



# DOCUMENTATION ISG-kernel

## PLC library McpControl

Short Description:  
MCP-CTRL

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# Preface

## Legal information

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This documentation was produced with utmost care. The products and scope of functions described are under continuous development. We reserve the right to revise and amend the documentation at any time and without prior notice.

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## Personnel qualifications

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This description is solely intended for skilled technicians who were trained in control, automation and drive systems and who are familiar with the applicable standards, the relevant documentation and the machining application.

It is absolutely vital to refer to this documentation, the instructions below and the explanations to carry out installation and commissioning work. Skilled technicians are under the obligation to use the documentation duly published for every installation and commissioning operation.

Skilled technicians must ensure that the application or use of the products described fulfil all safety requirements including all applicable laws, regulations, provisions and standards.

## Further information

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Links below (DE)

<https://www.isg-stuttgart.de/produkte/softwareprodukte/isg-kernel/dokumente-und-downloads>

or (EN)

<https://www.isg-stuttgart.de/en/products/softwareproducts/isg-kernel/documents-and-downloads>

contains further information on messages generated in the NC kernel, online help, PLC libraries, tools, etc. in addition to the current documentation.

## Disclaimer

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It is forbidden to make any changes to the software configuration which are not contained in the options described in this documentation.

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# General and safety instructions

## Icons used and their meanings

This documentation uses the following icons next to the safety instruction and the associated text. Please read the (safety) instructions carefully and comply with them at all times.

## Icons in explanatory text

- Indicates an action.
- ⇒ Indicates an action statement.



### **⚠ DANGER**

#### **Acute danger to life!**

If you fail to comply with the safety instruction next to this icon, there is immediate danger to human life and health.



### **⚠ CAUTION**

#### **Personal injury and damage to machines!**

If you fail to comply with the safety instruction next to this icon, it may result in personal injury or damage to machines.



### **Attention**

#### **Restriction or error**

This icon describes restrictions or warns of errors.



### **Notice**

#### **Tips and other notes**

This icon indicates information to assist in general understanding or to provide additional information.



### **Example**

#### **General example**

Example that clarifies the text.



### **Programing Example**

#### **NC programming example**

Programming example (complete NC program or program sequence) of the described function or NC command.



### **Release Note**

#### **Specific version information**

Optional or restricted function. The availability of this function depends on the configuration and the scope of the version.

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# 1 Definitions

## 1.1 Abbreviations

AXHLI	Axis-specific High-Level Interface
CM	Continuous Motion (endless rotation)
DM	Discrete Motion (positioning)
FB	Function Block
FBSD	FB State Diagram
HLI	High-Level Interface between MC and PLC
MC	Motion Controller
MCP	Motion Control Platform
MCE	Motion Control Engine
MC-FB	Motion Controller Function Block
NL Slope	Non-linear slope
PCS	Part program coordinate system
PLC	Programmable Logic Control
POE	Program Organisation Unit
SAI	Single Axis Interpolator

## 1.2 Explanations of terms

Axis group	A combination of axes which can execute a motion on a spatial curve coordinated by a channel while maintaining the specified values for velocity, acceleration and jerk on this spatial curve.
CoDeSys	PLC programming system from 3S Smart Software Solutions
Function block:	Internal order format of the ISG Motion Controller.
HLI library	Access to the memory interface to the ISG-MCE.
ISG-MCE	This stands for the ISG NC Kernel which, in connection with this documentation, is also referred to as the "Motion Control Engine"
Channel	Unit which coordinates the axis motions of an axis group.
MC-FB	Designates the PLC function blocks that are used to issue commands to the ISG-MC.
Multiprog	PLC programming system from KW-Software
Motion library	PLC software application that contains function blocks to move axes in conformity with the PLCopen specification as well as further FBs to assume motion generation tasks

### ***Mandatory note on references to other documents***

For the sake of clarity, links to other documents and parameters are abbreviated, e.g. [PROG] for the Programming Manual or P-AXIS-00001 for an axis parameter.

For technical reasons, these links only function in the Online Help (HTML5, CHM) but not in pdf files since pdfs do not support cross-linking.

## 2 PLC library "McpControl"

The library contains function blocks which supplement the default PLCopen blocks.

### 2.1 Overview of the FBs

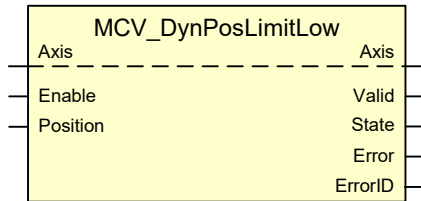
The table below provides an overview of the availability of PLCopen FBs depending on PLC and drive systems supported by ISG.

Function block	PLC systems		
	KW	3S	TwinCAT
MCV_AddCmdValues	SIMU KUKA	SIMU -	-
MCV_DynPosLimitLow [▶ 8]	-	X	
MCV_DynPosLimitHigh	-	X	
MCV_GrpFeedhold	SIMU KUKA	SIMU -	-
MCV_ReadActualTorque	SIMU KUKA	SIMU -	-
MCV_ReadCamTableElement [▶ 9]	X	X	-
MCV_Trace [▶ 10]	X	X	X
MCV_UpdateAllCamTables [▶ 16]	X	X	-
MCV_UpdateCamTable [▶ 17]	X	X	-
MCV_WriteCamTableElement [▶ 18]	X	X	-

## 2.2 MCV\_DynPosLimitLow

This is intended to prevent an axis position from undershooting a specific value; this FB specifies the limit which may not be undershot. When the axis moves towards the limit, the motion is controlled so that the axis stops within the limit value. The position limit can be crossed by the distance by which the control unit moves in a cycle.

### Blockdiagramm



### Parameters of the FB

VAR_IN_OUT		
Variable name	Data type	Description
axis	AXIS_REF	Axis reference

VAR_INPUT		
Variable name	Data type	Description
enable	BOOL	The position limit is written to the PLC interface (HLI) when the value is TRUE.
Position	DINT	Specifying the position limit

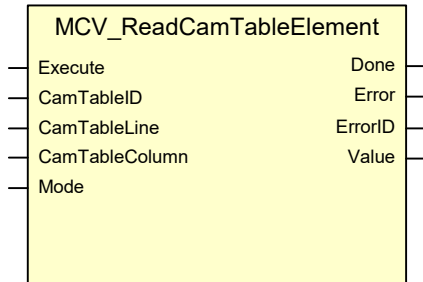
VAR_OUTPUT		
Variable name	Data type	Description
Valid	BOOL	Is TRUE when the setpoint specification is activated.
State	DINT	Current position limit
Error	BOOL	Indicates whether an error has occurred in an FB.
ErrorID	WORD	Error code.



## 2.3 MCV\_ReadCamTableElement

This FB can read CAM table elements online from the CAM table memory.

### Block diagram



### FB parameters

VAR_INPUT			
Variable name	Data type	Description	
Execute	BOOL	The new table value is read on the rising edge.	
CamTableID	MC_CAM_ID	CAM table ID	
CamTableLine	UDINT	CAM table line number for the table value to be read (starting at 0)	
CamTableColumn	UINT	CAM table column number for the table value to be read (starting at 0)	
Mode	UDINT	Select the CAM table element	
		<b>Value</b>	<b>Meaning</b>
		0	Table value (default)
		1	Table type "Tabletype"
		2	Interpolator type "Functiontype"
3	Line number "Lines"		

VAR_OUTPUT		
Variable name	Data type	Description
Done	BOOL	The CAM tables were read successfully.
Error	BOOL	Is TRUE if an error occurs in the FB.
ErrorID	WORD	Error identifier
Value	LREAL	Current table value referenced by specifying CamTableID, CamTableLine and CamTableColumn or current interpolation type "Functiontype" depending on the mode setting

## 2.4 MCV\_Trace

This FB can log axis positions and dynamic data cyclically or output diagnostic logs.

The logs for axes and trace data type can be parameterised.



### Notice

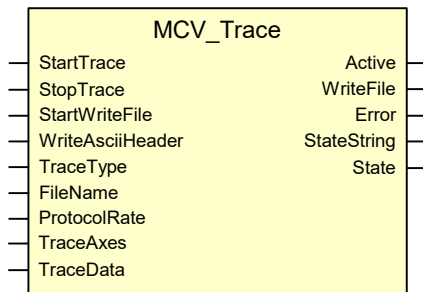
The FB can only be invoked sequentially, i.e. different trace logs cannot be generated in parallel. The FB can only be re-commanded if it was previously ended with StopTrace = TRUE or if writing of the TraceFile has ended.



### Notice

The "Error" output is currently not supported.

### Block diagram



### FB parameters

VAR_INPUT		
Variable name	Data type	Description
StartTrace	BOOL	The trace log starts on the rising edge of this input signal.
StopTrace	BOOL	The trace log stops on the rising edge of this input signal.
StartWriteFile	BOOL	The output to file starts on the rising edge of this input signal.
WriteAsciiHeader	BOOL	When TRUE, the header to describe the logged data is also written to the output file.
FileName	MCV_STRING128	Name of the trace file
TraceType	UDINT	Type of logged data (see Description of "TraceType" input: [▶ 12])
ProtocolRate	UDINT	Logging cycle in interpolator cycles.
TraceAxes	MCV_ARRAY_INT	Array with axis selection (see Description of "TraceAxes" input [▶ 12])
TraceData	UDINT	Selection of logged data (see Description of "TraceData" input [▶ 12])

VAR_OUTPUT			
Variable name	Data type	Description	
Active	BOOL	Is TRUE as long as data logging is active.	
WriteFile	BOOL	Is TRUE as long as data output is active.	
Error	BOOL	Indicates whether an error occurred in an FB (the output pin is currently not supported).	
StateString	STRING	Indicates the current state of the FB as a string. The following strings are possible: IDLE WRITE_TRACE_PARAMETER START_TRACE TRACING STOP_STOP TRACE_STOPPED START_WRITE_TO_FILE WRITING_TO_FILE TRACE_FILE_WRITTEN TRACE_ERROR	
State	INT	Indicates the current state of the FB. The possible values for State and their meanings are described below:	
		Value	Meaning
		1	TRACE_IDLE, TRACE_ERROR
		2	WRITE_TRACE_PARAMETER
		3	START_TRACE
		4	TRACING
		5	TRACE_STOP
		6	TRACE_STOPPED
		7	START_WRITE_TO_FILE
		8	WRITING_TO_FILE
9	TRACE_FILE_WRITTEN		

### 2.4.1 Description of "TraceType" input:

TraceType	Trace data logging in BF
1	Axis positions in BF BAHN
2	Axis positions in BF SPDL / SAI
3	Axis positions in BF LR
4	Log of master/slave coupling in BF SPDL / SAI
5	PLC Motion Control diagnostic prints in BF DIAG

### 2.4.2 Description of "TraceAxes" input

The input **TraceAxes** consists of an array containing 16 fields. The start index starts at 0. A maximum of 16 axes can be logged. They are entered by the logical axis number (1 to N); values not required contain the value 0. The number of axes therefore results from the number of entries > 0.



#### Example

**Assume that axes 1, 2, 5 and 9 are to be logged: The array may look like this:**

TraceAxes = [1,2,0,0,5,0,0,0,9,0,0,0,0,0,0,0]

TraceAxes = [1,2,5,9,0,0,0,0,0,0,0,0,0,0,0,0]

TraceAxes = [5,0,0,2,0,0,0,9,0,0,0,0,0,0,1,0]

### 2.4.3 Description of "TraceData" input

The pin **TraceData** can define which data is to be logged. The tables below indicate the possible data depending on the selected **TraceType**. The input is used bit-encoded, i.e. several selection fields must be logically linked by "OR".



#### Example

**Assume that a trace of type 2 (SpindleTrace) is to be created using the following data:**

cmd\_position

v\_command

a\_act

v\_limit(IPO1)

The TraceData value is therefore:

TraceData = 0x000001 | 0x000004 | 0x000010 | 0x001000

= 0x001015

= 4117 decimal

= 100000010101 binary

### 2.4.3.1 BahnTrace (TraceType 1)

Data	Value	
all data	0x000000	All data is logged.
Actual value	0x000001	Actual value of the position.
Setpoint	0x000002	Setpoint of the position.
Follerr.	0x000004	Position lag.
max. following error.	0x000008	Maximum position lag.
Actvel.	0x000010	Actual value of velocity.
Setvel.	0x000020	Setpoint of velocity.
reserved	0x000040	-
Path vel.	0x000080	Path velocity
reserved	0x000100	-

### 2.4.3.2 SpindleTrace (TraceType 2)

Data	Value	
all data	0x000000	All data is logged.
cmd_position	0x000001	Target position of the axis.
act_position	0x000002	Set position of the axis.
v_command	0x000004	Commanded velocity of the axis.
v_act	0x000008	Set velocity of the axis.
a_act	0x000010	Set acceleration of a spindle.
job_ackn	0x000020	Job acknowledgement
block_type(IPO1)	0x000040	Type of motion job (e.g. NC_MOVE_LIN, NC_MOVREF, NC_MOVE_ENDLOS).
block_type(IPO2)	0x000080	Type of superimposed motion job (only NC_MOVE_LIN).
target(IPO1)	0x000100	Programmed target position.
target(IPO2)	0x000200	Programmed target position of superimposed motion job.
abs_position(IPO1)	0x000400	Set position.
abs_position(IPO2)	0x000800	Set position of superimposed motion job.
v_limit(IPO1)	0x001000	Specified velocity for slope (minimum of v_max and v_prog).
v_limit(IPO2)	0x002000	Specified velocity for slope of superimposed motion job.
v(IPO1)	0x004000	Velocity currently generated by slope.
v(IPO2)	0x008000	Velocity of superimposed motion job currently generated by slope.
a_limit(IPO1)	0x010000	Specified acceleration for slope (minimum of v_max and v_prog).
a_limit(IPO2)	0x020000	Specified acceleration for slope of superimposed motion job.
d_limit(IPO1)	0x040000	Specified deceleration for slope (minimum of v_max and v_prog).
d_limit(IPO2)	0x080000	Specified deceleration for slope of superimposed motion job.
a(IPO1)	0x100000	Acceleration currently generated by slope.
a(IPO2)	0x200000	Acceleration of superimposed motion job currently generated by slope.
j(IPO1)	0x400000	Jerk currently generated by slope.
j(IPO2)	0x800000	Jerk of superimposed motion job currently generated by slope.

### 2.4.3.3 Position controller trace (TraceType 3):

Data	Value	
all data	0x000000	All data is logged.
m_sollw_absolut	0x000001	Absolute metric set position.
m_istw_absolut	0x000002	Absolute metric actual position.
active_feedrate	0x000004	Currently set velocity.
active_accel	0x000008	Currently set acceleration.
cmd_pos_outp (INTIME only)	0x000010	Absolute set position output to the drive interface.

### 2.4.3.4 Trace synchronisation data (TraceType 4):



#### Notice

A table comprising 146 columns is used internally to save trace data. When parameterising trace data, make sure that this number is not exceeded since the data exceeding the maximum column index is not logged.

A column is created for each axis for every individual datum (e.g. *Actvel.* for BahnTrace), i.e. when a column is used for each of 7 axes for *Actvel.*

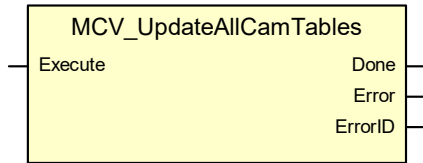
### 2.4.3.5 TraceType 5 - PLC Motion Control diagnostic prints

The FBs "MCV\_Trace" and TraceType = 5 can log PLC Motion Control diagnostic prints saved in the diagnostic circular buffer to the logfile "PLCaxes\_Diagnostic\_<date\_time>.log".

## 2.5 MCV\_UpdateAllCamTables

This FB can command the reload of all CAM tables listed in "tab\_idr.lis".

### Blockdiagramm



### Parameters of the FB

VAR_INPUT		
Variable name	Data type	Description
Execute	BOOL	All CAM tables are reloaded on the rising edge.

VAR_OUTPUT		
Variable name	Data type	Description
Done	BOOL	The CAM tables were successfully loaded.
Error	BOOL	Is TRUE when an error occurs in the FB.
ErrorID	WORD	Error code.



### Notice

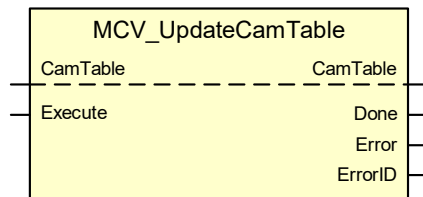
Reloading all CAM tables can only be executed if there is currently no access to any tables.



## 2.6 MCV\_UpdateCamTable

This FB can command the reload of individual CAM tables.

### Block diagram



### FB parameters

VAR_IN_OUT		
Variable name	Data type	Description
CamTable	MC_CAM_REF	This structure contains the filename of the CAM table.

VAR_INPUT		
Variable name	Data type	Description
Execute	BOOL	The specified CAM table is loaded on the rising edge.

VAR_OUTPUT		
Variable name	Data type	Description
Done	BOOL	The CAM table was successfully loaded.
Error	BOOL	Is TRUE if an error occurs in the FB.
ErrorID	WORD	Error identifier

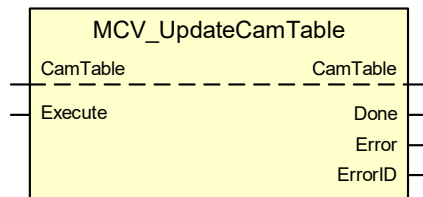
### Behaviour of the FB:

- Only CAM tables which are currently not accessed can be reloaded.
- The CAM table is referenced by its filename.
- If the CAM table ID entered in the CAM table header already exists in the CAM table memory, an attempt is made to save the new table to the previous memory. If the previous memory location is insufficient, the table is saved to the next free memory location.
- If the CAM table ID does not exist in the CAM table memory, the new table is saved to the next free memory location.

## 2.7 MCV\_WriteCamTableElement

FB to change the online elements of a CAM table in the CAM table memory.

### Block diagram



### FB parameters

VAR_INPUT			
Variable name	Data type	Description	
Execute	BOOL	The new table value is written on the rising edge.	
CamTableID	MC_CAM_ID	CAM table ID	
CamTableLine	UDINT	CAM table line number for the table value to be written (starting at 0)	
CamTableColumn	UINT	CAM table column number for the table value to be written (starting at 0)	
Mode	UDINT	Selecting the CAM table element	
		Value	Meaning
		0	Table value (default)
		1	Table type "Tabletype"
		2	Interpolator type "Functiontype"
3	Line number "Lines"		
Value	LREAL	New table value	

VAR_OUTPUT		
Variable name	Data type	Description
Done	BOOL	The CAM tables were successfully written.
Error	BOOL	Is TRUE if an error occurs in the FB.
ErrorID	WORD	Error identifier

### Behaviour of the FB:

- Only CAM tables which are currently not accessed can be changed.

### 3

## References

- [1] PLCopen specifications: TC2 Task Force Motion Control “Function Blocks for motion control” Version 1.0, dated 23 Nov. 2001
- [2] CNC PLC overall control system documentation
- [3] MCP FB error messages documentation [DIAG]
- [4] The PLCopen Compliance Statement V1.0 from ISG can be found on the PLCopen website ([www.plcopen.org](http://www.plcopen.org)).

## 4 Appendix

### 4.1 Suggestions, corrections and the latest documentation

Did you find any errors? Do you have any suggestions or constructive criticism? Then please contact us at [documentation@isg-stuttgart.de](mailto:documentation@isg-stuttgart.de). The latest documentation is posted in our Online Help (DE/EN):



QR code link: <https://www.isg-stuttgart.de/documentation-kernel/>

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