DOCUMENTATION ISG-kernel

PLC library
McpControl

Short Description:
MCP-CTRL

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Preface

Legal information

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.

No claims may be made for products which have already been delivered if such claims are based on the specifications, figures and descriptions contained in this documentation.

Personnel qualifications

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

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

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

Trade marks and patents

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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.

Table of contents

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

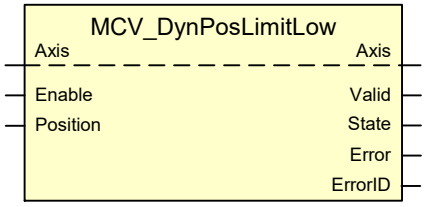
The table below provides an overview of the availability of PLCopen FBs depending on PLC and drive systems supported by ISG.

Function block	PLC systems		
	KW	3S	TwinCAT
MCV_AddCmdValues	SIMU KUKA	SIMU -	-
MCV_DynPosLimitLow [▶ 8]	-	X	
MCV_DynPosLimitHigh	-	X	
MCV_GrpFeedhold [▶ 19]	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

If an axis position should be prevented from undershooting a specific value, this function block specifies the limit that may not be undershot. If the axis moves towards the limit, the motion is controlled so that the axis stops within the limit range. The position limit may be crossed by the distance which is travelled in one controller cycle.

Block diagram



FB parameters

VAR_IN_OUT		
Variable name	**Data type**	**Description**
Axis	AXIS_REF	Axis reference

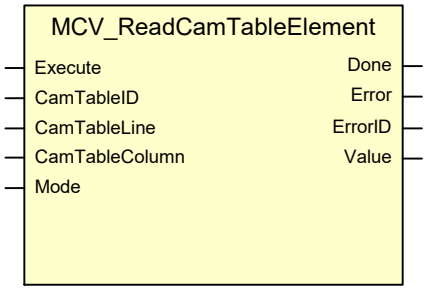
VAR_INPUT		
Variable name	**Data type**	**Description**
Enable	BOOL	If TRUE, the position limit is written to the PLC interface (HLI).
Position	DINT	Position limit specification

VAR_OUTPUT		
Variable name	**Data type**	**Description**
Valid	BOOL	Is TRUE when specified set value is activated.
State	DINT	Current position limit
Error	BOOL	Indicates whether an error has occurred in an FB.
ErrorID	WORD	Error identifier

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	
		Value	**Meaning**
		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.

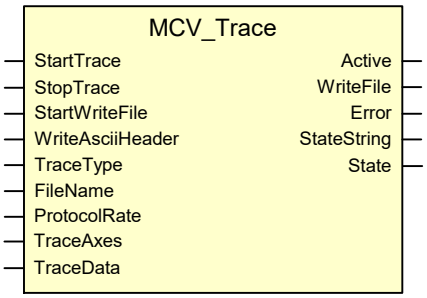
Notice

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]

<table>
<tr><th colspan="4">VAR_OUTPUT</th></tr>
<tr><th>Variable name</th><th>Data type</th><th colspan="2">Description</th></tr>
<tr><td>Active</td><td>BOOL</td><td colspan="2">Is TRUE as long as data logging is active.</td></tr>
<tr><td>WriteFile</td><td>BOOL</td><td colspan="2">Is TRUE as long as data output is active.</td></tr>
<tr><td>Error</td><td>BOOL</td><td colspan="2">Indicates whether an error occurred in an FB (the output pin is currently not supported).</td></tr>
<tr><td>StateString</td><td>STRING</td><td colspan="2">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</td></tr>
<tr><td rowspan="11">State</td><td rowspan="11">INT</td><td colspan="2">Indicates the current state of the FB. The possible values for State and their meanings are described below:</td></tr>
<tr><td>Value</td><td>Meaning</td></tr>
<tr><td>1</td><td>TRACE_IDLE, TRACE_ERROR</td></tr>
<tr><td>2</td><td>WRITE_TRACE_PARAMETER</td></tr>
<tr><td>3</td><td>START_TRACE</td></tr>
<tr><td>4</td><td>TRACING</td></tr>
<tr><td>5</td><td>TRACE_STOP</td></tr>
<tr><td>6</td><td>TRACE_STOPPED</td></tr>
<tr><td>7</td><td>START_WRITE_TO_FILE</td></tr>
<tr><td>8</td><td>WRITING_TO_FILE</td></tr>
<tr><td>9</td><td>TRACE_FILE_WRITTEN</td></tr>
</table>

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

= 1000000010101 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*.

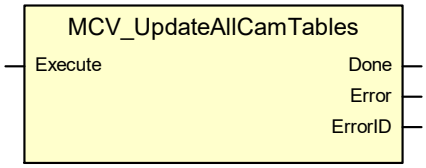
2.4.3.5 TraceType 5 - PLC Motion Control diagnostic prints

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_ldr.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.

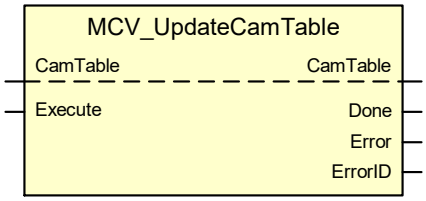
Notice

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

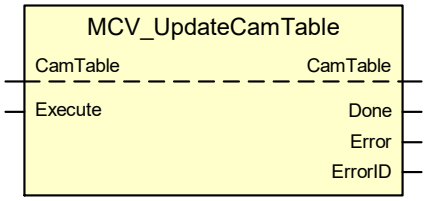
Behaviour of the FB:

- 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

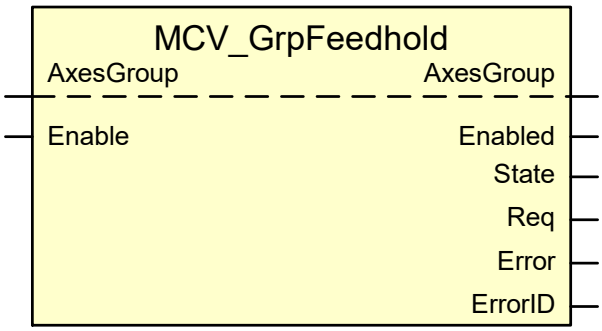
Behaviour of the FB:

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

2.8 MCV_GrpFeedhold

This FB triggers a feed hold for an axis group during the interpolation. Deceleration takes place down to the feed rate 0 at the acceleration values entered in the axis group-specific configuration list (see [CHAN]).

Block diagram



FB parameters

VAR_IN_OUT		
Variable name	**Data type**	**Description**
AxesGroup	AXES_GROUP_REF	Axis group reference

VAR_INPUT		
Variable name	**Data type**	**Description**
Enable	BOOL	Feed hold is activated for the axis group as long as the input is TRUE.

VAR_OUTPUT		
Variable name	**Data type**	**Description**
Enabled	BOOL	Is TRUE when feed hold is activated.
State	BOOL	Status from the MCP that feed hold is activated.
Req	BOOL	TRUE indicates that another control system unit intends to command a feed hold. If this is to be implemented, the Enable input must be assigned TRUE in the PLC application.
Error	BOOL	Indicates whether an error has occurred in an FB.
ErrorID	WORD	Error code

Notice

We recommend you to use the PLCopen Standard FBs MC_GrpInterrupt and MC_GrpContinue.

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).

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. The latest documentation is posted in our Online Help (DE/EN):

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

The link above forwards you to:

https://www.isg-stuttgart.de/fileadmin/kernel/kernel-html/index.html

Notice

Change options for favourite links in your browser;

Technical changes to the website layout concerning folder paths or a change in the HTML framework and therefore the link structure cannot be excluded.

We recommend you to save the above "QR code link" as your primary favourite link.

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