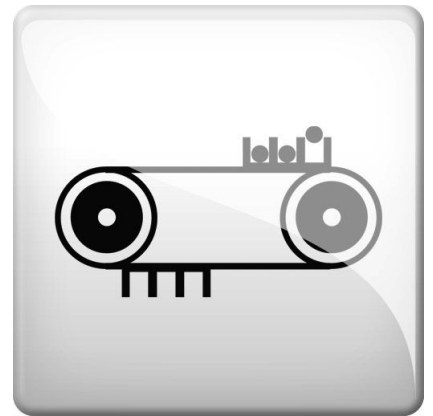


Technology module



Magic Track -----

Reference Manual

EN



Contents

1	About this documentation	3
1.1	Document history	5
1.2	Conventions used	5
1.3	Definition of the notes used	6
2	Safety instructions	7
3	Functional description "Magic Track"	9
3.1	Overview of the technology module functions	11
3.2	Important notes on how to operate the technology module	12
3.3	L_TT1P_MagicTrackControl [Base/State] function module	14
3.3.1	Inputs	15
3.3.2	Outputs	17
3.3.3	Parameter	18
3.4	L_TT1P_MagicTrackAxis function module	22
3.4.1	Inputs/outputs	22
3.4.2	Inputs	22
3.4.3	Outputs	23
3.5	State machine	24
3.5.1	L_TT1P_MagicTrackControl [Base/State]	24
3.5.2	L_TT1P_MagicTrackAxis	25
3.5.3	States of the eTMState output (L_TT1P_States)	26
3.6	Description of the technology module functions	27
3.6.1	Parameter setting of a track	27
3.6.2	Jogging	30
3.6.3	Homing	31
3.6.4	Reference run	32
3.6.5	Collision monitoring	33
3.6.6	Starting/stopping automatic operation	34
3.6.7	Defining the loading and unloading mode	36
3.7	CPU utilisation (example Controller 3231 C)	37
	Index	38
	Your opinion is important to us	39

1 About this documentation

This documentation ...

- contains detailed information on the functionalities of the "Magic Track" 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
2.0	06/2019	TD29	General revisions
1.0	07/2016	TD29	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	<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	 5	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 ...

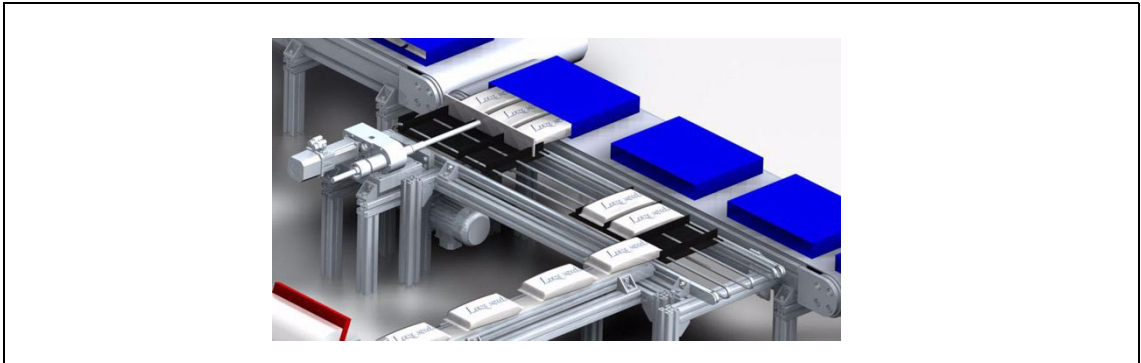
- Short circuit or static discharges (ESD);
- unpredictable motor movements (e.g. unintended direction of rotation, too high velocities or jerky movement);
- impermissible operating states during the parameterisation while there is an active online connection to the device.

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 "Magic Track"

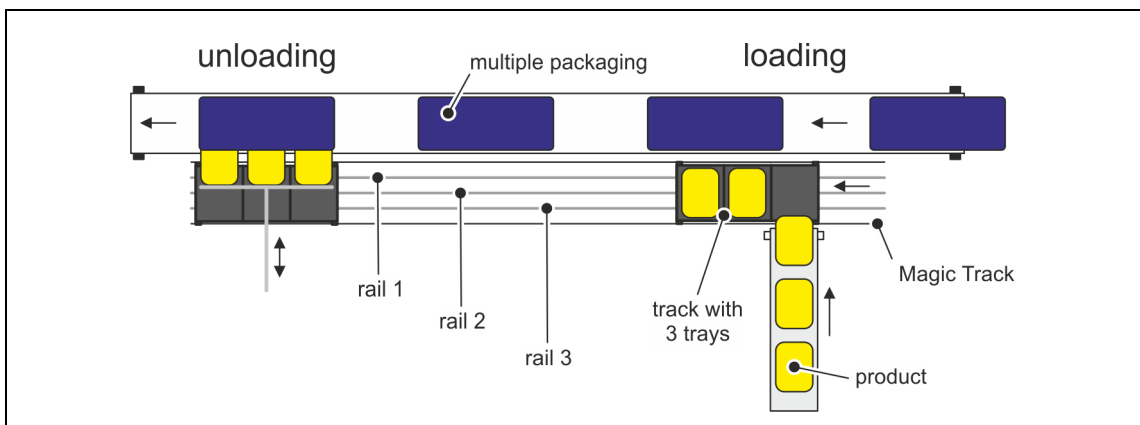
3 Functional description "Magic Track"



[3-1] Typical mechanics of the technology module

Magic Tracks are used for grouping (packaged) products, in order to fill them into a multiple packaging afterwards.

Functional principle



[3-2] Functional principle of Magic Tracks (here with 3 rails)

- So-called "tracks" (product carriers) with "trays" are running on so-called "rails" (parallel belt conveyors), each of those rails being driven by an "axis".
 - A Magic Track consists of at least 2 rails (max. 12) on which tracks can move independently of each other, which, however, cannot overtake each other.
 - Each track can consist of an optional number of identical or different trays.
 - Several tracks can run on one rail. (Condition: symmetrical arrangement of tracks of the same design.)
- In the loading station, a track is loaded with products via an infeed.
- When the track has been fully loaded, it goes to the unloading station.
- In the unloading station, the products grouped are carried off; i.e. slid into the multi-packaging.
- Then the empty track returns to the loading station upside down below the rail.

3 Functional description "Magic Track"

Components of the TM

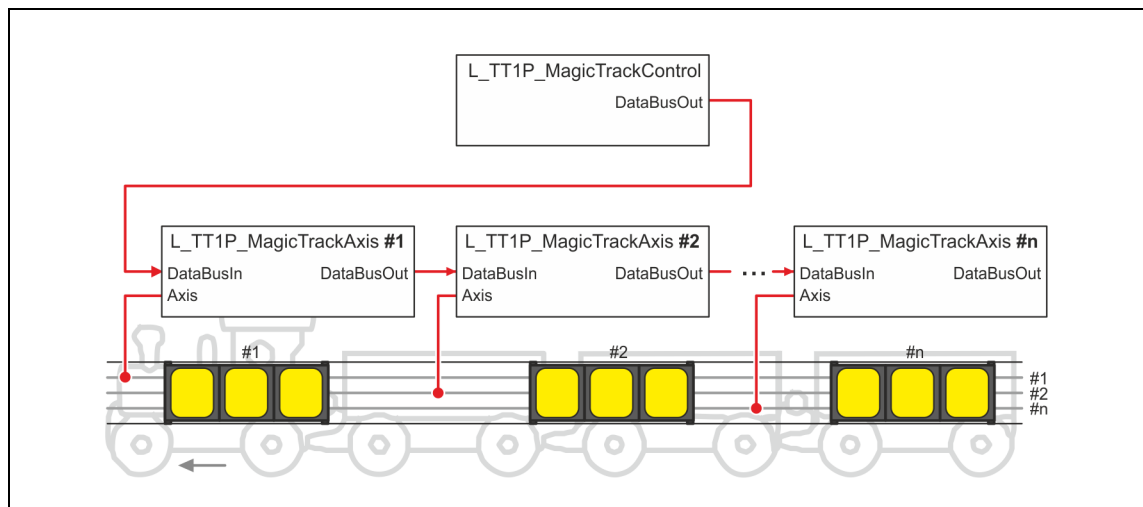
The technology module consists of the following function modules (FMs):

L_TT1P_MagicTrackControl [Base/State]: This FM manages the work processes and controls several FMs for the axes (L_TT1P_MagicTrackAxis). This FM is provided in the "Base" variant and, with an advanced functionality, in the "State" variant.

► [Overview of the technology module functions](#)

L_TT1P_MagicTrackAxis: This FM controls the movement of exactly one axis or rail. Since a Magic Track TM at least has 2 rails, a minimum of 2 items is required by this FM. The TM supports a maximum of 12 axes/rails.

Interconnection of the TM



[3-3] Interconnection of the TM Magic Track

The interconnection of the L_TT1P_MagicTrackAxis FMs should reflect the mechanical structure: The first track is the master track, runs on the first rail and is controlled by the first L_TT1P_MagicTrackAxis FM. Then the second track follows analogously, etc.

The call sequence must take place according to the interconnection of the tracks in the motion task.

3.1 Overview of the technology module functions

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

Functionality	Variant	
	Base	State
Parameter setting of a track	●	●
Jogging	●	●
Homing	●	●
Collision monitoring	●	●
Defining the loading and unloading mode • Base variant: only clocked loading/unloading • State variant: loading/unloading mode can be selected (clocked or synchronous)		●



»PLC Designer« online help

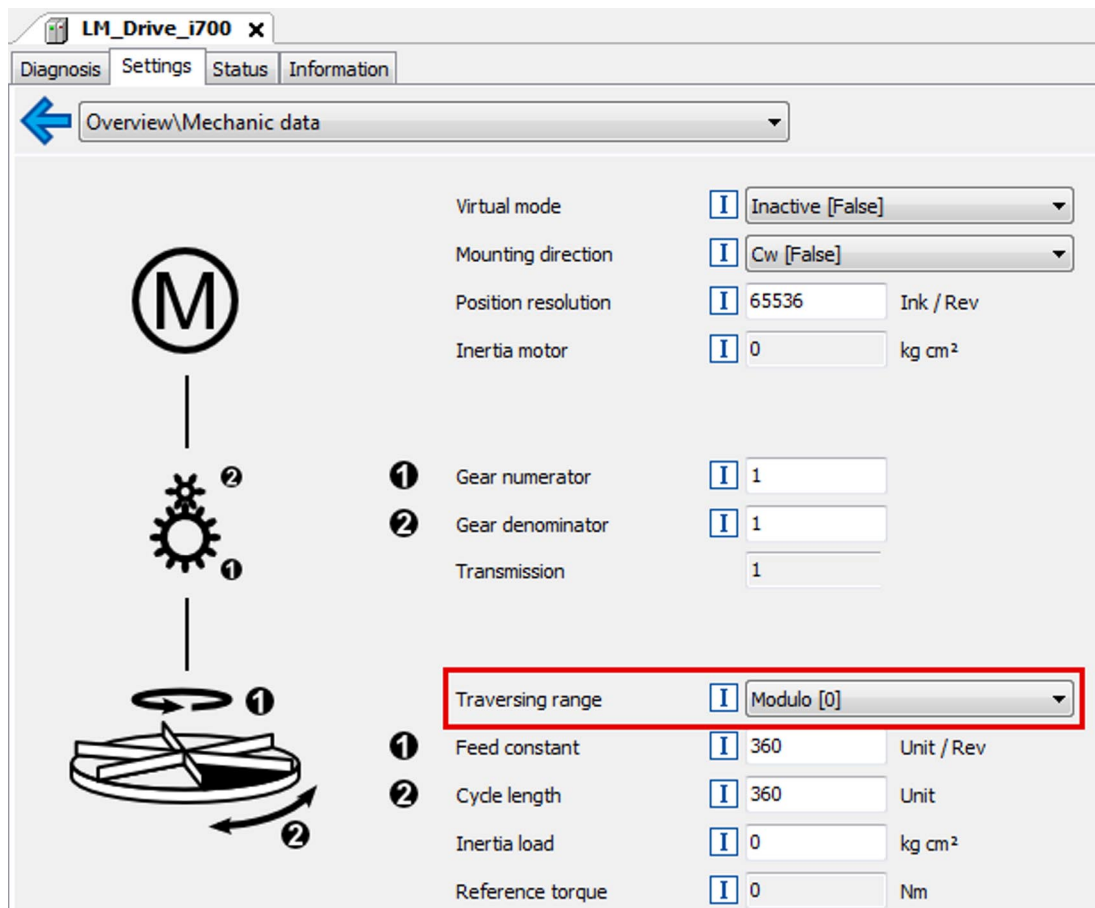
Here you will find detailed information on the **L_MC1P_AxisBasicControl** function block, the **stop function** and the **holding function**.

3.2

Important notes on how to operate the technology module

The "Magic Track" technology module only supports Modulo axes. The cycle length of an axis corresponds to the cycle length of a rail on which a track moves.

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



Setting of the operating mode

The operating mode must be set to "cyclic sync position mode" (csp), since 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 ($xRegulatorOnAll = TRUE$), 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:**

1. In the inhibited axis state ($xAxisEnabled = FALSE$), $xJogPos$ is set to TRUE.
 - $xRegulatorOnAll = FALSE$ (axis is inhibited.
==> "READY" status ($xAxisEnabled = FALSE$)
 - $xJogPos = TRUE$ (manual jog is to be executed.)
2. Enable axis.
 - $xRegulatorOnAll = TRUE$
==> "READY" status ($xAxisEnabled = TRUE$)
3. Execute manual jog.
 - $xJogPos = FALSE \rightarrow TRUE$
==> "JOGPOS" state

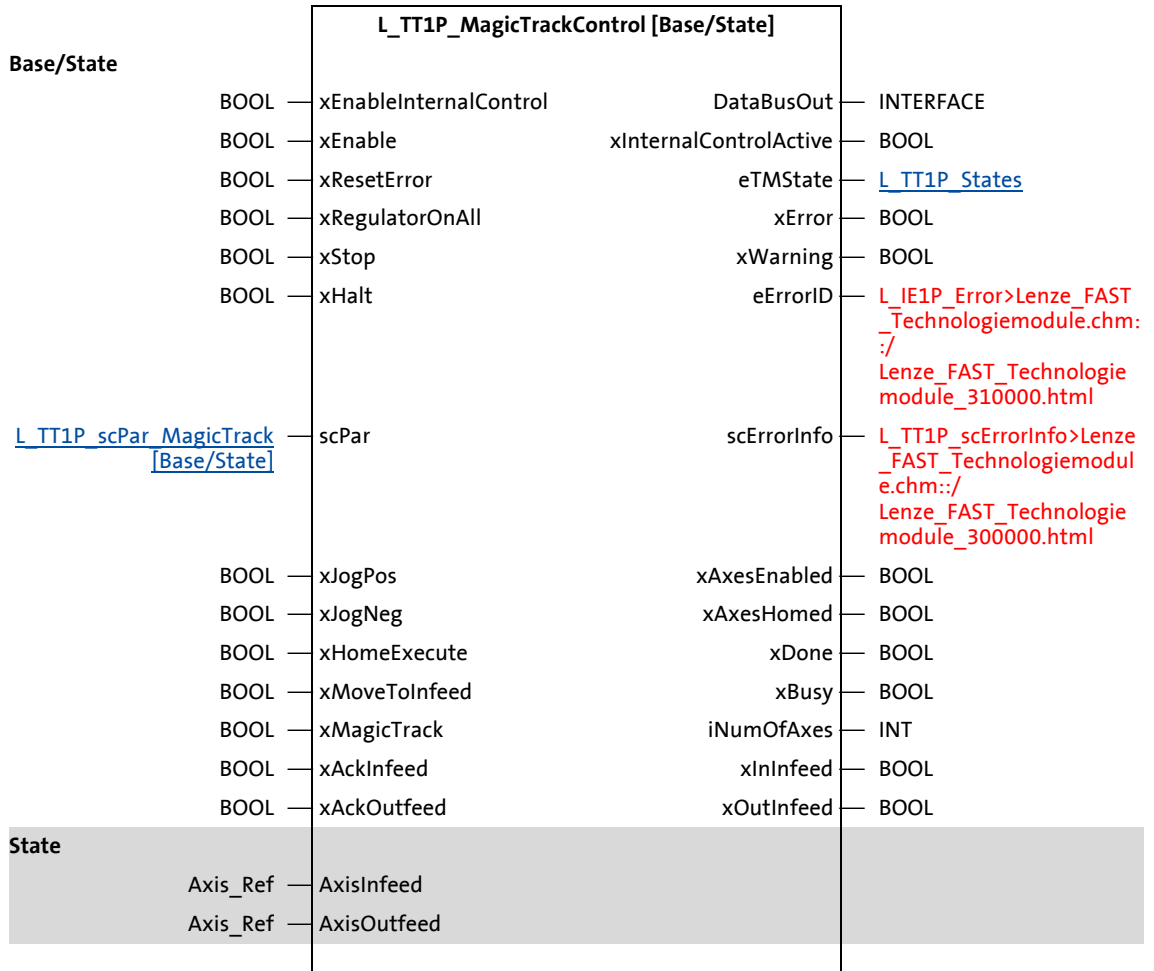
3.3

L_TT1P_MagicTrackControl [Base/State] function module

[Topic-IDs]
200000

The figure shows the relation of the inputs and outputs to the "Base" and "State" versions.

The additional inputs and outputs of the "State" version are shaded.



3.3.1 Inputs

Designator	Data type	Description		Available in version	
				Base	State
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.		
xResetError	BOOL	TRUE	Reset axis error or software errors.	●	●
xRegulatorOnALL	BOOL	TRUE	Activate controller enable for all axes (via the MC_Power function block).	●	●
xStop	BOOL	TRUE	Cancel the active movement and brake the axes to a standstill with the deceleration defined via the <i>IrStopDec</i> parameter. - The state changes to "Stop". - The STOP state is exited if (Not xStop AND Not xHalt) AND eAxisState = StandStill - The input is also active with "Internal Control".	●	●
xHalt	BOOL	TRUE	Cancel the active movement and brake the axes to a standstill with the deceleration defined via the <i>IrHaltDec</i> 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_MagicTrack [Base/State]	The parameter structure contains the parameters of the technology module. The data type depends on the version used (Base/State).		●	●
xJogPos	BOOL	TRUE	Traverse all axes of the TM in positive direction (manual jog). If <i>xJogNeg</i> is also TRUE, the traversing direction selected first remains set.	●	●
xJogNeg	BOOL	TRUE	Traverse all axes of the TM in negative direction (manual jog). If <i>xJogPos</i> is also TRUE, the traversing direction selected first remains set.	●	●
xHomeExecute	BOOL	FALSE TRUE	Traverse all axes of the TM to the home position. All axes of the TM are synchronised in a group to the master track. Each rail, i.e. each track has its own TP sensor. The master track is moved for a bit more than one round. After a complete round, the positions detected (TP sensor) are offset against the current position of the tracks and are directly referenced to the axis. The <i>xDone</i> output is set if homing for the axis took place.	●	●
xMoveToInfeed	BOOL	FALSE TRUE	Move track to the loading station. The track that is nearest to the infeed moves into the loading station. The subsequent track are arranged in a line.	●	●
xMagicTrack	BOOL	FALSE TRUE	Enable automatic operation of MagicTrack. ► Functional principle	●	●

Designator	Data type	Description		Available in version	
				Base	State
xAckInfeed	BOOL	FALSE TRUE	Relevant for clocked loading of the tracks. With a rising edge of the <i>xAckInfeed</i> input, loading of a tray is acknowledged. The acknowledgement process can be executed at any time, irrespective of whether a track is in the loading station or not. After the acknowledgement has been executed, the next tray position is approached. When all trays have been loaded, the track automatically continues moving towards the unloading station.	●	●
xAckOutfeed	BOOL	FALSE TRUE	Relevant for clocked unloading of the tracks. With a rising edge of <i>xAckOutfeed</i> input, loading of a tray is acknowledged. The acknowledgement process can be executed at any time, irrespective of whether a track is in the unloading station or not. When the track has been unloaded, it automatically continuous moving towards the loading station.	●	●
AxisInfeed	Axis_Ref	Reference to an axis for synchronous loading of the tracks: Master track in the loading station. When entering the loading station, the track is synchronised to the infeed. It moves synchronously to the infeed. When passing the track end with the infeed position, the synchronisation is interrupted and the track travels on to the unloading station.			●
AxisOutfeed	Axis_Ref	Reference to an axis for synchronous unloading of the tracks. Master track in the unloading station. When entering the unloading station, the track is synchronised to the outfeed. It moves synchronously to the outfeed. When passing the track end with the outfeed position, the synchronous travel is completed and the track travels on to the loading station.			●

3.3.2 Outputs

Designator	Data type	Description		Available in version	
				Base	State
DataBusOut	INTERFACE	Communication within a Magic Track interconnection. The communication bus output is interconnected with the <i>DataBusIn</i> input of the following "MagicTrackAxis". ► Interconnection of the TM		●	●
xEnableInternalControl	BOOL	TRUE	The internal control of the axis is activated via the visualisation. (xEnableInternalControl input = TRUE)	●	●
eTMState	L_TT1P_States	Current state of the TM. ► State machine		●	●
xError	BOOL	TRUE	Status signal: There is an error in the TM.	●	●
xWarning	BOOL	TRUE	Status signal: There is a warning in the TM.	●	●
eErrorID	L_IE1P_Error>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_310000.html	ID of the error or warning message if xError = TRUE or xWarning = TRUE. Here you can find some information with regard to error and warning messages: L_IE1P_ErrorL_IE1P_Error>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_310000.html		●	●
scErrorInfo	L_TT1P_scErrorInfo>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_300000.html	Error information structure for a more detailed analysis of the error cause		●	●
xAxesEnabled	BOOL	TRUE	All axes in the Magic Track TM are enabled.	●	●
xAxesHomed	BOOL	TRUE	All axes have been referenced ("reference known").	●	●
xDone	BOOL	TRUE	The request/action has been completed successfully.	●	●
xBusy	BOOL	TRUE	The request/action is currently being executed.	●	●
iNumOfAxes	INT	Number of axes in the Magic Track TM		●	●
xInInfeed	BOOL	TRUE	There is a tray in the loading station in front of the infeed.	●	●
xOutInfeed	BOOL	TRUE	A track is in the unloading station.	●	●

3.3.3 Parameter

L_TT1P_scPar_MagicTrack [Base/State]

The structure contains the parameters of the technology module.

Designator	Data type	Description		Available in version	
				Base	State
IrStopDec	LREAL	Deceleration for the stop function and for the activation of the hardware/software limit switches and the following error monitoring function • Unit: units/s ² • Initial value: 10000		●	●
IrStopJerk	LREAL	Jerk for the stop function and for the activation of the hardware limit switches, software limit positions, and the following error monitoring function. • Unit: units/s ³ • Initial value: 100000		●	●
IrHaltDec	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.		●	●
IrJerk	LREAL	Jerk for an offset value, trimming, coupling or holding functions. • Unit: units/s ³ • Initial value: 100000		●	●
IrJogJerk	LREAL	Jerk for manual jog. • Unit: units/s ³ • Initial value: 10000		●	●
IrJogVel	LREAL	Maximum speed for manual jog. • Unit: units/s • Initial value: 10		●	●
IrJogAcc	LREAL	Maximum acceleration for manual jog. • Unit: units/s ² • Initial value: 100		●	●
IrJogDec	LREAL	Maximum deceleration for manual jog. • Unit: units/s ² • Initial value: 100		●	●
xCollisionControl	BOOL	TRUE	Collision monitoring is activated. • Initial value: TRUE	●	●
IrSafeDist	LREAL	Safety distance between tracks. • Unit: units • Initial value: 10		●	●
eStartMode	WORD	Specify starting mode • Initial value: 1		●	●
		0	All tracks are starting from the current position.		
		1	All tracks are starting from the loading station.		
ascContainer	ARRAY[1..32] OF L_TT1P_MagicTrackContainer		Parameterisation of the tracks ▶ Parameter setting of a track	●	●

Designator	Data type	Description	Available in version	
			Base	State
eHomeMode L_TT1P_MagicTrackHome Mode		Select homing mode • Initial value: 0	●	●
		0 SetPositionDirect: set reference directly. Same function as MC_SetPosition without movement of the axis.		
		101 GroupVelMode: technological reference mode for the Magic Track TM. Here, all axes are executed with synchronous speed. The home positions are set via the TPs of the axes.		
alrHomePosition ARRAY[1..12] OF LREAL		Specify home position for the desired axis. Homing is started with a rising edge (FALSE→TRUE) at the <i>xHomeExecute</i> input. • Unit: units • Initial value: [0.0]	●	●
ascHomeExtTP ARRAY[1..12] OF LREAL		Transfer of an external touch probe event for the axes. • For information about the structure of MC_TRIGGER_REF, see MC_TouchProbe function block.	●	●
lrHomeJerk LREAL		Jerk for homing • Unit: units/s ² • Initial value: 10000	●	●
lrHomeAcc LREAL		Maximum acceleration during homing • Unit: units/s ² • Initial value: 100	●	●
lrHomeDec LREAL		Maximum deceleration during homing • Unit: units/s ² • Initial value: 100	●	●
lrHomeVel LREAL		Maximum speed during homing • Unit: units/s • Initial value: 10	●	●
eInfeedMode WORD		Track loading mode • Initial value: 0		●
		0 Clocked infeed (loading)		
		1 Synchronous infeed (loading)		
eOutfeedMode WORD		Track unloading mode • Initial value: 0		●
		0 Clocked outfeed (unloading)		
		1 Synchronous outfeed (unloading)		
lrInfeedPos LREAL		Position of the loading station • Unit: units • Initial value: 0	●	●
lrOutfeedPos LREAL		Position of the unloading station • Unit: units • Initial value: 180	●	●
lrInfeedSyncLength LREAL		Length of the loading station (for the synchronous travel of tracks) • Unit: • Initial value: 0		●
lrOutfeedSyncLength LREAL		Length of the unloading station (for the synchronous travel of tracks) • Unit: • Initial value: 0		●
lrDelayTimeAckInfeed LREAL		Deceleration time from activation of the <i>xAckInfeed</i> input until the start of track positioning. • Unit: s • Initial value: 0	●	●

Designator	Data type	Description	Available in version	
			Base	State
IrDelayTimeAckOutfeed	LREAL	Deceleration time from activation of the <i>xAckOutfeed</i> input until the start of track positioning. • Unit: s • Initial value: 0	●	●
IrToInfeedJerk	LREAL	Jerk for the travel from the unloading to the loading station • Unit: units/s ² • Initial value: 10000	●	●
IrToInfeedMaxAcc	LREAL	Maximum acceleration during the travel from the unloading to the loading station. • Unit: units/s ² • Initial value: 100	●	●
IrToInfeedMaxDec	LREAL	Maximum deceleration during the travel from the unloading to the loading station. • Unit: units/s ² • Initial value: 100	●	●
IrToInfeedMaxVel	LREAL	Maximum speed during the travel from the unloading to the loading station. • Unit: units/s • Initial value: 10	●	●
IrInInfeedJerk	LREAL	Jerk for the travel within the loading station. • Unit: units/s ² • Initial value: 10000	●	●
IrInInfeedMaxAcc	LREAL	Maximum acceleration during the travel within the loading station. • Unit: units/s ² • Initial value: 100	●	●
IrInInfeedMaxDec	LREAL	Maximum deceleration during the travel within the loading station. • Unit: units/s ² • Initial value: 100	●	●
IrInInfeedMaxVel	LREAL	Maximum speed during the travel within the loading station. • Unit: units/s • Initial value: 10	●	●
IrToOutfeedJerk	LREAL	Jerk for the travel from the loading to the unloading station. • Unit: units/s ² • Initial value: 10000	●	●
IrToOutfeedMaxAcc	LREAL	Maximum acceleration during the travel from the loading to the unloading station. • Unit: units/s ² • Initial value: 100	●	●
IrToOutfeedMaxDec	LREAL	Maximum deceleration during the travel from the loading to the unloading station. • Unit: units/s ² • Initial value: 100	●	●
IrToOutfeedMaxVel	LREAL	Maximum speed during the travel from the loading to the unloading station. • Unit: units/s • Initial value: 10	●	●
IrInOutfeedJerk	LREAL	Jerk for the travel within the unloading station. • Unit: units/s ² • Initial value: 10000	●	●
IrInOutfeedMaxAcc	LREAL	Maximum acceleration for the travel within the unloading station. • Unit: units/s ² • Initial value: 100	●	●

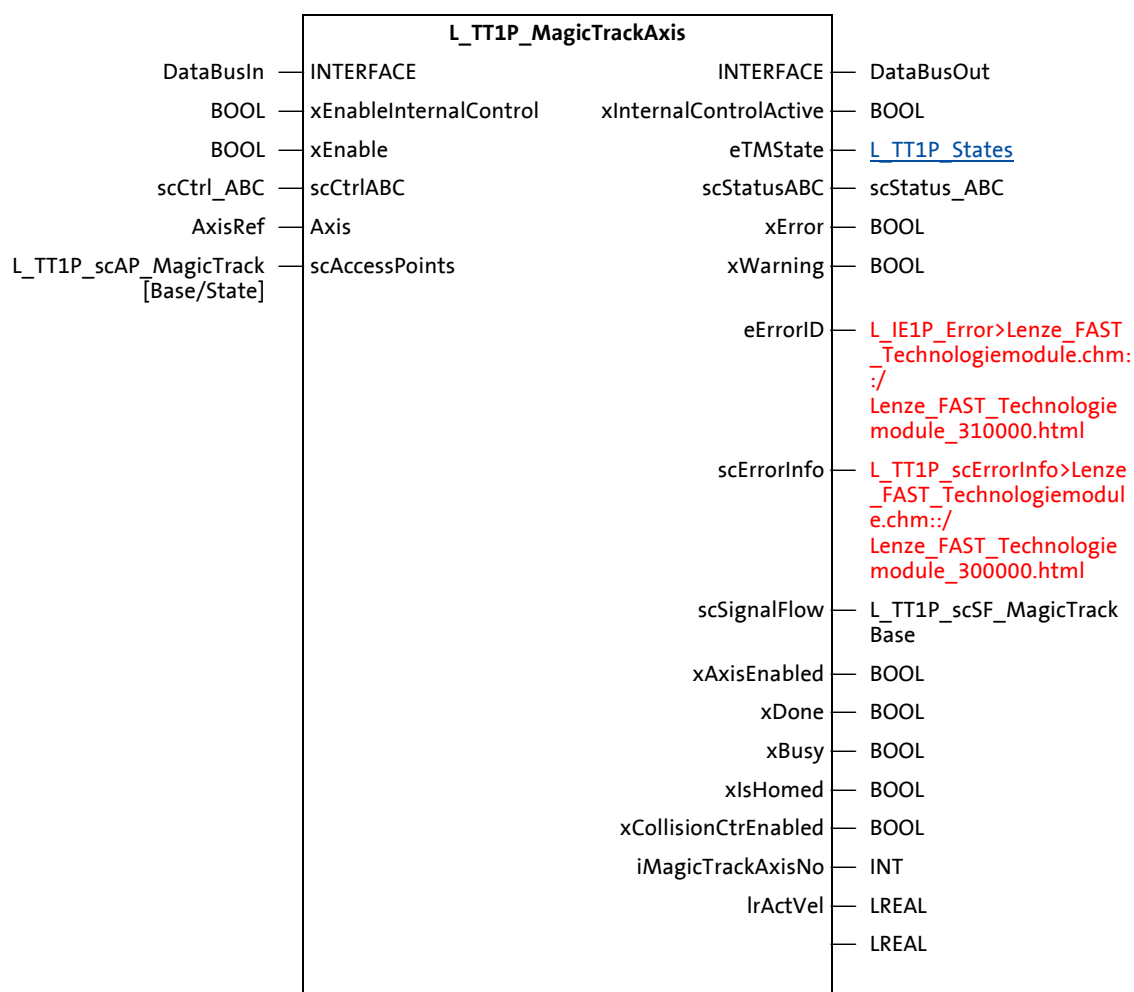
Designator	Data type	Description	Available in version	
			Base	State
IrInOutfeedMaxDec	LREAL	Maximum deceleration for the travel within the unloading station. • Unit: units/s ² • Initial value: 100	●	●
IrInOutfeedMaxVel	LREAL	Maximum speed for the travel within the unloading station. • Unit: units/s • Initial value: 10	●	●

3 Functional description "Magic Track"

3.4 L_TT1P_MagicTrackAxis function module

[Topic-IDs]
400000

3.4 L_TT1P_MagicTrackAxis function module



3.4.1 Inputs/outputs

Designator	Data type	Description
Axis	AXIS_REF	Reference to the axis
DataBusIn/DataBusOut		Communication within a Magic Track interconnection. The communication bus input is connected to the output of the preceding FM. ► Interconnection of the TM

3.4.2 Inputs

Designator	Data type	Description
xEnableInternalControl	TRUE	In the visualisation, the internal control of the axis can be selected via the "Internal Control" axis.
	BOOL	

Designator	Data type	Description
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 • <i>scCtrlABC</i> 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.
scAccessPoints L_TT1P_scAP_MagicTrack [Base/State]		Structure of the access points. The data type depends on the version used (Base/State).

3.4.3

Outputs

Designator	Data type	Description
xInternalControlActive	BOOL	TRUE The internal control of the axis is activated via the visualisation. (<i>xEnableInternalControl</i> input = TRUE)
eTMState	L_TT1P_States	Current state of the FM
scStatusABC	scStatus_ABC	Structure of the L_MC1P_AxisBasicControl FM status data
xError	BOOL	TRUE There is an error in the FM.
xWarning	BOOL	TRUE There is a warning in the FM.
eErrorID L_IE1P_Error>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_310000.html		ID of the error or warning message if xError = TRUE or xWarning = TRUE. Here you can find some information with regard to error and warning messages: L_IE1P_ErrorL_IE1P_Error>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_310000.html
scErrorInfo L_TT1P_scErrorInfo>Lenze_FAST_Technologiemodule.chm::/Lenze_FAST_Technologiemodule_300000.html		Error information structure for a more detailed analysis of the error cause
scSignalFlow L_TT1P_scSF_MagicTrack Base		Structure of the signal flow.
xAxisEnabled	BOOL	TRUE The axis (the track) 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).
xCollisionCtrEnabled	BOOL	TRUE Collision monitoring is active.
iMagicTrackAxisNo	INT	Number of the track

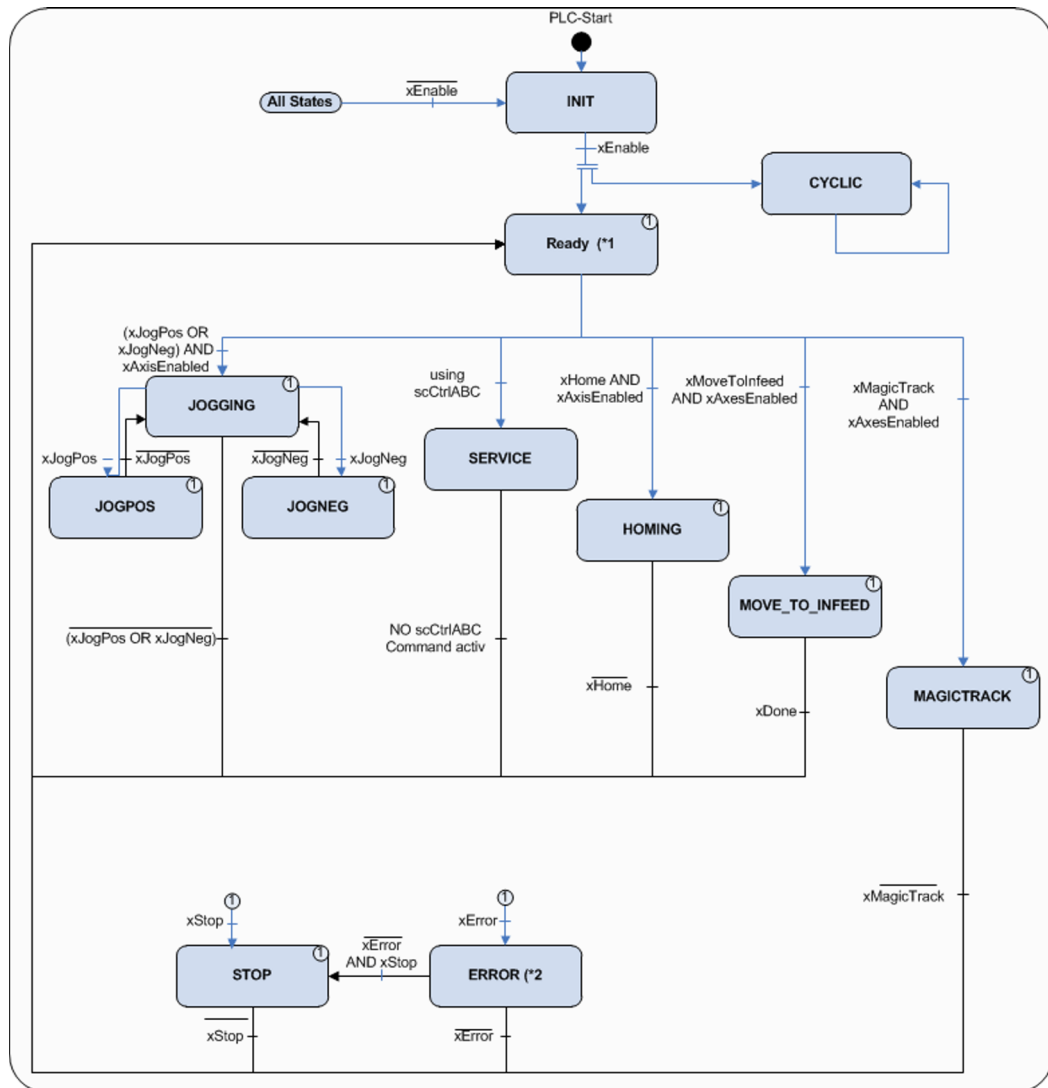
Designator	Data type	Description
IrActVel	LREAL	Current speed of the track • Unit: m/s
IrActPos	LREAL	Current position of the track • Unit: units

3 Functional description "Magic Track"

3.5 State machine

3.5 State machine

3.5.1 L_TT1P_MagicTrackControl [Base/State]



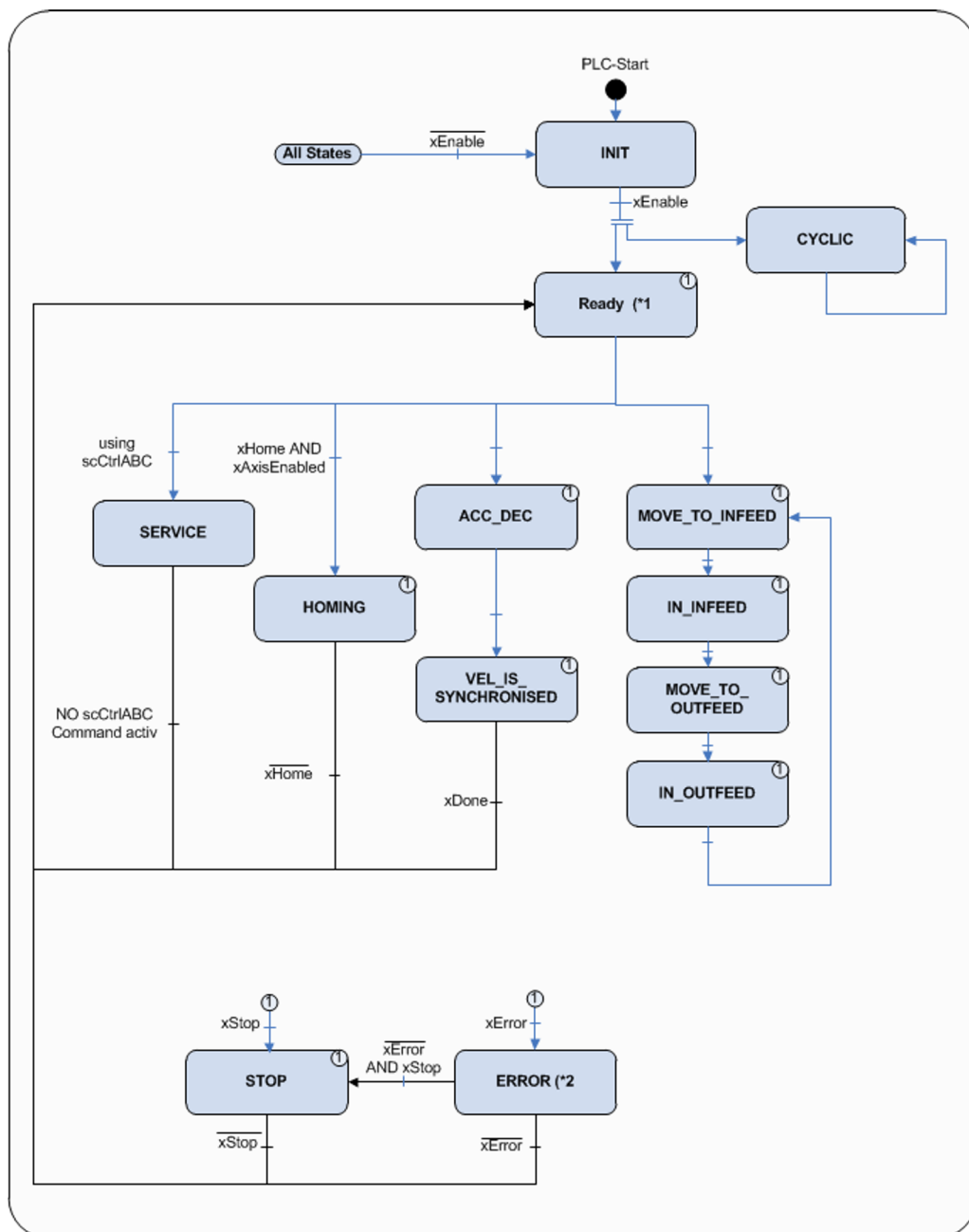
[3-4] State machine of the MagicTrackControl [Base /State] technology module

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

(*1 In the "Ready" state, xRegulatorOn und xDriveStart must be set to TRUE.

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

3.5.2 L_TT1P_MagicTrackAxis



[3-5] State machine of the MagicTrackAxis technology module

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

(*1 In the "Ready" state, xRegulatorOn und xDriveStart must be set to TRUE.

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

3.5.3 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.
181	MOVE_TO_INFEED	Track is travelling to the loading station.
182	IN_INFEED	Track is in loading position. Products are loaded.
183	MOVE_TO_OUTFEED	Track is travelling to the unloading station.
184	IN_OUTFEED	Track is in unloading position. Products are unloaded.
185	MAGICTRACK	The MagicTrack TM is activated
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

3.6 Description of the technology module functions

3.6.1 Parameter setting of a track

Precondition

- The technology module is in the "READY" state.
- All axes within the TM are referenced (*xAxesHomed* = TRUE).
- Collision monitoring is active (*scPar.xCollisionControl* = TRUE).
- The axis on the first rail is the axis with number 1, the axis on the second rail is the axis with number 2, etc.

L_TT1P_MagicTrackContainer

A track is parameterised via this structure and the array *scPar.ascContainer[i]* with 32 elements.

With i = number of the element (tray, gap)

Designator	Data type	Description	Available in version	
			Base	State
iNumOfContainer	INT	Specify number of trays.	●	●
		> 0 Number of trays of the same length		
		0 Gap		
lrContainerLegth	LREAL	Specify length of tray. If the length of tray > 0, the element is activated. If iNumOfContainer = 0; a gap with the length <i>lrContainerLength</i> is defined. If iNumOfContainer > 0: exactly this number of trays with the length = <i>lrContainerLength</i> is defined. • Unit: [units] • Initial value: 0	●	●
lrContainerOffset	LREAL	Specify offset for the stopping point Specification of the distance in which the tray has to stop from the centre of the station. <i>lrContainerOffset</i> = 0: start of tray directly in the centre of the station. • Unit: Units • Initial : = 0	●	●
dwlInfeedMask	DWORD	Specify stopping points for loading (if <i>iNumOfContainer</i> > 0) The masking described in the following defines which tray is loaded and which tray is skipped. One bit of the <i>dwlInfeedMask</i> DWORD is assigned to each tray. Only the trays for which the bit is set are loaded. • Bit = 1: track stops; bit = 0: track does not stop • Initial value: 0 • Only for clocked loading or unloading	●	●
		BIT 0 1st tray		
		BIT 1 2nd tray		
		Bit n n + 1st tray		

Designator	Data type	Description	Available in version	
			Base	State
dwOutfeedMask	DWORD	Specify stopping points for unloading (if <i>iNumOfContainer</i> > 0) Function analogous to <i>dwInfeedMask</i> . • Bit = 1: track stops; bit = 0: track does not stop • Initial value: 0 • Only for clocked loading or unloading	●	●
		BIT 0 1st tray		
		BIT 1 2nd tray		
		Bit n n + 1... tray		

Parameters to be set

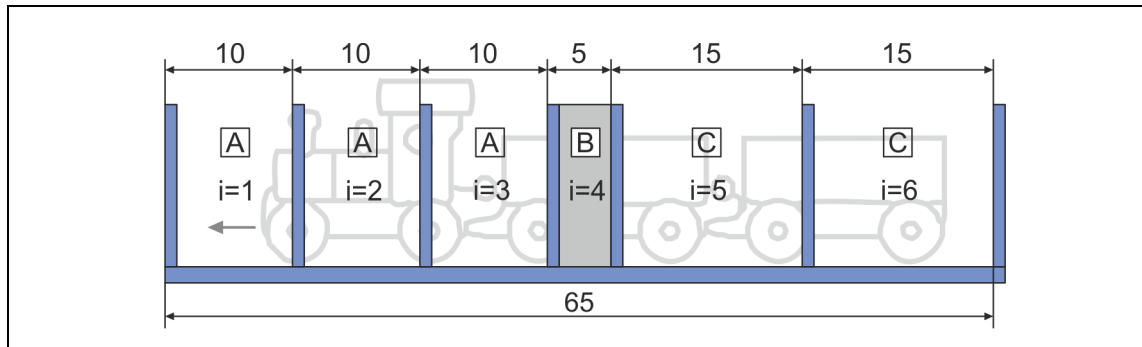
The parameters are located in the *scPar.ascContainer[i]* parameter structure.

```
iNumOfContainer : LREAL := 0;
lrContainerLegth : LREAL := 0;
dwInfeedMask : DWORD := 0000 0000 0000 0000;
dwOutfeedMask : DWORD := 0000 0000 0000 0000;
```

The parameter values cannot be changed during operation. Changes are only accepted at the restart of automatic operation.

Sample parameterisation

- Each axis moves one track on a rail.
- eInfeedMode = 0 (pulse) -> clocked loading
- eOutfeedMode = 0 (pulse) -> clocked unloading



[3-6] Sample track

- The track has 3 trays of the same length at the front **A**
-> `ascContainer[1].iNumOfContainer : INT := 3;`
- They have a length of 10 units
-> `ascContainer[1].lrContainerLegth : LREAL := 10;`
- When being loaded, the track is to stop in front of every tray
-> `ascContainer[1].dwInfeedMask = 2#111`
- When being unloaded, the track is to stop in front of the first and third tray
-> `ascContainer[1].dwOutfeedMask = 2#101`
- The track has 1 gap **B**
-> `ascContainer[2].iNumOfContainer : INT := 0;`
- It has a length of 5 units
-> `ascContainer[2].lrContainerLegth : LREAL := 5;`
- The track has 2 trays of the same length at the back **C**
-> `ascContainer[3].iNumOfContainer : INT := 2;`
- They have a length of 15 units
-> `ascContainer[3].lrContainerLegth : LREAL := 15;`
- When being loaded, the track is to stop in front of every tray **C**
-> `ascContainer[3].dwInfeedMask = 2#11`
- When being unloaded, the track is to stop in front of every tray **C**
-> `ascContainer[3].dwOutfeedMask = 2#11`

The track length results from the sum of the lengths of trays and gaps. In this example, the total track length is 65 length units.

3.6.2 Jogging

Precondition

- The TM is in the "READY" status.
- All axes of the Magic Tracks are enabled ($xRegulatorOnALL = TRUE$).

Type

In the inching mode, manual jog of all TM axes (manual group jog) at the L_TT1P_MagicTrackControl [Base/State] FM is activated with input $xJogPos$ or $xJogNeg = TRUE$ and stopped with $xJogPos$ or $xJogNeg = FALSE$.

- Via the L_TT1P_MagicTrackAxis FMs, the axes are synchronised. Each L_TT1P_MagicTrackAxis FM changes to the "VEL_IS_SYNCHRONISED" status.
- The L_TT1P_MagicTrackControl FM [Base/State] changes to one of the states, "JOGGING", "JOGPOS", or "JOGNEG".
- A change of direction from "JogPos" to "JogNeg" or vice versa can only be triggered if both inputs, $xJogPos$ AND $xJogNeg = FALSE$, i.e. if the L_TT1P_MagicTrackControl FM is in the "READY" status.



Note!

The synchronous movement of the axes rules out a collision of tracks. Therefore, the inching mode does not require any collision monitoring.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack \[Base/State\]](#) parameter structure .

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

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

3.6.3 Homing

Precondition

- The TM is in the "READY" status.
- All axes of the Magic Tracks are enabled (*xRegulatorOnALL* = TRUE).

Function

By means of homing, the positions of the tracks are declared.



Note!

Due to the synchronous axis movements, track collisions are ruled out, thus making collision monitoring redundant.

Type

Homing is activated at the `L_TT1P_MagicTrackControl` FM [Base/State] by means of input *xHomeExecute* = TRUE and can then only be cancelled by *xStop* or *xHalt*, but not by *xHomeExecute* = FALSE.

- During the homing process, the FM changes to the "HOMING" status, and, upon completion of the homing process, it changes to "READY". The *xDone* and *xAxesHomed* outputs are set.

Homing mode

Via the *eHomeMode* parameter, the homing mode can be selected:

- *eHomeMode* = 0 // *SetPositionDirect*:
The position from *scPar.alrHomePosition[i]* is set directly into the axis of the i-th *MagicTrackAxis* FM.
- *eHomeMode* = 101 // *GroupVelMode*:
All axes are referenced synchronously to TP. The precondition for this is that each axis (rail) comes with an individual installed TP sensor for detecting a mark. The axis that is controlled via the first *MagicTrackAxis* is traversed slightly more than a Modulo cycle length. The other axes are coupled and controlled along with synchronous velocity. After a complete round, the positions detected by the TP sensors of the respective axes are offset against the corresponding *scPar.alrHomePosition[i]* home positions and written to the axis.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack \[Base/State\]](#) parameter structure .

```
eHomeMode           : L_TT1P_MagicTrackHomeMode;
alrHomePosition      : ARRAY[1..12] OF LREAL;
scHomeExtTP          : ARRAY[1..12] OF MC_TRIGGER_REF
```

3.6.4 Reference run

Precondition

- The technology module is in the "READY" state.
- All axes within the TM are referenced (*xAxesHomed* = TRUE).
- All axes within the TM are enabled (*xRegulatorOnALL* = TRUE).

Function

A reference run serves to traverse all tracks independently of each other in the direction of the loading station and are lined up there.

The track located in the travel direction (positive direction of rotation of the axis) nearest to the loading station enters the loading station and stops at *scPar.lrlnfeedPos*. The subsequent tracks are directly lined up in succession with the "safe distance" *scPar.lrsafeDist*.



Note!

During the reference run, the collision monitoring function must be active.
(*scPar.xCollisionControl* = TRUE).

Type

A reference run is activated at the *L_TT1P_MagicTrackControl* [Base/State] FM by means of the *xMoveToInfeed* = TRUE input and can then only be cancelled by *xStop* or *xHalt*, but not by *xMoveToInfeed* = FALSE.

- During the reference run, the FM changes to the "MOVE_TO_INFEED" state, and, upon completion of homing, it changes to "READY". The *xDone* output is set.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack](#) [Base/State] parameter structure .

```
lrSafeDist :LREAL;
lrInfeedPos : LREAL;
lrOutfeedPos : LREAL;
lrToInfeedJerk : LREAL;
lrToInfeedMaxAcc: LREAL;
lrToInfeedMaxDec: LREAL;
lrToInfeedMaxVel: LREAL;
```

3.6.5 Collision monitoring

Precondition

- The technology module is in the "READY" state.
- All axes within the TM are referenced (*xAxesHomed* = TRUE).
- All axes within the TM are enabled (*xRegulatorOnALL* = TRUE).

Function

The "Collision monitoring" safety function monitors the distances between tracks and in this way prevents possible collisions.

When the "safe distance" (*scPar.lfSafeDist*) is reached between two tracks, all axes are brought to a standstill via a ramp (*scPar.lfStopDec*). At the same time, the "CollisionDetected" error (eErrorID = 17143) is reported.



Note!

The "safe distance" between the tracks is taken into consideration in the profile calculation.

Type

The collision monitoring function is activated and deactivated with *scPar.xCollisionControl* = TRUE/FALSE.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack \[Base/State\]](#) parameter structure .

```
lfSafeDist :LREAL;
xCollisionControl : BOOL;
```

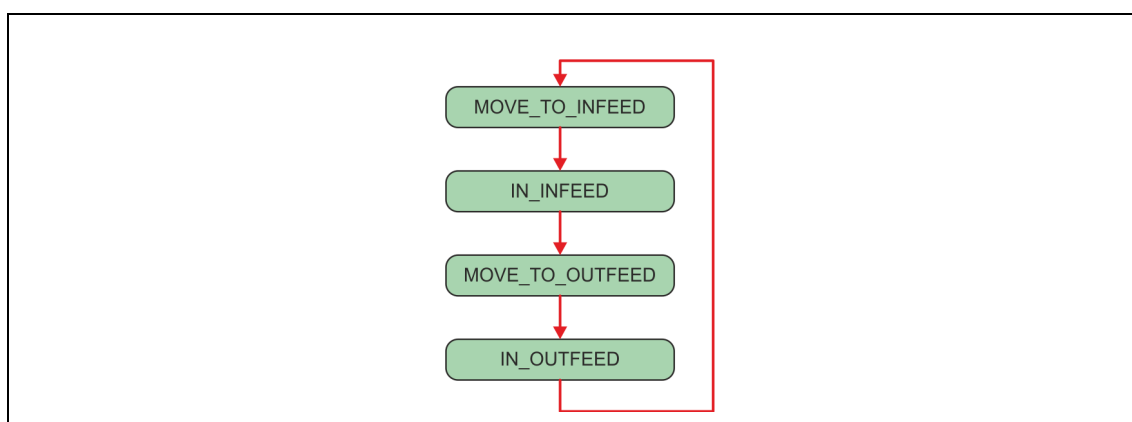
3.6.6 Starting/stopping automatic operation

Precondition

- The technology module is in the "READY" state.
- All axes within the TM are referenced (*xAxesHomed* = TRUE).
- All axes within the TM are enabled (*xRegulatorOnALL* = TRUE).
- Collision monitoring is active (*scPar.xCollisionControl* = TRUE).

Function

In automatic operation, the tracks are loaded in the loading station and unloaded in the unloading station. A travel process from the loading station to the unloading station and back to the loading station constitutes one Magic Track cycle. It consists of four phases:



[3-7] A MagicTrack cycle consists of four phases

MOVE_TO_INFEED: The track moves to the loading station.

If tracks are jammed in or in front of the loading station, the successive track synchronises with a "safe distance" (*scPar.lrsafeDist*) to the preceding track (it follows this track) until it can enter the loading station.

In this phase, the *lrToInfeedMaxVel*, *lrToInfeedMaxAcc*, *lrToInfeedMaxDec* and *lrToInfeedJerk* parameters are used for the profile calculation.

IN_INFEED: The track is loaded.

In the Base version, clocked loading of the trays of a track is supported, the tray that is enabled for loading via the parameter setting of the *lrInfeedMask* mask being stopped before the product infeed. *xAckInfeed* input = TRUE acknowledges the loading process. When the rate time (*scPar.lrsafeTimeAckInfeed*) has elapsed, the track is positioned so that the next tray can be loaded. When all trays have been loaded, the track moves towards the unloading station.

In this phase, the *lrInInfeedMaxVel*, *lrInInfeedMaxAcc*, *lrInInfeedMaxDec* and *lrInInfeedJerk* parameters are used for the profile calculation.

MOVE_TO_OUTFEED: The track moves to the unloading station.

If tracks are jammed in or in front of the unloading station, the successive track synchronises with a "safe distance" (*scPar.lsafeDist*) to the preceding track (it follows this track) until it can enter the unloading station.

In this phase, the *lrToOutfeedMaxVel*, *lrToOutfeedMaxAcc*, *lrToOutfeedMaxDec* and *lrToOutfeedJerk* parameters are used.

IN_OUTFEED: The track is unloaded.

In the Base version, the clocked unloading of all trays of a track is supported, the tray enabled for unloading via the parameter setting of the *lrOutfeedMask* mask being stopped before the product outfeed. The *xAckOutfeed* input = TRUE acknowledges the unloading process. When the rate time (*scPar.lrdelayTimeAckOutfeed*) has elapsed, the track is positioned so that the next tray can be unloaded. When all trays have been unloaded, the track moves towards the loading station.

In this phase, the *lrInOutfeedMaxVel*, *lrInOutfeedMaxAcc*, *lrInOutfeedMaxDec* and *lrInOutfeedJerk* parameters are used for the profile calculation.

Type

Automatic operation is started at the L_TT1P_MagicTrackControl [Base/State] FM with the *xMagicTrack* input:= TRUE and is stopped by reset to FALSE. When the operation is stopped, all axes of the TM are brought to a standstill via the *scPar.lrhaltDec* ramp.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack \[Base/State\]](#) parameter structure .

```
lrSafeDist :LREAL;
xCollisionControl : BOOL;
ascContainer :ARRAY[1..32] OF L_TT1P_Container;
lrInfeedPos:LREAL;
lrOutfeedPos:LREAL;
lrToInfeedJerk :LREAL;
lrToInfeedMaxAcc:LREAL;
lrToInfeedMaxDec:LREAL;
lrToInfeedMaxVel:LREAL;
lrInInfeedJerk:LREAL;
lrInInfeedMaxAcc:LREAL;
lrInInfeedMaxDec:LREAL;
lrInInfeedMaxVel:LREAL;
lrToOutfeedJerk:LREAL;
lrToOutfeedMaxAcc:LREAL;
lrToOutfeedMaxDec:LREAL;
lrToOutfeedMaxVel:LREAL;
lrInOutfeedJerk:LREAL;
lrInOutfeedMaxAcc:LREAL;
lrInOutfeedMaxDec:LREAL;
lrInOutfeedMaxVel:LREAL;
```

3.6.7 Defining the loading and unloading mode

Precondition

- The technology module is in the "READY" state.

- All axes within the TM are referenced (*xAxesHomed* = TRUE).
- Collision monitoring is active (*scPar.xCollisionControl* = TRUE).
- The L_TT1P_MagicTrackControlState FM is used.

Type

With the *scPar.eInfeedMode* parameter, the type of track loading is defined.

- *eInfeedMode* = 0 (pulse) -> clocked loading of a track ("Base" and "State" version)
eOutfeedMode = 0 (pulse) -> clocked unloading of a track ("Base" and "State" version)
 A binary mask is used to define with which tray the track stops in front of the product infeed/outfeed.
 - In this process, bit 0 is assigned to the first tray, bit 1 to the second tray, etc.
 - If bit = 1, the track stops in front of the infeed/outfeed with the corresponding tray.

- *eInfeedMode* = 1 (sync) -> synchronous loading of a track (only "State" version)
eOutfeedMode = 1 (sync) -> synchronous unloading of a track (only "State" version)

When the track pulls into a station, it is synchronised to the *AxisInfeed* or *AxisOutfeed* axis via the speed.

The respective station lengths are specified via parameters *scPar.lInfeedSyncLength* and *scPar.lOutfeedSyncLength*.

As soon as the track pulls out of the station, it cancels the synchronous travel and moves on to the next station.

Parameters to be set

The parameters are located in the [L_TT1P_scPar_MagicTrack \[Base/State\]](#) parameter structure .

```
eInfeedMode; WORD ;           //0 pulse, 1 sync
eOutfeedMode; WORD ;          //0 pulse, 1 sync
```

3.7 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).

Variant	Wiring of the technology module	CPU utilisation	
		Average	Maximum peak
1 x MagicTrackControlBase 2 x MagicTrackAxis	xEnable := TRUE; xRegulatorOnAll := TRUE; xMagicTrack := TRUE;	185 s	345 s
1 x MagicTrackControlState 2 x MagicTrackAxis	xEnable := TRUE; xRegulatorOnAll := TRUE; xMagicTrack := TRUE;	185 s	359 s

Index

A

Application notes [6](#)

B

L_TT1P_MagicTrackControl [14](#)

L_TT1P_scPar_MagicTrack [18](#)

C

Collision monitoring [33](#)

Conventions used [5](#)

CPU utilisation [37](#)

D

Defining the loading and unloading mode [36](#)

Document history [5](#)

E

E-mail to Lenze [39](#)

eTMState [26](#)

F

Feedback to Lenze [39](#)

function module [14](#)

Function of the technology module (overview) [11](#)

Functional description "Magic Track" [9](#)

H

Homing [31](#)

I

Inputs [15](#), [22](#)

Inputs/outputs [22](#)

J

Jogging [30](#)

L

L_TT1P_MagicTrackAxis function module [22](#)

Layout of the safety instructions [6](#)

N

Notes to operate the technology module [12](#)

O

Outputs [17](#), [23](#)

P

Parameter [18](#)

Parameter setting of a track [27](#)

R

Reference run [32](#)

S

Safety instructions [6](#), [7](#)

Starting/stopping automatic operation [34](#)

State machine [24](#)

States of the eTMState output [26](#)

T

Target group [4](#)

V

Variable names [5](#)



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.

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
✉ lenze@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@lenze.com