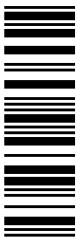
Application Software

PLC Designer

Lenze FAST _____

Reference Manual EN



Lenze

Contents

1 About this documentation

This documentation describes the basics for easily developing a modular machine control with the Lenze FAST application software in the »PLC Designer«.

This documentation 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« (backup, restore, 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 • 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

1 About this documentation

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.

Screenshots/application examples

All screenshots in this documentation are application examples. Depending on the firmware version of the Lenze devices used and the software version of the Engineering tools installed (e.g. »PLC Designer«), screenshots in this documentation may differ from the representation on the screen.

Information regarding the validity

The information in this documentation applies to:

Lenze Engineering tool	From software version
»PLC Designer«	3.10

The Lenze engineering tools are available for download at:

www.lenze.com → **Download** → **Software Downloads**

1.1 Document history

Version			Description
4.2	05/2017	TD17	• New: "Traverser" technology module • Error messages (overview) (📖 37) updated.
4.1	08/2016	TD17	Information on Controller c300/p300 supplemented: ▸ "Pick & Place" applications (📖 23) ▸ FAST Motion (📖 33)
4.0	06/2016	TD17	Content structure revised.
3.2	04/2016	TD17	Update for the "Controller-based Automation" 3.13 Lenze automation system • New: "Track Pick & Place" technology module
3.1	02/2016	TD17	Note with regard to the Lenze »Backup & Restore« tool added: ▸ SD card/licence card with "Application Credit" (📖 16)
3.0	11/2015	TD17	Update for the "Controller-based Automation" 3.12 Lenze automation system • New: "Temperature Control" technology module • Error messages (overview) (📖 37) updated.
2.0	05/2015	TD17	General revision for the "Controller-based Automation" 3.10 Lenze automation system New information on: • Technology modules "Basic Motion", "Flying Saw", "Table Positioning" • Licencing (Application Credit) • Operation • Error numbers 17124 ... 17128
1.0	10/2014	TD11	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		
Version information	Blue text colour	All information that only applies to a certain controller software version or higher is identified accordingly in this documentation. Example: This function extension is available from software version V3.0 onwards!
Program name	» «	Lenze »PLC Designer«...
Function blocks	**bold**	The **L_MC1P_AxisBasicControl** function block ...
Function libraries		The **L_TT1P_TechnologyModules** function library ...
Sequence of menu commands		If several commands must be used in sequence to carry out a function, the individual commands are separated by an arrow. Select **File → Open** to...
Variable names	*italics*	By setting *bEnable* to TRUE...

Source code	Font
	"Courier new"
		`...`
		`dwNumerator := 1;`
		`dwDenominator := 1;`
		`...`

Hyperlink	underlined	Optically highlighted reference to another topic. It is activated with a mouse-click in this online documentation.
Icons		
Page reference	(📖 7)	Reference to further information: Page number in PDF file.

1.3 Terminology used

Term	Meaning
Controllers	The Controller is the central component of the Lenze automation system which controls the motion sequences by means of the operating system. The Controller communicates with the field devices (inverters) via the fieldbus.
Engineering PC	The Engineering PC and the Engineering tools installed serve to configure and parameterise the system. The Engineering PC communicates with the controller via Ethernet.
FAST	Application software ▸ Lenze FAST components (📖 14)
Inverters	Generic term for Lenze frequency inverters, servo inverters
PLC	Programmable Logic Controller (German designation: SPS - Speicherprogrammierbare Steuerung)
Bus systems	
CAN	CAN (Controller Area Network) is an asynchronous, serial fieldbus system.
EtherCAT	EtherCAT® (Ethernet for Controller and Automation Technology) is an Ethernet-based fieldbus system which fulfils the application profile for industrial real-time systems. EtherCAT® is a registered trademark and patented technology, licenced by Beckhoff Automation GmbH, Germany.
PROFIBUS	PROFIBUS® (Process Field Bus) is a commonly used fieldbus system for automating machines and production plants. PROFIBUS® is a registered trademark and patented technology licensed by the PROFIBUS & PROFINET International (PI) user organisation.
PROFINET	PROFINET® (Process Field Network) is a real-time capable fieldbus system based on Ethernet. PROFINET® is a registered trademark and patented technology licensed by the PROFIBUS & PROFINET International (PI) user organisation.

1.4 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 ...

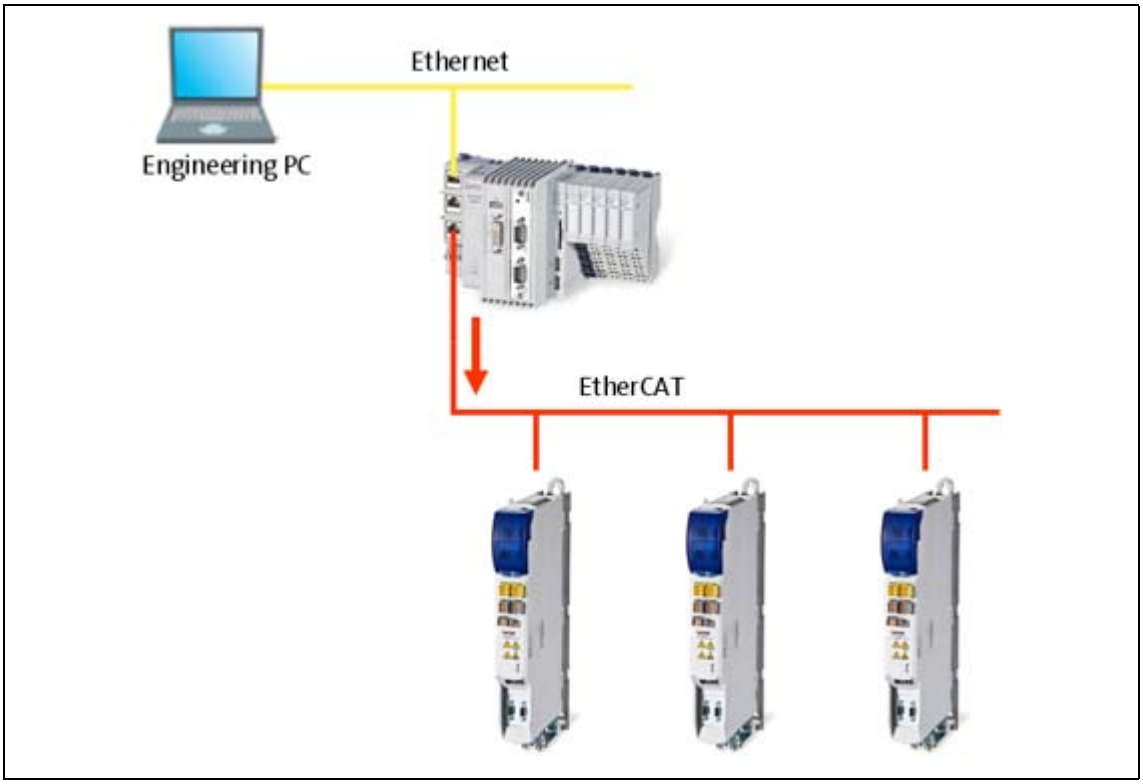
- Short circuit or static discharges (ESD);
- unpredictable motor movements (e.g. unintended direction of rotation, too high velocities or jerky movement);
- impermissible operating states during the parameterisation while there is an active online connection to the device.

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 Conditions

3.1 System requirements



[3-1] **Example:** Controller 3231 C and Servo-Inverter i700 with EtherCAT bus system

	Engineering PC	Controllers	
Hardware	PC/notebook	• Lenze Controller (3200 C, c300, p500, p300) • SD card with "Application Credit"	
Operating system of	Windows®	3200C	Windows® CE
		p500	
		c300	Windows® Embedded Compact 7
		p300	
Engineering tool	»PLC Designer« from V3.9 onwards Including: • FAST Application Template (📖 19) • FAST technology modules (📖 20) • FAST Motion modules (📖 33)	Application software: • "FAST Runtime" (formerly "L-force Logic" (LPC 1000)) • "FAST Motion"	
Further requirements	-	Depending on the application case: • EtherCAT/CAN bus system • Node (Inverter Drives)	

Detailed information on the system requirements for the Lenze engineering tools can be found on the download sites of the engineering tools at:

www.lenze.com → **Download → Software Downloads**

3.2 Establishing communication with the controller

Connect the Engineering PC to the Lenze Controller via a network cable. The »PLC Designer« accesses the Controller via Ethernet.

More information about the bus systems and the subject of configuration can be found in these **communication manuals**:

- Controller-based Automation EtherCAT®
- Controller-based Automation CANopen®

4 Lenze FAST components

The Lenze FAST application software provides standard software modules for the easy development of a modular machine control:

- FAST Application Template (📖 19)
  Standardised application templates for modular programming in the »PLC Designer«.
- FAST technology modules (📖 20)
  Standardised software modules that contain a complete and previously tested drive function.
- FAST Motion (📖 33)
  Optimised function blocks based on "PLCopen motion control" for individual extension of the FAST technology modules.

The Lenze FAST Application Software is licensed via "Application Credit".

▸ Application Credit (licence for Lenze FAST) (📖 15)

Highlights

- Up to 80 % of the software engineering can be covered by standards.
- Considerable reduction of the development times for the basic functions
- Saved time can be invested in the further development of the special features of the machine.
- Prepared and tested software modules
- Structure of the programming
- Easy reuse and extension of programming sections
- Error reduction by tested software

4.1 Application Credit (licence for Lenze FAST)

The Lenze FAST Application Software is based on a licence model. In order to use the FAST technology modules and motion functions for your drive solution, an SD licence card with a sufficient "Application Credit" is required.

The SD licence card can be ordered via the responsible Lenze sales partner.

Product catalogue for the Lenze Controller

Here you will find information on how to order an SD licence card with "Application Credit".

4.1.1 Determination of the required "Application Credit"

Each FAST technology module and each motion function has a clearly defined valency the height of which (points of the "Application Credit") depends on the functionality. During the dimensioning process of the machine (concept phase) it shows which modules and functions have to be used to implement the drive tasks.

In order to detect the required "Application Credit", simply add the points of the used FAST technology modules for each instance.

Points for FAST Motion functions only have to be added once. The FAST Motion functions can then be instanced as often as required.

Example 1	
4 x Basic Motion	100 points
1 x Virtual Master	25 points
1 x Electrical Shaft Velocity	25 points
2 x Winder Dancer-controlled	200 points
1 x Cross Cutter	100 points
Total:	**450 points**

Example 2	
3 x Basic Motion	75 points
1 x Virtual Master	25 points
2 x Flex Cam	100 points
1 x Pick & Place with Delta 3	200 points
1 x Motion Control - Camming	150 points
Total:	**550 points**

The points for using the FAST technology modules and motion functions can be found here:

- Overview of the FAST technology modules (📖 21)
- Overview of the FAST Motion functions (📖 34)

Calculation of the Application Credit

The Application Credit of modules that are declared in the declaration part of a POU is always calculated even if the module is not used.

The Application Credit of modules that are declared in a global variable list will only be calculated if at least one element from the variable list is used. As soon as one (any) element is used, the Application Credit of all instances declared in this list is calculated.

4.1.2 SD card/licence card with "Application Credit"

Note!

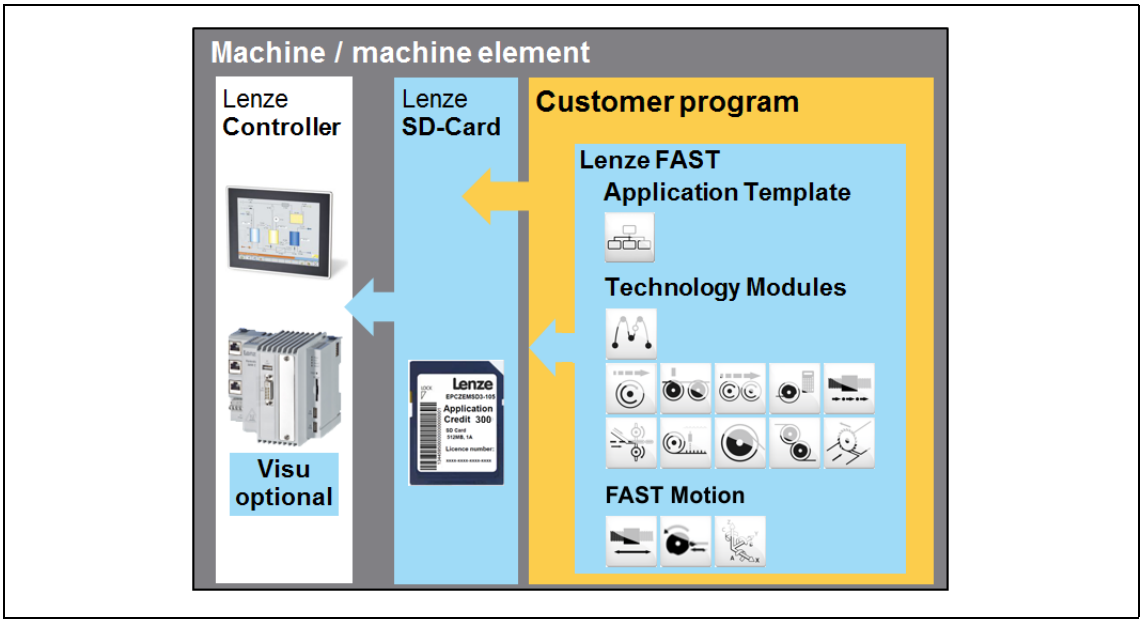
The "Application Credit" stored on the SD licence card gets lost by ...

- formatting the SD card;
- deletion of the data on the SD card;

In case of a "Restore" with the Lenze »Global Drive Control«-Tool from V3.9, no licence data gets lost.

The SD licence card is available with "Application Credit" from 100 to 4000 points.

The PLC program (application) with the used FAST technology modules and motion function is stored on the SD licence card.



[4-1] SD licence card of the Lenze Controller

- The SD licence card has to feature a sufficient "Application Credit" in order to operate without restriction with the FAST technology modules and motion functions.
- Exchange the SD card supplied with the Lenze Controller for the SD licence card with "Application Credit".
  By default, the Controller always contains an SD card without "Application Credit" (score '0'). Here, the FAST technology modules and FAST motion functions can only be used for test purposes.
- The SD licence card is not bound to a certain Controller, so the "Application Credit" can be used for different Controllers.

[4-2] SD licence card with "Application Credit"

4.1.3 If the available "Application Credit" is not sufficient (test mode)

Note!

The SD licence card has to feature a sufficient "Application Credit" in order to operate without restriction with the FAST technology modules and motion functions.

If the available "Application Credit" for implementing your application is not sufficient, ...

- the Lenze Controller is operated in test mode;
- the starting time of the application increases.

Deleting or renaming instances of the FAST software modules

If instances of the FAST software modules are deleted or renamed, the corresponding "Application Credits" are only removed if a complete compilation process is carried out (not with "Online Change"). Therefore, before generating a boot project in the »PLC Designer«, execute the **Create → Clean** menu command.

When the project is compiled, the »PLC Designer« detects whether the available "Application Credit" (on the SD licence card) is sufficient.

- The message window of the »PLC Designer« outputs respective messages.
- In the logbook of the »WebConfig«, the available "Application Credit" is output in parameter **660** parameter and the required "Application Credit" in parameter **661**.

4.1.3.1 Operation of the Lenze Controller in test mode

If the available "Application Credit" for implementing your application is not sufficient, the Controller is operated in test mode. This changes the starting performance of the application:

- Each time the Controller is restarted, the delay time until the start of the application increases.
- The delay time during the starting sequence can be up to 20 minutes.

Except for this restriction, the PLC program can still be used.

Termination of the test mode

In order to close the test mode, an SD licence card with sufficient "Application Credit" has to be used and the PLC program has to be transferred to the card.

4.1.3.2 Identification of the test mode

Status LEDs of the Controllers

LED Colour 1 / colour 2		Interval	Meaning
Error			
green	red	blinking (5.0 Hz)	A problem has occurred, but the Controller keeps running.
Status 1			
green	yellow	blinking (0.5 Hz)	SD licence card with higher "Application Credit" required.

Messages in »PLC Designer« and »WebConfig« (logbook)

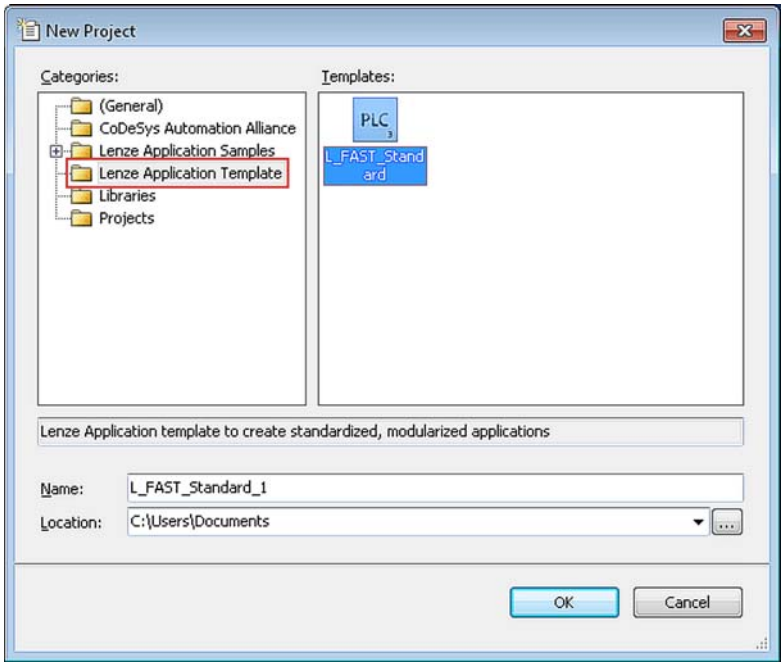
```
License_Manager: Application starts in 1200 seconds.
License_Manager: Boot application needs more Application Credit!
License_Manager: Invalid Lenze-License-Information.
```

4.2 FAST Application Template

The FAST application template is an application template standardised by Lenze for modularised and transparent programming in the »PLC Designer«. In order to generate a modularised mechatronic structure within an automation system, ready-made, reusable machine modules and module applications (e.g. a cross cutter) can be created in the application template.

The FAST application template is integrated into the »PLC Designer« in the form of an **L_EATP_ApplicationTemplate** function library. The library contains the structure and the basic functionality (e.g. state machine and error handling) of the application template.

When creating a new project using the **File → New project** menu command, the application template (L_FAST_Standard) can be selected:



Software manual for FAST Application Template

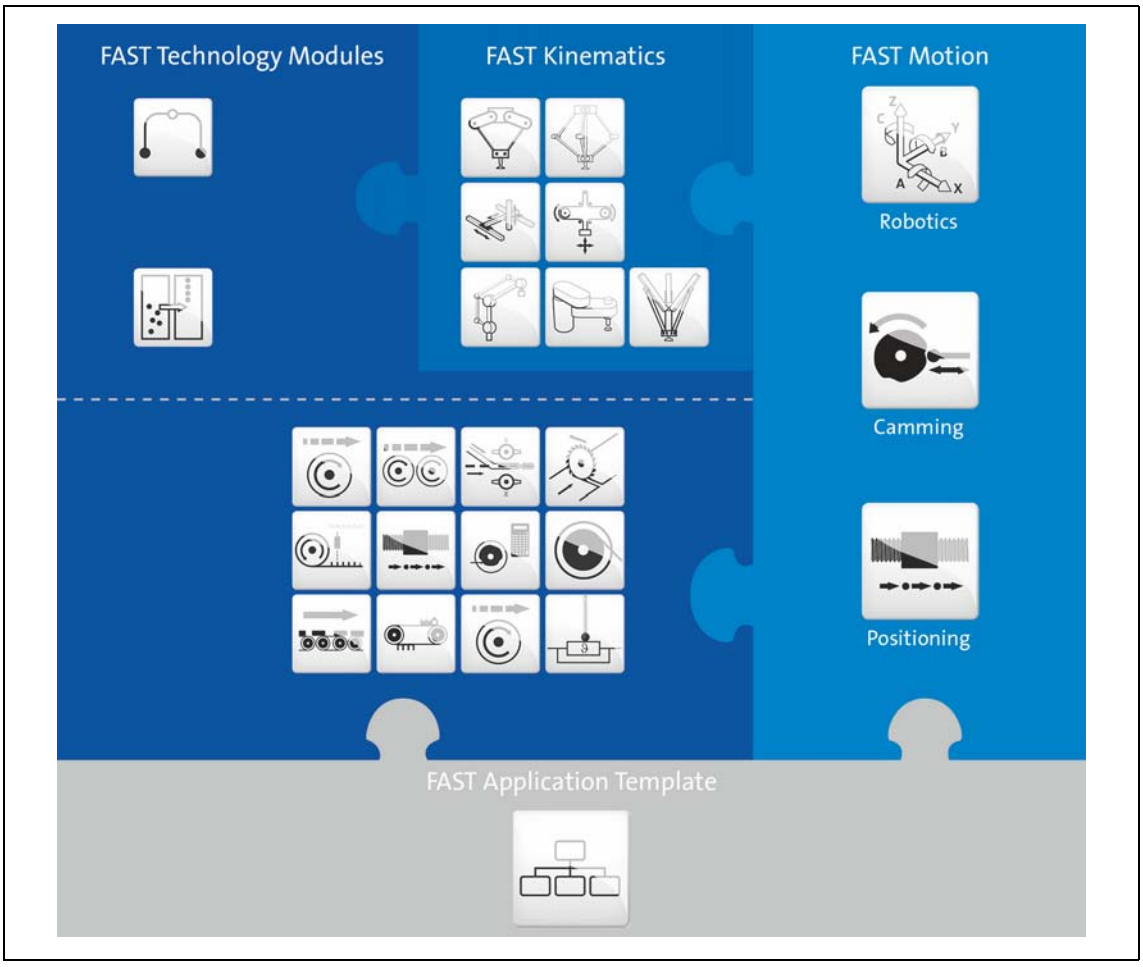
Here you'll find some detailed information on how to use the application template.

4.3 FAST technology modules

The predefined FAST technology modules serve to easily implement the required machine functions.

The technology modules are standardised software modules for modular programming of the machine control. A technology module contains a complete and previously tested drive function.

Integrated basic functions (manual jog, homing, positioning) and an integrated visualisation provide for the easy commissioning and testing of the modules. The reusability of the modules increases the quality of the software and considerably reduces the time required for programming, commissioning and testing.



[4-3] FAST technology modules

The FAST technology modules are included in the »PLC Designer« as autonomous function blocks in the L_TT1P_TechnologyModules_LM function library (📖 24). They use the standardised interfaces and can thus be easily integrated into the machine program, combined as required and extended individually by FAST Motion functions (📖 33).

The **L_TT1P_TechnologyModules_SM3** function library contains FAST technology modules for previous projects ("L-force Motion" applications).

4.3.1 Overview of the FAST technology modules

Technology module	Symbol	Function	Points for use (Application Credit)
Basic Motion		Implementation of basic drive functions for the establishment or continuous movements of an axis	25
Virtual Master		Implementation of a virtual master axis in the machine	
Electrical Shaft Position		Positionally accurate synchronisation and coupling of drives	
Electrical Shaft Velocity		Speed-accurate synchronisation and coupling of drives	
Temperature Control		Control of the temperature of a (partial) system that is equipped with a heating element and a thermal sensor.	50
Flex Cam		• Implementation of one or several electrical cams • Flexible management of cams created online and offline	
Table Positioning		Positioning profile for single axes with smoothing and touch probe positioning	

Technology module	Symbol	Function	Points for use (Application Credit)
Cross cutter		Synchronisation of the movements of drives for the cross-sealing and/or cross-cutting of products	100
Register Control		Implementation of a clock-synchronised drive for setting up a register control with print mark detection	
Winder dancer-controlled		Implementation of a winding drive with dancer position control	
Winder tension-controlled		Implementation of a winding drive with tension control or speed control	
Traverser		Controls the even distribution of a material to be wound across the total winding width.	
Flying Saw		Cutting and machining material during the movement	

"Pick & Place" applications

Note!

The technology modules "Pick & Place" and "Track Pick & Place" are not supported by the Controller **c300** and **p300**.

Technology module	Symbol	Function	Points for use (Application Credit)
Pick & Place		Implementation of complex three-dimensional movements by means of profiles for up to four drives with different kinematics.	100
Track Pick & Place		Implementing gripper movements which, for instance, pick workpieces from a conveying belt and place it to another position or another conveying belt.	150
Kinematics for the "Pick & Place" technology modules			
Portal		Universal Cartesian portal kinematics with 2, 3 and 4 degrees of freedom for "Pick & Place" with high loads and large workspaces	0
Belt		Universally usable belt kinematics with 2 degrees of freedom	
Delta 2		Parallel kinematics with 2 degrees of freedom for highly dynamic "Pick & Place" tasks	+ 100
Delta 3		Parallel kinematics with 3 degrees of freedom for highly dynamic "Pick & Place" tasks	
LinearDelta 3		Parallel kinematics with 3 degrees of freedom with linear axes for highly dynamic "Pick & Place" tasks	
Scara		Universal serial Scara kinematics with 2 and 3 degrees of freedom	
Articulated P		Special form of an articulated arm kinematics with 4 degrees of freedom, especially suitable for palletizing	

4.3.2 L_TT1P_TechnologyModules_LM function library

The FAST technology modules are scaled in accordance with the respective drive task.

Depending on the required functional range, you can select the technology modules in the versions "Base", "State" and "High" in the »PLC Designer« in the **L_TT1P_TechnologyModules_LM** function library.

The "Base" version contains basic drive functions. The "State" and "High" versions complement the basic drive functions by further specific inputs/outputs and parameters for more complex drive tasks.

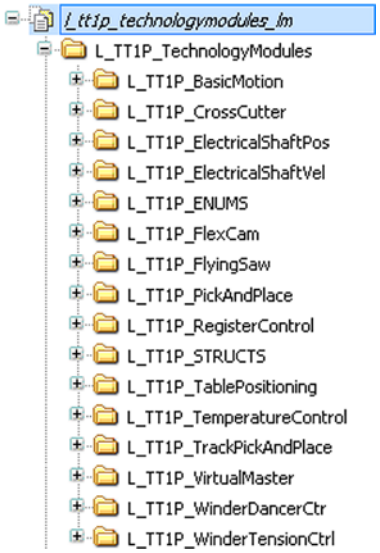
Contents of the function library

Note!

In the »PLC Designer«, only the function blocks and online help sections of the installed technology modules are displayed.

Missing components can be installed via the Lenze »EASY Package Manager«.

The **L_TT1P_TechnologyModules_LM** function library in the »PLC Designer«:

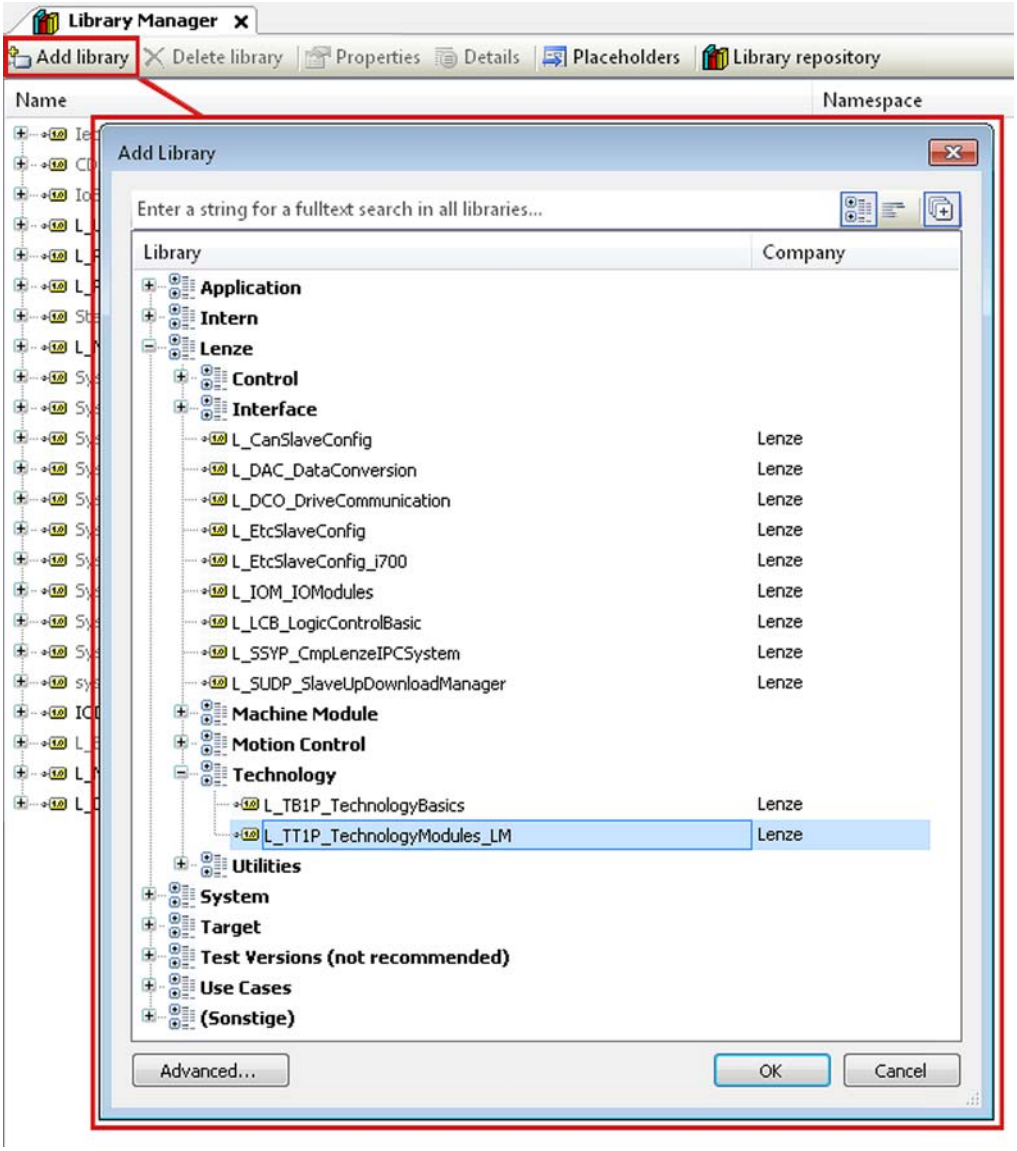


Reference manuals for the FAST technology modules

Here you will find detailed information on the functions of the technology modules.

4.3.2.1 Implementing the function library

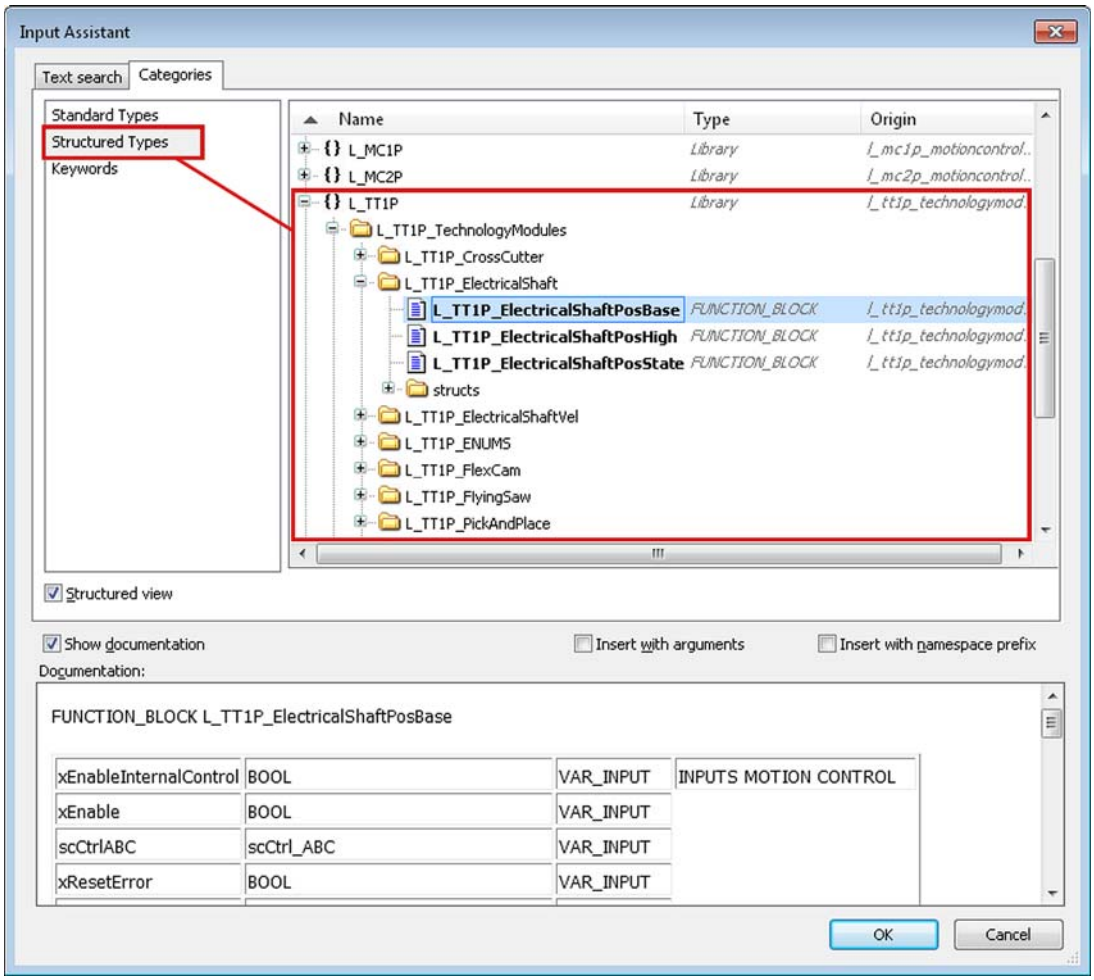
The library manager of the »PLC Designer« serves to implement the **L_TT1P_TechnologyModules_LM** function library via the "Add library" button.



4.3.2.2 Implementing a technology module

A technology module can be implemented like a function block via the input assistance of the »PLC Designer« into the program:

- Go to "Structured types" and select the technology module to be implemented in the version "Base", "State" or "High".
- Confirm the selection by clicking **OK**.



4.3.3 Operation of the technology modules (Internal Control)

The FAST technology modules are operated via the visualisation.

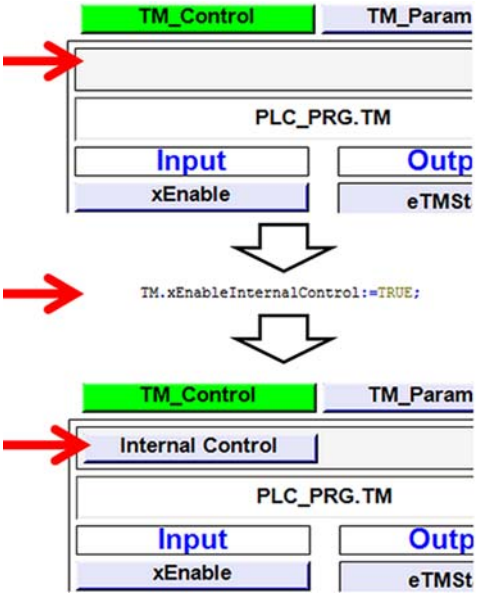
Note!

When the operation takes place via the visualisation ...

- the interconnection in the PLC program has no impact.
- the *xStop* input is continued to be evaluated. Thus, the technology modules can be stopped any time from the PLC program and the visualisation.

How to activate the operation via the visualisation:

1. Insert and reference the visualisation of the technology module.
2. Set the *xEnableInternalControl* input = TRUE in the PLC program.
   - In the visualisation, the "Internal Control" button gets visible.



3. Press the "Internal Control" button.
   - The operation via the visualisation is activated.
   - The interconnected inputs in the PLC program are disconnected.

4.3.4 Activating/deactivating the technology module

For activating the technology module, the *xEnable* input has to be set = TRUE.

The technology module is initialised and enables the execution of the state machine and the respective functions for further actions.

A reset of the input (*xEnable* = FALSE) deactivates the technology module.

In the deactivated state ...

- all actions and functions are cancelled;
- all outputs of the technology module are reset;
- the state machine is not executed anymore.

4.3.5 Enable axis

The technology module has to be activated (input *xEnable* = TRUE) in order to enable the axis.

When the *xRegulatorOn* input = TRUE, the axis is enabled.

Only if the axis is enabled, further functions can be activated and executed in the technology module.

4.3.6 Stop function

The stop function serves to abort an active motion with the highest priority. The axis is brought to a standstill with the deceleration (*lrStopDec* parameter) and the defined jerk (*lrStopJerk* parameter).

A precondition for executing the stop function is the enabling of the axis (*xRegulatorOn* input = TRUE).

The stop function is activated when the *xStop* input = TRUE. The technology module changes to the "STOP" state as long as the *xStop* input is set = TRUE.

When the *xStop* input = FALSE, the stop function is deactivated and the technology module changes to the "READY" state.

Parameters to be set

The parameters for the stop function are located in the "scPar" parameter structure of the technology module.

```
lrStopDec : LREAL := 10000;
lrStopJerk : LREAL := 100000;
```

4.3.7 Holding function

The holding function serves to abort an active motion. The axis is brought to a standstill with the deceleration (*lrHaltDec* parameter) and the defined jerk (*lrHaltJerk* parameter).

A precondition for executing the holding function is the enabling of the axis (*xRegulatorOn* input = TRUE).

The holding function is activated with a FALSE↗TRUE edge at the *xHalt* input. The technology module changes to the "STOP" state as long as the *xHalt* input is set = TRUE.

When the *xHalt* input = FALSE, the holding function is deactivated and the technology module changes to the "READY" state.

Parameters to be set

The parameters for the holding function are located in the "scPar" parameter structure of the technology module.

```
lrHaltDec : LREAL := 3600;
lrJerk : LREAL := 100000;
```

4.3.8 First commissioning with the L_MC1P_AxisBasicControl function block

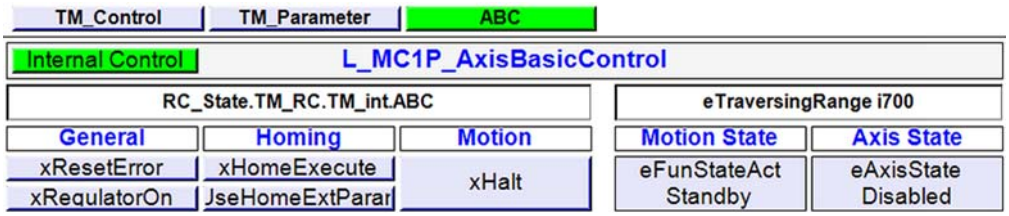
Activation of the **L_MC1P_AxisBasicControl** function block is only required for initial commissioning (e.g. for a controller adjustment or a simple positioning, irrespective of the technology module function).

The function block is included in all technology modules. It can be activated via the "scCtrlABC" structure or via the visualisation. The structure contains all inputs of the function block. The outputs are included in the "scStatusABC" structure.

In the visualisation of the technology module, the **L_MC1P_AxisBasicControl** function block is displayed in the "ABC" button. The operation of the function block via visualisation has to be activated (like the "Internal Control" of the technology module).

How to activate the operation via the visualisation:

1. Activate the "Internal Control" button in the visualisation of the technology module.
   ▸ Operation of the technology modules (Internal Control) (📖 27)
2. Set the *xEnable* input in the technology module = TRUE.
   - The technology module changes to the "READY" state.
   - The "Internal Control" button appears in the visualisation of the **L_MC1P_AxisBasicControl** function block.



3. Press the "Internal Control" button.
   - The technology module changes to the "SERVICE" state.
   - The operation via the visualisation is activated.

In the "SERVICE" state ...

- only the functions of the **L_MC1P_AxisBasicControl** function block can be used;
- the functions of the technology module are inhibited.

The technology module remains in the "SERVICE" state until the visualisation of the **L_MC1P_AxisBasicControl** function block is deactivated via the "Internal Control" button.

»PLC Designer« Online help

Here you will find detailed information on the **L_MC1P_AxisBasicControl** function block.

4.3.9 Hardware limit switches

The hardware limit switches are used for the **Homing** technology module function and for limit switch monitoring.

For controlling the hardware limit switches, the **L_MC1P_HWLimitSwitchInterface** function block must be used. This function block is an interface to the connection of the hardware limit switches of an axis.

For some technology modules for which the hardware limit switches are often used, the three inputs *xEnableHWLimit*, *xHWLimitPos*, and *xHWLimitNeg* are designed as direct inputs. These inputs are OR'd with the inputs of the **L_MC1P_HWLimitSwitchInterface** function block and are therefore equivalent.

When the *xEnableHWLimit* input = TRUE, the monitoring of the hardware limit switches is activated. The inputs *xHWLimitPos* and *xHWLimitNeg* serve to connect the limit switches.

The control and monitoring of the hardware limit switches is independent of the state of the technology module and the state of the "Internal Control" visualisation mode and can be activated any time from the PLC program.

4.3.10 Signal flow diagrams

In the documentations of the technology modules, the relationships between signals and process variables are displayed by means of block diagrams in signal flow diagrams.

The signal flow diagram of a technology module does not cover the entire process (machine topology or system view). Here, the focus is on the representation of the measuring points in order to enable a practical diagnostics option and to understand the exact course of the function.

In the signal flow diagrams, the most important signals are differentiated according to their type and designated and numbered accordingly:

- IP: Inputs and Parameters
- OP: Outputs
- MP: Measuring Points
- AP: Access Points
  Each access point is activated as an alternative branch (OR operation) via a switch.

These signals are included in the "scSignalFlow" structure at the output of the technology module. The contents of the "scSignalFlow" structure can be read only. The signals cannot be written there. A detailed description of the signals can be found in the documentation of the technology module.

Access points in the signal flow of a technology module

In some technology modules, it is possible to influence signals via predefined access points (AP). The access points act as alternative branches (OR operations or switches).

The access points are included in the "scAccessPoints" structure at the input of the technology module. In the initial state, the access points do not have any effect. An access point is activated via the corresponding switch that is also included in the "scAccessPoints" structure.

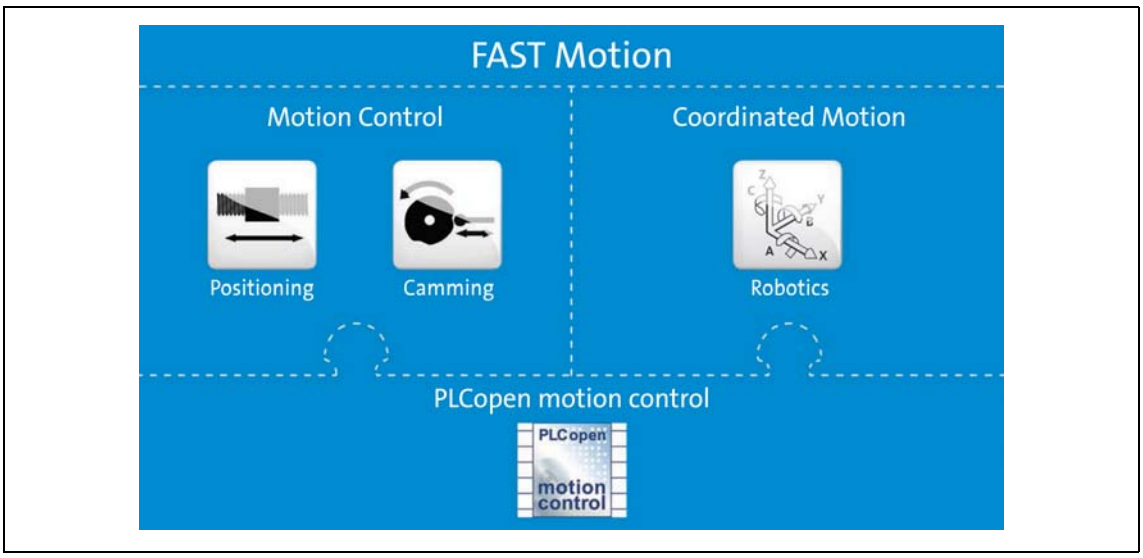
Reference manuals for the technology modules

Here you will find detailed information on the functions of the technology modules.

4.4 FAST Motion

FAST Motion provides full flexibility and scalability for programming in accordance with the specifications of IEC 61131 and comprises optimised function blocks that are based on "PLCopen motion control".

If the functionalities of the FAST technology module are not sufficient, they can be supplemented individually with the FAST Motion modules.



[4-4] FAST technology modules

Note!

FAST Motion in case of Controller c300 and p300

- The Motion Control libraries are not loaded into the library manager by default.
- FAST Motion for "Coordinated Motion" (robot kinematics) and axes groups are not supported.

Overview of the FAST Motion functions

FAST Motion	Symbol	Function	Points for use (Application Credit)
Motion Control		**Positioning** Basic Motion functions for single-axis movements based on "PLCopen motion control" (formerly Part 1) for positioning. They serve to freely program positioning processes and further single-axis movements.	150
		**Camming** Basic Motion functions for cam movements and synchronisation on the basis of "PLCopen motion control" (formerly Part 2). They serve to freely program axis synchronisation processes as well as cams for single axes.	
Coordinated Motion		**Robotics** Basic Motion functions for multi-axis-coordinated movements based on "PLCopen coordinated motion control" (Part4). They serve to interpolate axes groups such as robot kinematics in multidimensional spaces. The movements can also be controlled by the "Pick & Place" and "Track Pick & Place" FAST technology modules.	300

The "PLC Designer" includes the "Motion Control" modules and the "Coordinated Motion" modules in different libraries:

- L_MC1P_MotionControlBasic for single axes
- L_MC2P_MotionControlCam for multi-axes
- L_MC4P_RoboticHandling for coordinated multi-axis movements

"FAST Motion function libraries" reference manual

Here you will find detailed information on the FAST Motion function libraries and Motion function blocks.

5 Error handling

With regard to the subject of error handling, the FAST software modules – application template, technology modules, Motion modules – make a basic distinction between an **Error** and a **Warning**.

- An **Error** refers to maloperation that sets the module to an error status.
- A **Warning** refers to a potential impairment of the function, which, however, does not set the module to an error status.

Error sources

Errors and warnings can be caused by three different sources.

- Error source 1: Internal error, e.g. triggered by a wrong parameter setting.
- Error source 2: Error in the axis (axis driver), e.g. triggered by approaching an invalid position outside the permissible range.
- Error source 3: Error in the Inverter Drive, e.g. triggered by exceeding the defined temperature range.

Error response

The error response defines the behaviour that is triggered when an error or warning has occurred.

If, for example, an error occurs in a technology module, the technology module switches to the "ERROR" state (*xError* output = TRUE). The axis is brought to a standstill with the deceleration set in the *lrStopDec* parameter.

If a warning occurs, the *xWarning* output is set = TRUE. The technology module continues to execute the current action without any interruptions.

Error output

The error code (see L_IE1P_Error (📖 37)) with the description of the error or the warning is provided at the *eErrorID* output.

The L_TT1P_scErrorInfo (📖 36) error information structure serves to carry out an exact analysis of an error or warning. In this structure, the errors and warnings are distinguished by their error sources and are displayed separately.

5.1 Error information structure

L_TT1P_scErrorInfo

The **L_TT1P_scErrorInfo** error information structure contains information for a more precise analysis of the error cause.

Designator Data type	Description		Available in version		
			Base	State	High
xError BOOL	Status signal if an error has occurred in the FAST module/ technology module.		●	●	●
	TRUE	An error has occurred in the FAST module/technology module.			
xWarning BOOL	Status signal if a warning has occurred in the FAST module/ technology module.		●	●	●
	TRUE	A warning has occurred in the FAST module/ technology module.			
eErrorID L_IE1P_Error	Error number if xError = TRUE or xWarning = TRUE.		●	●	●
xAxisError BOOL	Status signal if an error has occurred in the axis.		●	●	●
	TRUE	An error has occurred in the axis.			
xAxisWarning BOOL	Status signal if a warning has occurred in the axis.		●	●	●
	TRUE	A warning has occurred in the axis.			
eAxisErrorID L_IE1P_Error	Error number if xAxisError = TRUE or xAxisWarning = TRUE.		●	●	●
xDriveError BOOL	Status signal if an error has occurred in the Inverter Drive.		●	●	●
	TRUE	An error has occurred in the Inverter Drive.			
xDriveWarning BOOL	Status signal if a warning has occurred in the Inverter Drive.		●	●	●
	TRUE	A warning has occurred in the Inverter Drive.			
dwDriveErrorID DWORD	Error number if xDriveError = TRUE or xDriveWarning = TRUE.		●	●	●

5.2 Error messages (overview)

L_IE1P_Error

The **L_IE1P_Error** type describes the error messages of the FAST software modules (application template, technology modules, Motion modules).

Error no.	Error text	Error cause
0	No Error	No error
17000	ModuloAxisIsRequired	Instead of a Modulo axis, a linear axis is connected.
17003	StartPosOutOfCycleLength	The starting position is outside the valid cycle length of the axis.
17004	CycleLengthsHaveToBeEqual	The connected axes have different cycle lengths.
17005	InvalidDirection	Invalid direction of rotation
17006	MarkStackLimitReached	The length of the stacks of the end marks have been exceeded as the distance between touch probe sensor and tool is bigger than the length of the register.
17007	MaxMissedMarks	Maximum number of virtual marks was exceeded.
17008	InvalidFollowLineAccVel	Invalid parameter setting of the synchronisation
17009	InvalidJoggingAccVel	Invalid parameter setting of the manual jog function (jogging)
17010	InvalidStopDec	Invalid deceleration ramp for the stop function
17011	InvalidDiameter	Invalid value for the diameter
17012	TorqueFollowerNotReadyForMotion	The torque follower cannot be activated.
17013	SpeedFollowerNotReadyForMotion	The speed follower cannot be activated.
17014	InvalidInverter	The referenced axis (AXIS_REF) is invalid. Possible axes are e.g. Servo Inverters i700, Servo Drives 9400 Highline.
17015	SDO_AccessFailedToMotorparameters	The access to the motor parameters via SDO has failed.
17016	MissedMappingParameterLower SpeedLimit	The process image (mapping) cannot be reached for the lower speed limit.
17017	MissedMappingParameter UpperSpeedLimit	The process image (mapping) cannot be reached for the upper speed limit.
17018	MissedMappingParameterTorqueOffset	The process image (mapping) cannot be reached for the feedforward control of the torque.
17019	DancerPosOutOfRange	The dancer position is outside of the defined area.
17020	InvalidLimitDancerPos	The dancer limit positions are invalid.
17021	InvalidClutchParameters	The parameter setting of the clutch is invalid.
17022	WasNotCalledDuringMotion	The technology module was not called periodically.
17030	InvalidNumberOfCAMPoints	The number of points in the cam is invalid.
17032	InvalidPathPar	The parameter setting of the path is invalid.
17033	InvalidBlendingRadius	Invalid for the blending radius.
17034	PathNotSupported	Invalid CNC program
17035	X_PathLimitPositiveExceeded	The limitation of the X axis in positive direction has been exceeded.
17036	X_PathLimitNegativeExceeded	The limitation of the X axis in negative direction has been exceeded.
17037	Y_PathLimitPositiveExceeded	The limitation of the Y axis in positive direction has been exceeded.

Error no.	Error text	Error cause
17038	Y_PathLimitNegativeExceeded	The limitation of the Y axis in negative direction has been exceeded.
17039	Z_PathLimitPositiveExceeded	The limitation of the Z axis in positive direction has been exceeded.
17040	Z_PathLimitNegativeExceeded	The limitation of the Z axis in negative direction has been exceeded.
17041	C_PathLimitPositiveExceeded	The limitation of the C axis in positive direction has been exceeded.
17042	C_PathLimitNegativeExceeded	The limitation of the C axis in negative direction has been exceeded.
17043	InvalidPathData	The path preparation has failed.
17046	ProfileReceivedGaps	The setting in the path profile is invalid.
17047	InvalidTargetPLC	The technology module is not compatible with the selected Controller. The firmware version < 3.7 is not supported!
17100	MasterIsMoving	Clutching in to the master axis is not possible as the master axis is moving.
17101	InvalidPoductLength	The parameter setting of the product length is invalid.
17102	TPSensorNotTeached	The home position of the touch probe sensor is not known.
17103	SlaveReceivedGaps	A discontinuity in the slave axis has occurred.
17104	MasterReceivedGaps	A discontinuity in the master axis has occurred.
17105	InternalError	An internal error has occurred in the technology module due to an internal calculation.
17106	InvalidParameterCuttingAngle	The parameter setting of the synchronous angle is invalid. The sum of all synchronous phases exceeds an angle of 360 degrees.
17107	InvalidCuttingParameters	The parameter setting of the cross cutter for the cutting operation is invalid.
17108	InvalidCuttingLength	The parameter setting of the cutting length is invalid.
17109	SlaveNotInParkPos	Clutching in to the master axis is not possible as the slave axis is outside the parking position.
17110	MasterIsReversing	The master axis changes the direction of rotation.
17111	IntInvalidSelectCAM	Internal error from the internal calculation in the technology module. An invalid cam was switched.
17112	SelectedAxisIsNotSupported	The function is not supported for the selected axis.
17113	AxisIsNotSupported	The axis is not supported.
17114	InvalidProfile	The parameter setting of the profile is invalid.
17115	AxisEnabledIsRequired	The axis has to be enabled to execute the required action.
17116	CorrLimitOutOfCycleLength	The parameters for the correction window are outside of the cycle length of the connected measuring system.
17117	CorrectionGreaterCorrWindow	The correction value is greater than the available correction window.
17118	InvalidCNCProgram	The CNC program is invalid or missing.
17121	InvalidGCodeLine	The CNC command set is invalid.

Error no.	Error text	Error cause
17122	CoordSystemACSNotSupported	A wrong coordinate system has been connected. Suitable coordinate systems are ... • product coordinate system (PCS) and • machine coordinate system (MCS). The axis coordinate system (ACS) is not supported!
17123	DancerLimitsNotTeached	The dancer limit positions have not been referenced.
17124	NotReadyForAddProfile	Warning: Loading the profile is not possible because the technology module is still preparing the path. The profile has not been accepted.
17125	SlavePosUpperLimit	Warning: The position of the slave axis exceeds the set "lrUpperLimit" parameter.
17126	SlavePosLowerLimit	Warning: The position of the slave axis falls below the set "lrLowerLimit" parameter.
17127	TargetPosUpperLimit	Warning: The target position to be approached exceeds the set "lrUpperLimit" parameter.
17128	InvalidMarkPosition	Warning: The position detected by the mark sensor is out of the valid range.
17129	InvalidPositioningMode	An invalid positioning mode has been selected.
17130	TMDataBusDisconnected	Communication between master and slave node is interrupted.
17131	InvalidTMDataBus	The communication bus is not permissible.
17132	TMDataBusConfigChanged	The node number has changed.
17133	TMNotCalledInMotionTask	Invalid task cycle time
17135	SlaveTMStateService	The desired function cannot be executed.
17137	CollisionDetectionDisabled	Collision monitoring is not active.
17138	CollisionDetected	A collision between nodes has occurred.
17150	InvalidTraversingProfileParameter	Invalid profile parameters Reversal curves too long, constant travel no longer possible. Check all profile-relevant parameters.
17151	InvalidTraversingCoilParameter	xError = TRUE: • Invalid coil parameters. • Check all coil-relevant parameters (*scCoilData*) xWarning = TRUE: • Check all access points used for the radius correction.
17152	TraversingAngularShiftLimitReached	Error in the calculation of the reversal offset (*lrAngularShiftLimit*) Change parameter setting of the reversal offset.
17918		The maximum number of workpieces (30) has been detected. The "Track Pick & Place" technology module can detect any further workpieces.
19000	DelayTimeInvalid_PT1Filter	A negative filter time constant has been indicated.
19002	ModeInvalid_Curve	The selected curve mode is invalid.
19003	ModeInvalid_Compare	The selected comparison mode is invalid.
19005	ModeInvalid_ConvAxisV	The selected compilation mode does not exist.
19006	DelayTimeInvalid_ProcessController	A negative filter time constant has been entered.
19007	RateTimeInvalid_ProcessController	A negative rate time has been entered.

Error no.	Error text	Error cause
19008	ResetTimeInvalid_ProcessController	A negative reset time has been entered.
19034	DMinBiggerDMax_CalcDiameter	The value for the minimum diameter is higher than the value for the maximum diameter.
19048	MaxSpeedOrMaxTorque_IdentMInertia	The entered values for the maximum speed or maximum torque are too high.
19049	AbortedByStartIdent_IdentMInertia	The identification of the moment of inertia has been aborted due to invalid parameter setting.
19050	AbortedByFollowerDisabled _IdentMInertia	The identification of the moment of inertia has been aborted due to non-enabled torque follower.
19051	AbortedByFollowerEnabled _IdentMInertia	The identification of the moment of inertia has been aborted because an external source has activated the torque follower outside the identification of the moment of inertia.
19052	NmaxNotReached_IdentMInertia	The maximum speed set for the identification of the moment of inertia has not been reached.
19053	MNotReached_IdentMInertia	The set maximum torque has not been reached.
20306	SWLimitPos	The positive software limit position has been exceeded.
20307	SWLimitNeg	The negative software limit position has been exceeded.
20500	HWLimitPos	The positive hardware limit switch has been reached or approached.
20501	HWLimitNeg	The negative hardware limit switch has been reached or approached.
20664	InvalidGearFactor	The setpoint position of the axis is outside of the valid cycle length of the axis.
20665	PosOutOfCycleLength	The parameter setting of the gearbox factor is invalid.
20696	AxisNotHomed	For the axis, no home position is known.
21221	KinematicIllegalParameter	The kinematic parameter setting of the axis group is invalid.
21258	AxisGroupNotHomed	The motion sequence is not possible since the axis group has not been referenced.
21284	MainAxisNotConnected	One or several Cartesian main axes of the axis group are not connected. The initialisation of the axis group has not been completed yet.
21285	RealAxisNotConnected	The real drive axes are not connected.
22025	MasterOutOfCam	The master axis is outside the valid cam range.
22026	InvalidVelAcc_OffsetScaling	The value for the velocity of the "Offset/Scaling" function is too small.
22027	InvalidCamTable	The defined cam is invalid.
22028	InvalidStartOrEndPosOfCam	The start/final value of the cam is invalid.
22029	InvalidScalingFactor	The scaling factor is invalid.
22036	ClutchIsReversing	Change in direction of the clutch is required.
22038	InvalidOpenInstantDec	The deceleration ramp set for instant opening is invalid.

5.3 Resetting an error

If a FAST module/technology module is in the "ERROR" state, the error can be reset when the *xResetError* input = TRUE.

- An error can only be triggered and reset if the FAST module/technology module is activated (*xEnable* input = TRUE).
- If a FAST module/technology module is deactivated (*xEnable*input = FALSE), no error messages are output.

Resetting all errors of a module

In order to reset all errors, the FAST module/technology module has to be switched off (*xEnable* = FALSE) and then switched on again (*xEnable* = TRUE). After switch-on, the FAST module/technology module is set to the "Init" initialisation state.

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FEEDBACK

Your opinion is important to us

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

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

feedback-docu@lenze.com

Thank you very much for your support.

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