerance window for following error monitoring • Initial value: FALSE	●	●	●
		TRUE The tolerance window is activated. The xInPosition output is set to TRUE if the "Tool Center Point" (tool zero point) is within the tolerance window.			
		FALSE The tolerance window is not activated.			
IrPosInWindow	LREAL	Size of the tolerance window for following error monitoring. All axes are monitored to check whether the actual values are within the window parameterised. • Unit: units • Initial value: 0.5	●	●	●
IrTimePosInWindow	LREAL	Period during which the "Tool Center Point" (tool zero point) is within the tolerance window (duration of the following error) • Unit: ms • Initial value: 50	●	●	●
eTargetCoordSystem L_MC4P_CoordSystem		Selection of the coordinate system to be used in the target point: • WCS (= 0): World Coordinate System • MCS (= 1000): Machine Coordinate System • PCS1(= 1) ... PSC16(= 16): Product Coordinate System (1...16) • Initial value: 0	●		

Designator	Data type	Description	Available in version		
			Base	State	High
IrXTargetPos	LREAL	Target position in X direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrYTargetPos	LREAL	Target position in Y direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrZTargetPos	LREAL	Target position in Z direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrATargetPos	LREAL	Target position in A direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 180	●		
IrBTargetPos	LREAL	Target position in B direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrCTargetPos	LREAL	Target position in C direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrAux1TargetPos	LREAL	Target position in Aux1 direction for the "Pick & Place" profile in the Base version • Unit: units • Initial value: 0	●		
IrZStartDist	LREAL	Difference in height at the start in Z direction • Unit: units • Initial value: 0	●		
IrZTargetDist	LREAL	Difference in height at the end/target in Z direction • Unit: units • Initial value: 0	●		
IrBlendingRadius	LREAL	Blending radius for the "Pick & Place" profile in the Base version The value specifies the distance from the target point in which the rounding motion is to start. • Unit: units • Initial value: 0	●		
IrPathVel	LREAL	Limitation of the path speed • Unit: units/s • Initial value: 10	●		
IrPathAcc	LREAL	Limitation of the path acceleration • Unit: units/s ² • Initial value: 100	●		
IrPathDec	LREAL	Limitation of the path deceleration • Unit: units/s ² • Initial value: 100	●		

Designator	Data type	Description	Available in version		
			Base	State	High
xSingleStep	BOOL	Single step function • Initial value: FALSE		●	●
		TRUE Activate single step function: • During the path interpolation, the interpolator stops in every point. • The breakpoint must be acknowledged during the interpolation with input xAckPathHalt = TRUE. • Blending radii are not taken into consideration, so that all segments without blending radii are executed.			
ascProfilePar ARRAY[1..10] OF L_TT1P_scProfilePar		In the ascProfilePar structure, a maximum of 10 interpolation points can be defined for a travel profile in the Cartesian coordinate system.		●	●

3.4.5

Parameters for interpolation points (travel profile parameters)

L_TT1P_scProfilePar

In the *ascProfilePar* parameter in the [L_TT1P_scPar PickAndPlace \[Base/State/High\]](#) (26) parameter structure, a data array with 10 interpolation points can be specified for a travel profile.

The *ascProfilePar* parameter is only provided in the "State" and "High" technology module versions.

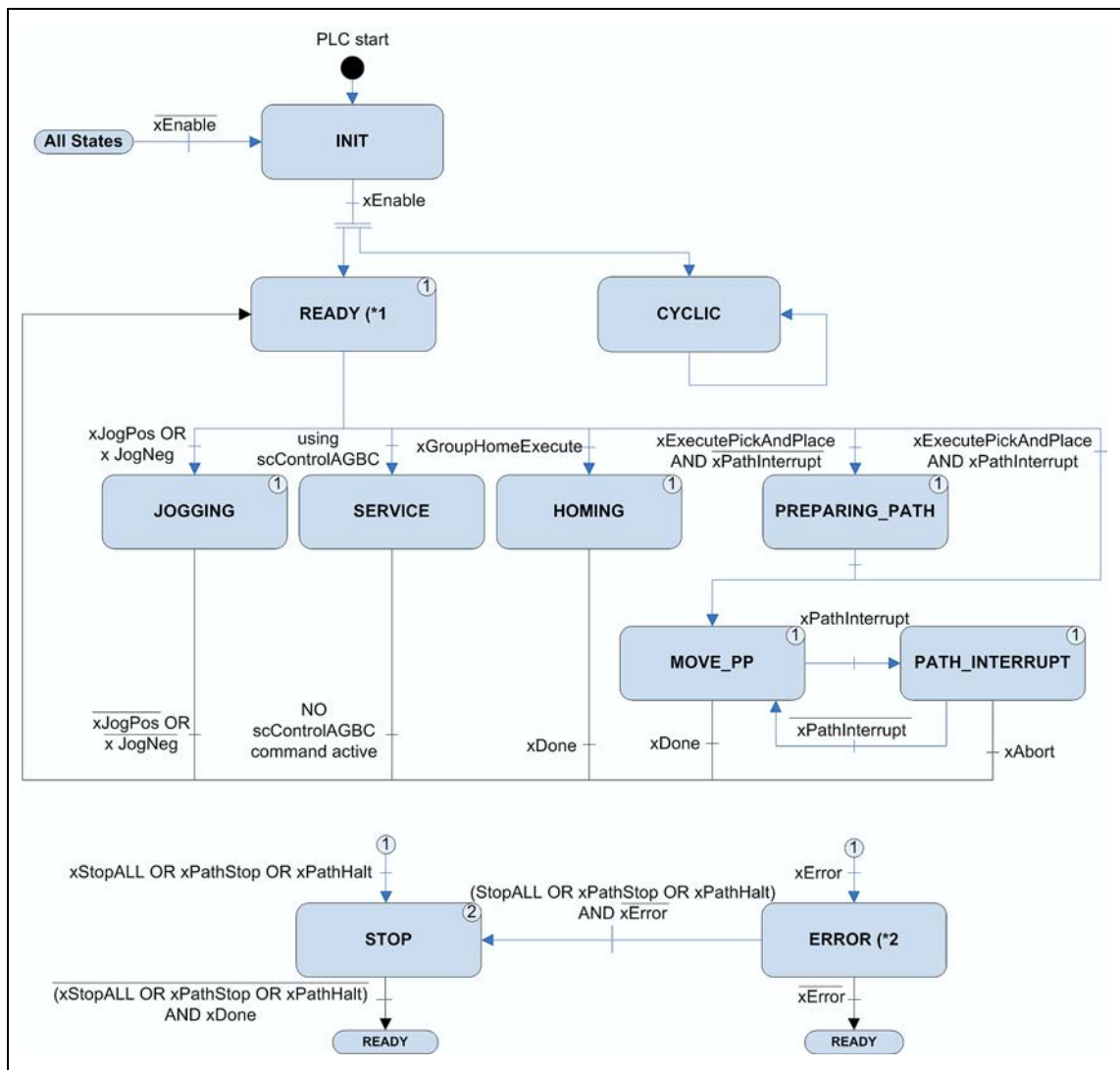
Each interpolation point features the following parameters:

Designator	Data type	Description	Available in version		
			Base	State	High
eCoordSystem L_MC4P_CoordSystem		Selection of the coordinate system to be used: • MCS: Machine Coordinate System (initial value) • PCS_1...16: Product Coordinate System (1...16) • ACS: Axes Coordinate System - is not supported!		●	●
IrXPos	LREAL	Position in X direction • Unit: units • Initial value: 0		●	●
IrYPos	LREAL	Position in Y direction • Unit: units • Initial value: 0		●	●
IrZPos	LREAL	Position in Z direction • Unit: units • Initial value: 0		●	●
IrAPos	LREAL	Position in A direction • Unit: units • Initial value: 180		●	●
IrBPos	LREAL	Position in B direction • Unit: units • Initial value: 0		●	●
IrCPos	LREAL	Position in C direction • Unit: units • Initial value: 0		●	●
IrAux1Pos	LREAL	Position in Aux1 direction (auxiliary axis direction) • Unit: units • Initial value: 0		●	●

Designator	Data type	Description	Available in version		
			Base	State	High
lrPathVel	LREAL	Limitation of the path speed • Unit: units/s • Initial value: 0		●	●
lrPathAcc	LREAL	Limitation of the path acceleration • Unit: units/s ² • Initial value: 0		●	●
lrPathDec	LREAL	Limitation of the path deceleration • Unit: units/s ² • Initial value: 0		●	●
lrBlendingRadius	LREAL	Blending radius The value specifies the distance from the target point in which the rounding motion is to start. • Unit: units • Initial value: 0		●	●
xHalt	BOOL	Stop path • Initial value: FALSE		●	●
		TRUE The path is stopped. The breakpoint must be acknowledged during the interpolation with input xAckPathHalt = TRUE.			

3.5

State machine



[3-3] State machine of the technology module

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

(*1 In the "Ready" state, xRegulatorOnALL 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.

States of the eTMState output (L_TT1P_States)

No.	L_TT1P_States	Description
1	INIT	Initialisation of the technology module active.
2	READY	Technology module ready for operation.
3	HOMING	Referencing active.
10	JOGGING	Manual jog active.
11	JOGPOS	Manual jog in positive direction active.
12	JOGNEG	Manual jog in negative direction active.
112	PREPARING_PATH	Contour preparation active.
114	MOVE_PP	Movement from the pick-and-place position active.
117	PATH_INTERRUPT	Movement from the pick-and-place position interrupted.
150	JOGGING_X	Manual jog in X-axis active (Cartesian).
151	JOGGING_Y	Manual jog in Y-axis active (Cartesian).
152	JOGGING_Z	Manual jog in Z-axis active (Cartesian).
153	JOGGING_A	Manual jog in A-axis active.
154	JOGGING_B	Manual jog in B-axis active.
155	JOGGING_C	Manual jog in C-axis active.
156	JOGGING_A1	Manual jog of real axis A1 active.
157	JOGGING_A2	Manual jog of real axis A2 active.
158	JOGGING_A3	Manual jog of real axis A3 active.
159	JOGGING_A4	Manual jog of real axis A4 active.
160	JOGGING_A5	Manual jog of real axis A5 active.
161	JOGGING_A6	Manual jog of real axis A6 active.
162	JOGGING_AUX1	Manual jog of auxiliary axis Aux1 active.
163	JOGGING_AUX2	Manual jog of auxiliary axis Aux2 active.
164	JOGGING_AUX3	Manual jog of auxiliary axis Aux3 active.
165	JOGGING_AUX4	Manual jog of auxiliary axis Aux4 active.
166	JOGGING_AUX5	Manual jog of auxiliary axis Aux5 active.
167	JOGGING_AUX6	Manual jog of auxiliary axis Aux6 active.
996	STOP	Stop/Halt active.
998	SERVICE	The technology module is in service mode. The internal L_MC1P_AxisBasicControl function block is controlled via the <i>scCtrlABC</i> input structure. The status of the function block can be viewed via the <i>scStatusABC</i> output structure.
999	ERROR	Error state
1000	SYSTEMFAULT	System fault

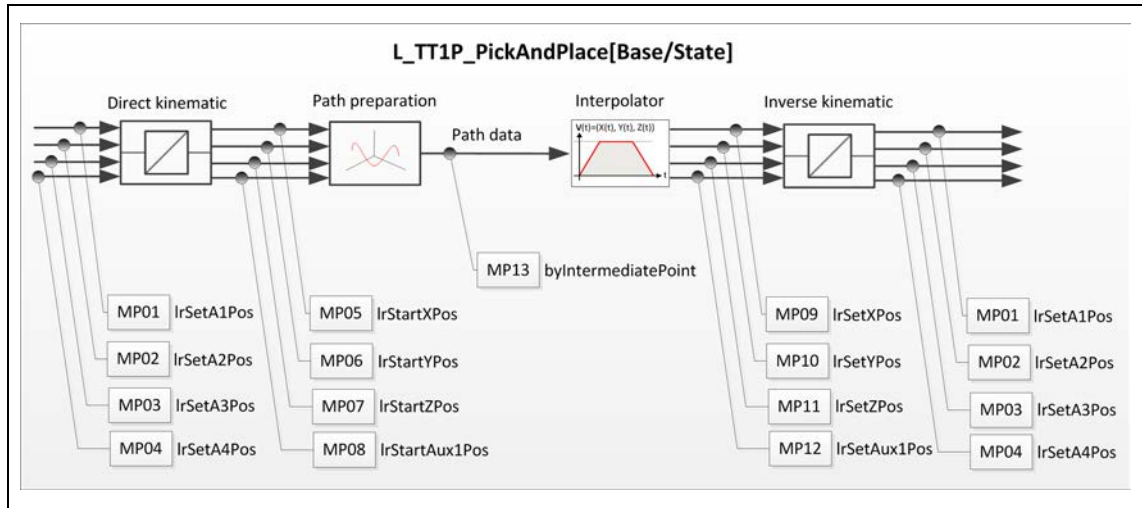
3 Functional description of "Pick & Place"

3.6 Signal flow diagram

3.6 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.



[3-4] Signal flow diagram: Pick & Place

3.6.1 Structure of the signal flow

L_TT1P_scSF_PickAndPlace [Base/State/High]

The contents of the L_TT1P_scSF_PickAndPlace[Base/State/High] structure are read-only and offer a practical diagnostics option within the signal flow ([Signal flow diagram](#) (36)).

Designator	Data type	Description	Available in version		
			Base	State	High
MP00_lwTChecksum	LWORD	Checksum	●	●	●
MP01_lrSetA1Pos	LREAL	Position setpoints for axes A1 ... A4 Before a movement in the virtual space (X, Y, Z) is executed, the setpoints of the real axes (A1 ... A4) are converted via the direct kinematics and are used as starting value.	●	●	●
MP02_lrSetA2Pos	LREAL		●	●	●
MP03_lrSetA3Pos	LREAL		●	●	●
MP04_lrSetA4Pos	LREAL		●	●	●
MP05_lrStartXPos	LREAL	Starting value for axes X, Y, Z	●	●	●
MP06_lrStartYPos	LREAL		●	●	●
MP07_lrStartZPos	LREAL		●	●	●
MP08_lrStartAux1Pos	LREAL	Starting value for the Aux1 axis	●	●	●
MP09_lrSetXPos	LREAL	Position setpoints for axes X, Y, Z	●	●	●
MP10_lrSetYPos	LREAL		●	●	●
MP11_lrSetZPos	LREAL		●	●	●
MP12_lrSetAux1Pos	LREAL	Position setpoint for the Aux1 axis	●	●	●
MP13_bylIntermediatePoint	BYTE	Number of the intermediate point that is approached in the current path.	●	●	●

3.7 Manual jog (jogging)

Precondition

- The technology module is in the "Ready" state.
- All axes are enabled (*xRegulatorOnALL* input = TRUE).

Type

The axis to be travelled is selected via the *eSelectAxis* input:

Selection of <i>eSelectAxis</i>	
Value	Axis to be travelled
0	No axis
1	X axis
2	Y axis
3	Z axis
4	A axis
5	B axis
6	C axis
7	Axis 'A1'
8	Axis 'A2'
9	Axis 'A3'
10	Axis 'A4'
11	Axis 'A5'
12	Axis 'A6'
13	Axis 'Aux1'

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.

If the *xJogPos* or *xJogNeg* input is TRUE, the [State machine](#) (34) changes to the "Jogging" state. In that state, no other axis can be traversed. Only if the running axis is at a standstill, the state machine returns to the "Ready" state and another axis can be traversed



Note!

In manual operation, always only one axis can be traversed at a time, never several axes.

If the *eSelectAxis* axis selection is changed over to another axis while "Jogging" is active, the running axis is stopped. Only when all axes are at a standstill, the next axis can be traversed in manual operation.

Parameters to be set

The parameters to be set for the manual jog are located in the [L TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26) parameter structure.

```

lrCartesianJogVel : LREAL := 10;      // for axes X,Y,Z
lrCartesianJogAcc : LREAL := 100;     // for axes X,Y,Z
lrCartesianJogDec : LREAL := 100;     // for axes X,Y,Z
lrCartesianJogJerk : LREAL := 10000;  // for axes X,Y,Z
lrOrientationJogVel : LREAL := 10;    // for axes A,B,C
lrOrientationJogAcc : LREAL := 100;   // for axes A,B,C
lrOrientationJogDec : LREAL := 100;   // for axes A,B,C
lrOrientationJogJerk : LREAL := 10000; // for axes A,B,C
lrRealAxisJogVel : LREAL := 10;       // for axes A1...A6,Aux1
lrRealAxisJogAcc : LREAL := 100;      // for axes A1...A6,Aux1
lrRealAxisJogDec : LREAL := 100;      // for axes A1...A6,Aux1
lrRealAxisJogJerk : LREAL := 10000;   // for axes A1...A6,Aux1

```

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).

Type

Homing is started with a rising edge (FALSE→TRUE) at the *xGroupHomeExecute* input. The axis will be travelling until the home position is reached. After successful homing, the [State machine](#) (□ 34) changes back again to the "Ready" state.

Homing is not interrupted if the *xGroupHomeExecute* input is set to FALSE too early.

Depending on the connect axes group, only the real axes A1 ... A6 and Aux1 are referenced.

The axes are only referenced in the order that is given via the *aeHomingOrder* parameter.

Parameters to be set

The parameters for homing are located in the [L_TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (□ 26) parameter structure.

```
aeHomingOrder : ARRAY [1..12] OF L_MC4P_HomingOrder := NoHoming;
xUseHomeExtParameter : BOOL := FALSE;
alrHomePosition : ARRAY OF LREAL := 0;
ascHomeExtParameter : ARRAY OF L_MC1P_HomeParameter;
```

**»PLC Designer« Online help**

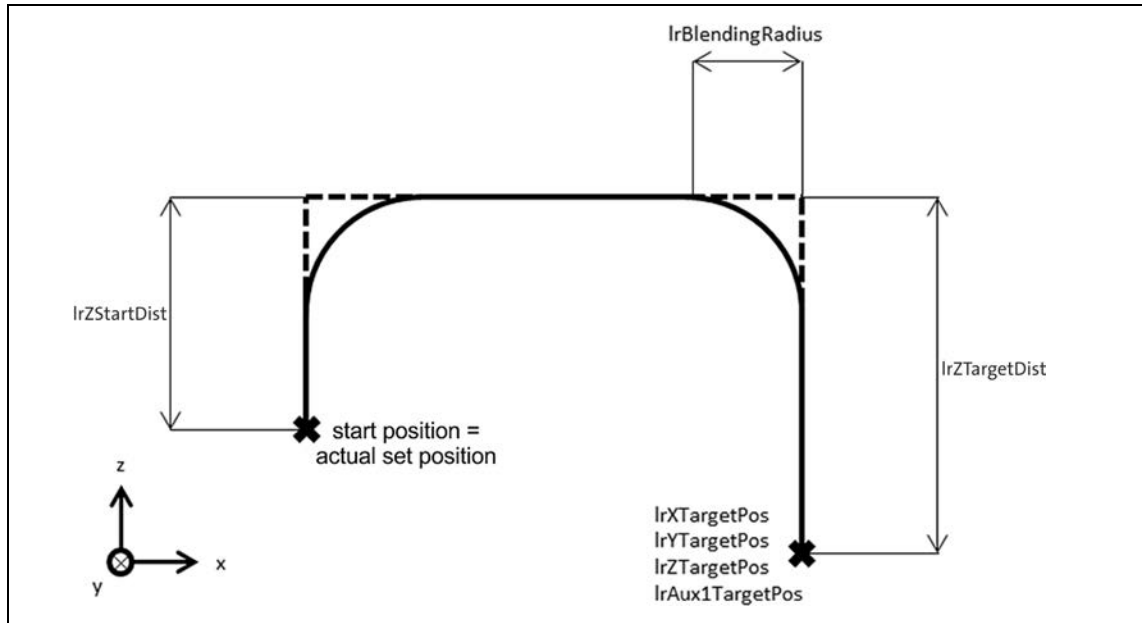
Further information about homing can be found in the description of the **L_MC4P_AxesGroupBasicControl** function block.

3 Functional description of "Pick & Place"

3.9 Specifying a travel profile

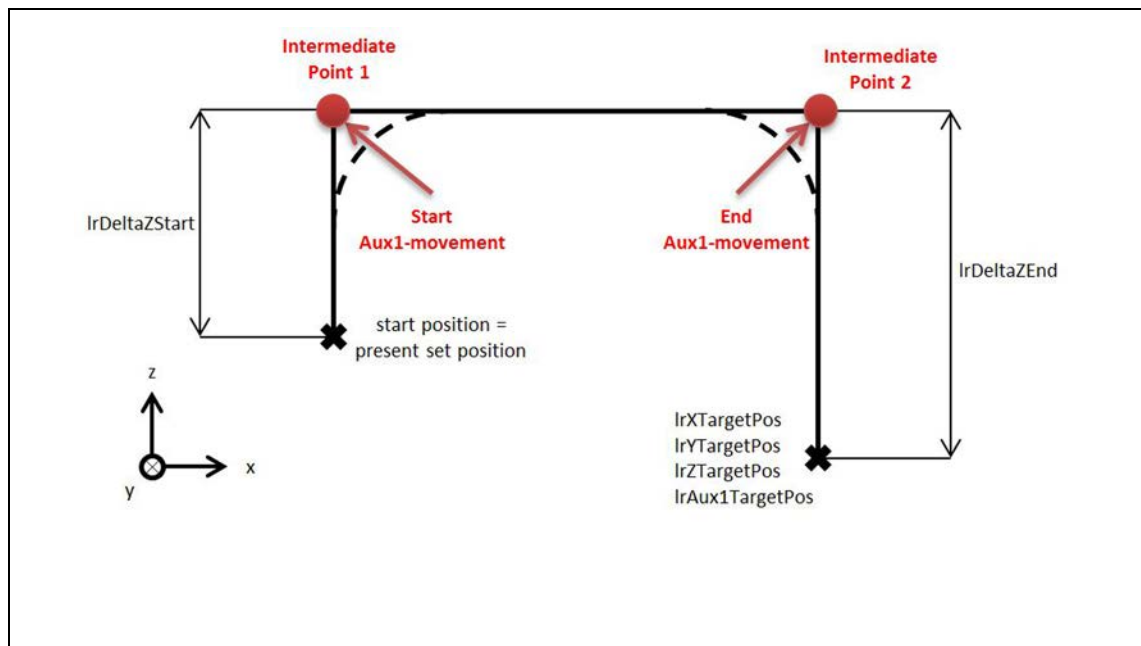
3.9 Specifying a travel profile

In the Base version, a simple "Pick & Place" profile can be defined by means of only a few parameters.



[3-5] Parameters for a simple "Pick & Place" profile

3.10

Calculation of the profile points with $lrBlendingRadius = 0$ [3-6] Calculation of the profile points with $lrBlendingRadius = 0$

In the case of this travel profile, the two intermediate points (intermediate points 1 and 2) between the starting and target position are approached and a short stop in the point is carried out (path speed = 0).

The actual position (X, Y, Z, A, B, C, Aux1) of the "Tool Center Point" in a certain space is the starting position of the profile.

The *lrDeltaZStart* parameter is used to define the height of the "Tool Center Point" (Intermediate Point 1) from which the target position in X/Y/Z/A/B/C direction is approached. This point is defined in the same coordinate system of the actual position (X, Y, Z, A, B, C, Aux1) of the "Tool Center Point".

For each interpolation point, a coordinate system can be defined via the *eCoordSystem* parameter. The "Machine Coordinate System" (MCS) and all "Product Coordinate Systems" (PCS 1...16) are supported. The "Axes Coordinate System" (ACS) is not supported.

The coordinates of "Intermediate Point 2" result from the sum of the target coordinates X, Y, Z, A, B, C, Aux1 using the *lrZTargetDist* parameter in the coordinate system. When this point has been reached, the target position is approached in X/Y/Z/A/B/C direction.

The movement of orientation axes A, B, C and auxiliary axis Aux1 starts in "Intermediate Point 1" and ends in "Intermediate Point 2".

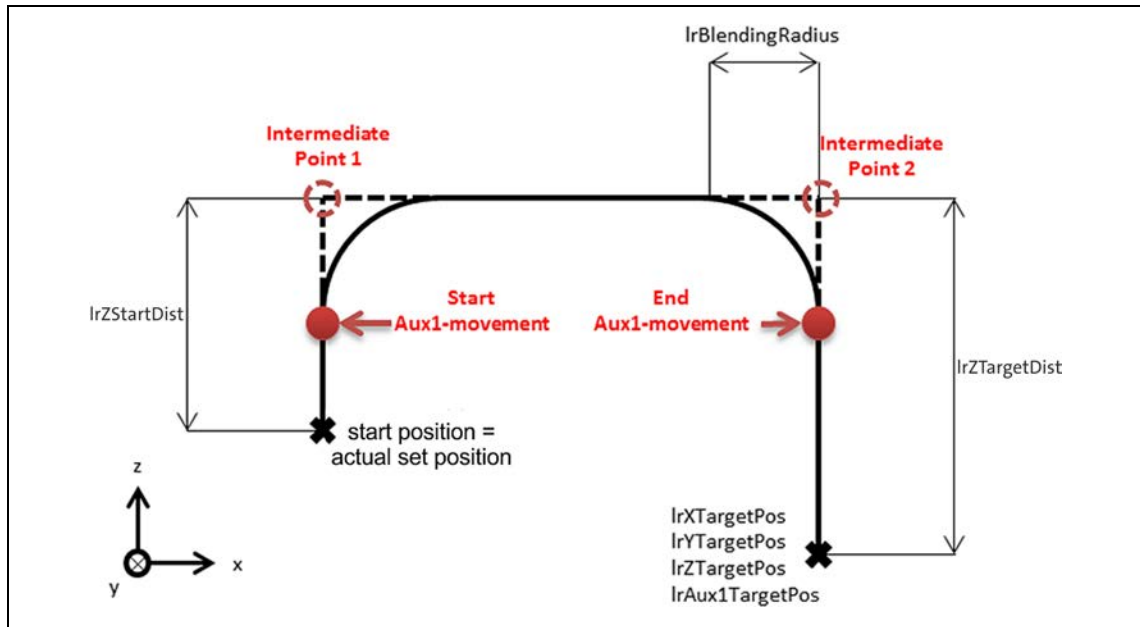
Parameters to be set

The parameters to be set are located in the following parameter structures:

- [L_TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26);
- [L_TT1P_scProfilePar](#) (32).

```
eTargetCoordSystem : L_MC4P_CoordSystem;  
lrXTargetPos : LREAL := 0;  
lrYTargetPos : LREAL := 0;  
lrZTargetPos : LREAL := 0;  
lrATargetPos : LREAL := 180;  
lrBTargetPos : LREAL := 0;  
lrCTargetPos : LREAL := 0;  
lrAux1TargetPos : LREAL := 0;  
lrZStartDist : LREAL := 0;  
lrZTargetDist : LREAL := 0;  
lrBlendingRadius : LREAL := 0;  
lrPathVel : LREAL := 10;  
lrPathAcc : LREAL := 100;  
lrPathDec : LREAL := 100;  
xPosInWindow : BOOL := FALSE;  
lrPosInWindow : LREAL := 0.5; [units]  
lrTimePosInWindow : LREAL := 50; [ms]
```

3.11

Calculation of the profile points with $lrBlendingRadius > 0$ 

[3-7] Calculation of the profile points with $lrBlendingRadius > 0$

In the case of this travel profile, the two intermediate points (intermediate points 1 and 2) between the starting and target position are not approached but the profile is rounded around these points. The profile is executed without a stop.

The actual position (X, Y, Z, A, B, C, Aux1) of the "Tool Center Point" in a certain space is the starting position of the profile.

The *lrZStartDist* parameter is used to define the height of the "Tool Center Point" (Intermediate Point 1). The profile travel process is lead around "Intermediate Point 1", depending on the blending radius in the *lrBlendingRadius* parameter.

The coordinates of "Intermediate Point 2" result from the sum of the target coordinates X, Y, Z, A, B, C, Aux1 using the *lrZTargetDist* parameter. Along the lines of the description above, the profile travel process here also takes place around "Intermediate Point 2", depending on the *lrBlendingRadius* parameter.

There is a maximum limit for setting the blending radius. The technology module internally limits the blending radius to a maximum of half of the path between the adjacent "Intermediate Points".

The movement of orientation axes A, B, C, and the auxiliary axis Aux1 starts in the moment in which the rounding movement around "Intermediate Point 1" is starting (depending on the blending radius). The movement of the axes ends when the rounding movement around "Intermediate Point 2" has been completed.

Parameters to be set

The parameters to be set are located in the following parameter structures:

- [L_TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26);
- [L_TT1P_scProfilePar](#) (32).

```
lrXTargetPos : LREAL := 0;  
lrYTargetPos : LREAL := 0;  
lrZTargetPos : LREAL := 0;  
lrATargetPos : LREAL := 180;  
lrBTargetPos : LREAL := 0;  
lrCTargetPos : LREAL := 0;  
lrAux1TargetPos : LREAL := 0;  
lrZStartDist : LREAL := 0;  
lrZTargetDist : LREAL := 0;  
lrBlendingRadius : LREAL := 0;  
lrPathVel : LREAL := 10;  
lrPathAcc : LREAL := 100;  
lrPathDec : LREAL := 100;  
xPosInWindow : BOOL := FALSE;  
lrPosInWindow : LREAL := 0.5; [units]  
lrTimePosInWindow : LREAL := 50; [ms]
```

3.12 Limitations (maximum values) for the axes on the travel profile

For the path calculation or interpolation, maximum values for the speed, acceleration and jerk can be defined for all axes.

Depending on these values, the resulting travel profile for the path is adapted:

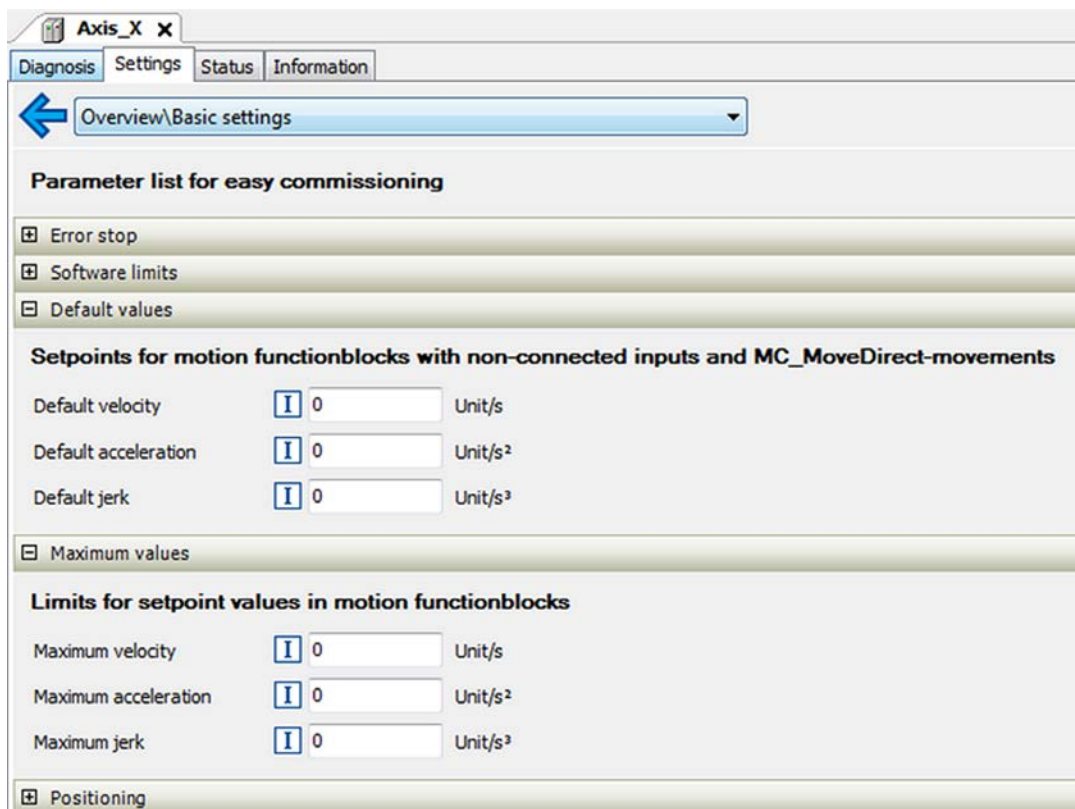
- In the course of the path calculation, the speed, acceleration and jerk of the path are automatically reduced, so that the maximum values of axes X, Y, Z, A, B, C and Aux1 are not exceeded.
- For the interpolation, the maximum values from the axis are taken into consideration. If the maximum values are exceeded in this process, interpolation is carried out with the maximum speed, maximum acceleration and the maximum jerk that have been set.

The limitations can be set at two points:

- Via the respective reference axis (AXIS_REF).
- By parameterisation of the maximum values for velocity, acceleration and jerk for the axes X, Y, Z, A, B, C and Aux1.

The setting '0' deactivates the limitation.

In the »PLC Designer«, the maximum values can be set under the "Settings" of the corresponding reference axis (AXIS_REF):



Parameters to be set

As an alternative, the limiting parameters can be preselected via the [L TT1P_scPar PickAndPlace \[Base/State/High\]](#) (26) parameter structure.

```
lrXMaxVel : LREAL := 10;  
lrYMaxVel : LREAL := 10;  
lrZMaxVel : LREAL := 10;  
lrAMaxVel : LREAL := 10;  
lrBMaxVel : LREAL := 10;  
lrCMaxVel : LREAL := 10;  
lrAux1MaxVel : LREAL := 10;  
lrXMaxAccDec : LREAL := 1000;  
lrYMaxAccDec : LREAL := 1000;  
lrZMaxAccDec : LREAL := 1000;  
lrAMaxAccDec : LREAL := 1000;  
lrBMaxAccDec : LREAL := 1000;  
lrCMaxAccDec : LREAL := 1000;  
lrAux1MaxAccDec : LREAL := 1000;  
lrXMaxJerk : LREAL := 10000;  
lrYMaxJerk : LREAL := 10000;  
lrZMaxJerk : LREAL := 10000;  
lrAMaxJerk : LREAL := 10000;  
lrBMaxJerk : LREAL := 10000;  
lrCMaxJerk : LREAL := 10000;  
lrAux1Jerk : LREAL := 10000;
```

3.13 Starting the travel profile (xExecutePickAndPlace)

With a rising edge (FALSE→TRUE) at the input *xExecutePickAndPlace*, the travel profile is started. For this purpose, the profile for the path is calculated and prepared in the background.

The *IrPreCalcProfileTime* output shows the time calculated for the travel from the start to the target point of the current profile to be travelled.

Possibilities of influencing the profile

- Input *xPathStop* = TRUE

With input *xPathStop* = TRUE, all axes are brought to a standstill so that they are accurate to the path (following the travel profile).

When the movement has been started again, execution of the path is continued from its breakpoint.

▶ [Stop/holding function \(xPathStop, xStopALL, xPathHalt\)](#) (📖 49)

- Input *xStopALL* = TRUE

With input *xStopALL* = TRUE, all axes are brought to a standstill individually – irrespectively of the path.

When "Stop" has been executed, the technology module changes to the "ERROR" state (display at the *eTMState* output).

- *xPathInterrupt* input = TRUE

▶ [Interrupting the travel profile/path \(xPathInterrupt\)](#) (📖 50)

- *xAbort* input = TRUE

With *xAbort* = TRUE, the travel profile can be cancelled.

The *xAbort* input can only be used if the axes have been stopped via *xPathStop*, *xPathHalt* or *xPathInterrupt* before.

3.14 Stop/holding function (xPathStop, xStopALL, xPathHalt)

xPathStop and xPathHalt inputs

If the *xPathStop* input or *xPathHalt* = TRUE, all axes are brought to a standstill with the deceleration defined via the *lrPathDec* parameter and accurate to the path (following the travel profile).

The technology module changes to the "STOP" state (display at the *eTMState* output).

With the stop function, the jerk limitation is preselected via the *lrPathStopJerk* parameter, and with the holding function it is defined via *lrPathJerk*.

After reaching a standstill, output *xPathHold* = TRUE is set. This shows that the current position in the profile was remembered so that the path can be continued at this point.

If the path is to be continued at its breakpoint:

- As soon as the *xPathStop* and *xPathHalt* inputs are reset to FALSE, the technology module is set to the "Ready" state.
- From the "Ready" state, the travel can be continued with a renewed FALSE→TRUE edge at input *xExecutePickAndPlace* (prerequisite: output *xPathHold* = TRUE).

If the travel profile is to be cancelled:

- Set input *xAbort* = TRUE. (Aborting the travel profile is only possible when the axes are at a standstill.)
- If the travel profile has been successfully aborted, output *xPathHold* = FALSE is set.

Jog mode

If the technology module is in the "STOP" state and the travel profile has not been aborted yet, the axes can be traversed using the *xJogPos* or *xJogNeg* jog input. This may for instance be required for running the kinematics to a service position.

► [Manual jog \(jogging\)](#) (38)



Stop!

The holding position must be saved after the stop. After [Manual jog \(jogging\)](#) (38), all axes must be traversed to the holding positions. This is the application programmer's task; the technology module does not carry out this process automatically!

If this does not happen, a movement to the next target point takes place, which may cause unintended movements in the workspace.

xStopALL input

If the *xStopALL* input is TRUE, all axes are brought to a standstill individually – irrespective of the path – with the deceleration defined via the *alrStopDec* parameter. In this process, no information with regard to the path is stored. *xPathHold* remains FALSE.

The jerk limitation is defined via the *alrStopJerk* parameter.

The technology module changes to the "STOP" state (display at the *eTMState* output).

When the movement has been started again, the path is executed again from the start.

Parameters to be set

The parameters to be set are located in the [L TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26) parameter structure.

```

lrPathStopDec : LREAL := 10000;      // [units/s^2]
lrPathStopJerk : LREAL := 100000;   // [units/s^3]
lrPathHaltDec : LREAL := 10000      // [units/s^2]
lrPathJerk : LREAL := 100000;       // [units/s^3]
alrStopDec : ARRAY OF LREAL := 10000; // [units/s^2]
alrStopJerk : ARRAY OF LREAL := 100000; // [units/s^3]

```

3.15 Interrupting the travel profile/path (xPathInterrupt)

This function can only be activated in the "MOVE_PP" state.

If the *xPathInterrupt* input is TRUE, all axes are brought to a standstill with the deceleration defined via the *lrPathDec* parameter and accurate to the path (following the travel profile).

After reaching a standstill, output *xPathHold* = TRUE is set. This shows that the current position in the profile was remembered so that the path can be continued at this point.

The technology module changes to the "PATH_INTERRUPT" state (display at the *eTMState* output).

By using *xPathInterrupt*, the automatic gripper control for the current path is interrupted.

- The *xGripperCtrlActive* gripper output is set to FALSE.
- The *xPulseGripper* signal is only set at the end of the profile.

If the path is to be continued at its breakpoint:

- Set *xPathInterrupt* = FALSE.
- The technology module changes to the "MOVE_PP" state.

If the travel profile is to be cancelled:

- Set input *xAbort* = TRUE. (Aborting the travel profile is only possible when the axes are at a standstill.)
- If the travel profile has been successfully aborted, output *xPathHold* = FALSE is set.

3.16 Gripper control

The gripper control is activated if a non-zero value is set in the *IrGripperClosingTime* parameter. This is also shown by output *xGripperCtrlActive* = TRUE.

The *xxPulseGripper* output is controlled depending on the *IrGripperClosingTime* parameter:

- Positive values have the effect that the gripper is opened by the value set in seconds before the profile end is reached.
- Negative values have the effect that the gripper is opened by the value set in seconds after the profile end has been reached.

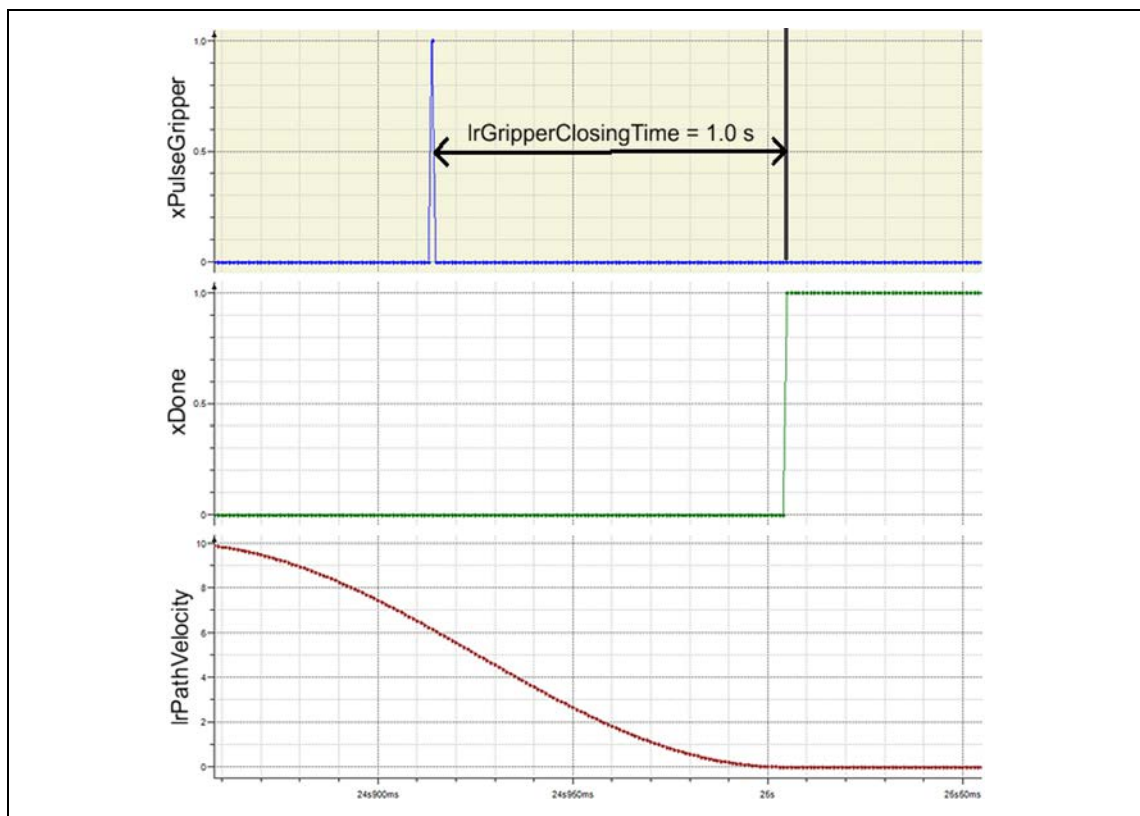
The *xPulseGripper* output is only active for one cycle.

The gripper control only works for as long as the travel process is not interrupted by a stop. Otherwise gripper control is deactivated for the path.

If a value not equalling '1.0' is set in the *IrOverride* input, gripper control is also deactivated. The [Speed override](#) (52) influences the travelling duration of the path; therefore it is not possible to implement a correct gripper control.

Deactivation of the gripper control is shown by output *xGripperCtrlActive* = FALSE.

Figure [3-8] shows the impact of the *IrGripperClosingTime* parameter from the [L TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26) parameter structure on the *xPulseGripper* output.

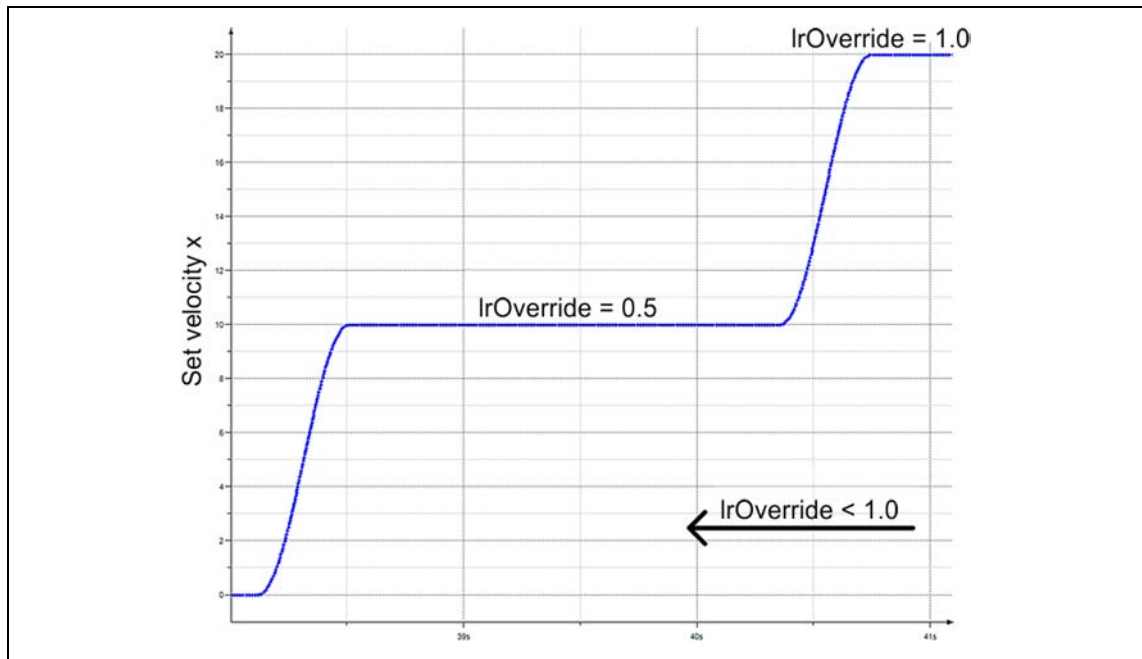


[3-8] Impact of the *IrGripperClosingTime* parameter on the *xPulseGripper* output

3.17 Speed override

Via the *IrOverride* input, the interpolation of the path can be influenced. The speed, acceleration and jerk are multiplied by the override factor set. The initial value of the input is '1.0'. A value not equalling '1.0' or a change in value during the travel process deactivates the [Gripper control](#) (51).

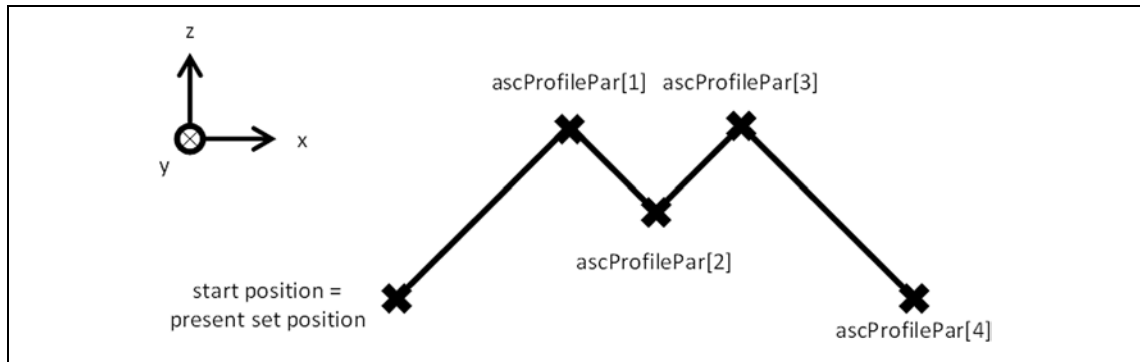
The impact of *IrOverride* on the speed is shown in figure [3-9]. The value '0.5' halves the speed, the acceleration, and the jerk.



[3-9] Impact of *IrOverride* on the speed

3.18

Defining a travel profile with up to 10 interpolation points



[3-10] Example: Path planning in the State version

Within the travel profile, maximally 10 interpolation points can be freely defined and parameterised via the *ascProfilePar* parameter in the [L TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26) parameter structure.

The parameters to be set for the interpolation points are located in the [L TT1P_scProfilePar](#) (32) parameter structure.

For each interpolation point, a coordinate system can be defined via the *eCoordSystem* parameter. The "Machine Coordinate System" (MCS) and all "Product Coordinate Systems" (PCS 1...16) are supported. The "Axes Coordinate System" (ACS) is not supported.

For a travel profile with less than 10 interpolation points, the speed selections for the points that are not available must be set to the value '0' in the *lrPathVel* parameter in each case.

If the *lrPathVel* parameter is 0 for one interpolation point and *lrPathVel* > 0 for the following interpolation point, the parameter set with *lrPathVel* = 0 is not taken into consideration. Therefore parameter sets are easily masked out.

For parameter sets with valid *lrPathVel* values (> 0) and the parameters *lrPathAcc* = 0 or *lrPathDec* = 0, always the last valid acceleration value (> 0) in the profile is used.

If, for instance, always the same acceleration is to be used in a travel profile, *lrPathAcc* > 0 and *lrPathDec* > 0 must only be set for the first interpolation point in the profile.

If *lrPathAcc* = 0 and *lrPathDec* = 0 are set for the first interpolation point, the standard acceleration $lrPathAcc = lrPathDec = 10 \text{ units/s}^2$ is used, which may cause the movement to take a very long time.

TM_Control

TM_Parameter

AGBC

L_TT1P_XYZCPickAndPlaceState

PickAndPlace_State.TM_PickAndPlace

L_TT1P_scProfilePar

X

PointNumber	1	2	3	4
eCoordSystem	MCS	MCS	MCS	MCS
IrXPos	100.00[u]	150.00[u]	200.00[u]	300.00[u]
IrYPos	0.00[u]	0.00[u]	0.00[u]	0.00[u]
IrZPos	300.00[u]	200.00[u]	300.00[u]	0.00[u]
IrAux1Pos	0.00[u]	0.00[u]	0.00[u]	0.00[u]
IrPathVel	100.00[u/s]	100.00[u/s]	100.00[u/s]	100.00[u/s]
IrPathAcc	1000.00[u/s²]	1000.00[u/s²]	1000.00[u/s²]	1000.00[u/s²]
IrPathDec	1000.00[u/s²]	1000.00[u/s²]	1000.00[u/s²]	1000.00[u/s²]
IrBlendingRadius	50.00[u]	50.00[u]	50.00[u]	50.00[u]
xHalt	xHalt	xHalt	xHalt	xHalt

▶

[3-11] Example: Parameters of interpolation points 1 ... 4 of a travel profile

3.19 Movement of the orientation axes and the auxiliary axis across several interpolation points

The orientation axes A, B, C and the Aux1 auxiliary axis can be moved across several interpolation points.

Example of the auxiliary axis (Aux1)

If the auxiliary axis is to be rounded starting from interpolation point 1 to interpolation point 5, the value '999' must be set as position value for "" in interpolation points 2, 3, and 4. Now the technology module knows that it always has to search for the next valid target (i.e. the next valid target point for "Aux1"). For interpolation point 5, a valid value must be entered in this example.

Irrespective of the control of main axes X, Y and Z, the auxiliary axis always stops at a point if ...

- a target point (entries for Aux1 not equalling '999') is defined,
- a breakpoint ($xHalt = TRUE$) has been programmed, or
- the single step function ($xSingleStep = TRUE$) is activated.

Restriction for orientation axes A, B, C

For the orientation axes, the value '999' must not be used if the selection of the *eCoordSystem* coordinate system (in parameter structure [L_TT1P_scProfilePar](#) (□ 32)) changes in the points in which the orientation axes are rounded.

Differences in rounding between the orientation axes and the auxiliary axis

The differences in rounding with the value '999' between the orientation axes A, B and C and the Aux1 auxiliary axis are:

	Orientation axes A, B, C	Aux1 auxiliary axis
Coupling to the path in X/Y/Z direction	Path-based: The speed, acceleration and deceleration for the A/B/C axes depend on the path. This means that the speed, acceleration and deceleration can change between the rounding points.	Time-based: The auxiliary axis is executed optimally in the rounding points without acceleration and deceleration phases.
Selection of the coordinate system	Each target position must be programmed when the coordinate system is changed. The rounding coding with the value '999' is impermissible if different coordinate systems are selected !	Programming of the auxiliary axis does not depend on the selection of the coordinate system. The rounding coding with the value '999' may be used if different coordinate systems are selected.
Definition of the target positions in the interpolation points with a blending radius > 0	The orientation axes are rounded in the interpolation points.	The auxiliary axis is stopped in the interpolation points. The path is also stopped in X/Y/Z direction.
Programming of a breakpoint ($xHalt = TRUE$) and Pre-acknowledgement (□ 56) during the path interpolation		

3.20 Defining optional breakpoints on the travel profile

Basically, a breakpoint can be set at every interpolation point ($xHalt = TRUE$). Each of these breakpoints programmed has to be acknowledged.

There are two possibilities of acknowledgement:

- Acknowledgement as a real breakpoint
- Pre-acknowledgement

Acknowledgement as a real breakpoint

The axes reach the point programmed and come to a stop. An acknowledgement signal at the $xAckPathHalt$ input is waited for. When the acknowledgement process has been carried out successfully, the next point is approached.

Pre-acknowledgement

Breakpoints on the path can be designed as optional waiting points, meaning that when the travel profile is started, it is not clear yet whether the target can be approached. If the target position up to a specific point on the path is not free yet (free storage area or conveying belt), a stop must be made at the breakpoint programmed. If, however, the storage area gets free while the profile is executed, the breakpoint can be pre-acknowledged and the breakpoint is overtravelled. The axes do not reach a standstill. If a smoothening process is programmed, the path is smoothed and executed without jerk.



Note!

The pre-acknowledgement signal ($xAckPathHalt$ input) must be set correspondingly early, providing for a sufficient amount of time before the breakpoint is reached and for calculating the rounding.

If acknowledgement is executed too late it may happen that the pre-acknowledgement is used for the next but one breakpoint. The breakpoint approached then has to be acknowledged nevertheless.

Examples: Breakpoint is set in interpolation point 5.

The pre-acknowledgement signal must be received before interpolation point 4. If the technology module is already in the path segment between point 4 and point 5, smoothening cannot take place anymore in the case of a pre-acknowledgement.

It is also possible to send several pre-acknowledgement signals in succession. In this case, as many breakpoints are acknowledged as there were FALSE→TRUE edges at the $xAckPathHalt$ input.

Single step function

The travel profile can also be executed in single step mode, inserting a breakpoint at each interpolation point. This has to be set before starting the travel profile using the parameter $xSingleStep = TRUE$ of the [L TT1P_scPar_PickAndPlace \[Base/State/High\]](#) (26) parameter structure.

Acknowledgement of the breakpoint after reaching the interpolation point is effected by means of input $xAckPathHalt = TRUE$. Pre-acknowledgement can also be carried out here.

Blending radii are not taken into consideration, so that all segments without blending radii are executed.

3.21 Adding more travel profiles

Precondition

- All axes are enabled (*xRegulatorOnALL* input = TRUE).
- A travel profile with maximally 10 interpolation points has been defined. Each point may contain an optional hold.
 - ▶ [Defining a travel profile with up to 10 interpolation points](#) (53)
- Changing the profiles that have been accepted in the technology module is not possible.

Type

With a rising edge (FALSE→TRUE) at the *xExecutePickAndPlace* input, the profile is started. Output *xProfileInPreparation* = TRUE indicates that the technology module is calculating and preparing the profile (the path) in the background.

With the output *xProfileInPreparation* = FALSE, the preparation of the profile is completed and the next profile can be appended. For this purpose, the profile points can be newly defined in the *ascProfilePar* parameter.

When the profile has been executed (*xPathDone* = TRUE), no further profiles can be appended via *xAddProfile*. Further profiles can be appended even if the path at the profile end is in the breakpoint and the breakpoint has not been acknowledged yet.

With a rising edge (FALSE→TRUE) at the *xAddProfile* input, the profile is appended from the *ascProfilePar* parameter. The output *xProfileInPreparation* = TRUE is set.

The profiles can be influenced via the inputs *xPathStop*, *xPathHalt*, *xPathInterrupt* or *IrOverride*, irrespective of the number of profiles loaded.

3.22 CPU utilisation (example Controller 3231 C)

The following table shows the CPU utilisation in microseconds taking the Controller 3231 C (Intel ATOM™-processor, 1.6 GHz) as an example when using a PickAndPlace TM.

Variant	Wiring of the technology module	CPU utilisation	
		Average	Maximum peak
Base	<i>xEnable</i> := TRUE; <i>xRegulatorOn</i> := TRUE; <i>xExecutePickAndPlace</i> := TRUE;	200 µs	511 µs
State	<i>xEnable</i> := TRUE; <i>xRegulatorOn</i> := TRUE; <i>xExecutePickAndPlace</i> := TRUE;	230 µs	565 µs
High	<i>xEnable</i> := TRUE; <i>xRegulatorOn</i> := TRUE; <i>xExecutePickAndPlace</i> := TRUE;	230 µs	565 µs



Note!

The times given do not take the runtimes for the calculation of the kinematics and for the EtherCat connection into consideration. The path preparation is processed over several task cycles. The duration of the path preparation process depends on the task utilisation of the CPU. The time between the activation of the path travel process and the execution of the path travel process can be delayed by up to 25 cycles.

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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.

Your Lenze documentation team

Lenze Automation GmbH
Postfach 10 13 52, 31763 Hameln
Hans-Lenze-Straße 1, 31855 Aerzen
Germany
HR Hannover B 205381
 +49 5154 82-0
 +49 5154 82-2800
 sales.de@lenze.com
 www.lenze.com

Service

Lenze Service GmbH
Breslauer Straße 3, 32699 Extertal
Germany
 008000 24 46877 (24 h helpline)
 +49 5154 82-1112
 service.de@lenze.com