



DOCUMENTATION ISG-kernel

PLC library McpBase

Short Description:
MCP-BASE

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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

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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 "McpBase" – platform library

The library **McpBase.lib** contains definitions of data structures that represent objects as references in conformity with the PLCopen specification. Their use is intended to release motion tasks. The variables of the references are defined as global variables in this library.

The library **McpBase.zwt** contains definitions of data structures that represent objects as references in conformity with the PLCopen specification. Their use is intended to release motion tasks. These variables must be created as global variables in the PLC application.

3 Overview of PLCopen data structures

3.1 Data structure AXIS_REF

PLCopen requires the supply of a structure that goes by the name of `AXIS_REF`. It must be transferred to the individual FBs as `VAR_IN_OUT` parameter to identify an axis. As defined by PLCopen, the contents of the `AXIS_REF` structure are specific to each manufacturer. In the version realised by ISG, `AXIS_REF` contains a variable `hli_axis_idx` for the **axis index** with which an axis-specific area on the **HLI** can be addressed.

This axis index is assigned once in every PLC project by calling the FB `MCV_PlatformBase` [► 9].

This structure also contains working data that has to be kept for each axis at the PLC end. This includes the current state of the axis state diagram (Axis State Diagram – AXSD) in accordance with PLCopen, an array for the last six error messages that were reported by the MCE for an axis and a few other items of working data.



Attention

Before the application can access the axis-specific area of the HLI, the structure **AXIS_REF** must contain the axis state `axsd_state > 0`. This ensures that the motion libraries have initialised all the necessary safety processes (see example).



Example

```
IF Axis.axsd_state > 0 (*INIT_STATE*) THEN
  (* Access to axis-specific HLI area allowed*)
  hli_axis_idx := Axis.hli_axis_idx;
  hli.axis[hli_axis_idx]. ...
```

3.1.1 Field of data structures of the AXIS_REF type

The data structure `AXIS_REF` referred to above must exist for each axis and must be available in all programs pertaining to the PLC project tasks. To ensure this, all `AXIS_REF` structures are managed in an array with the name `g_array_axis_ref`.

If an application is developed for the CoDeSys environment, the array `g_array_axis_ref` is supplied as an element of the `McpBase.lib` library.

When an application is developed for the MultiProg environment, this array must be created as a global variable in a resource.

3.2 Data structure AXES_GROUP_REF

PLCopen Part4 specification defines a structure named `AXES_GROUP_REF`. Every FB that commands an axes group has a `VAR_IN_OUT` parameter of this type to be able to determine the commanded axes group. The contents of the `AXES_GROUP_REF` structure are specific to each manufacturer as stipulated in the PLCopen definition.

The ISG implementation, the `AXES_GROUP_REF` contains a variable `HliifIdx` which can be used for the **axis group index** which addresses an axis group-specific area on the **HLI**.

This axis group index is initialised once in a PLC project by the FB `MCV_PlatformBase`.

In addition, the structure contains an array for the last six error messages that were notified by the motion controller for an axis group. However, the structure is not defined in the “`McpPlcopenP4`” library but in the “`McpBase`” library.

3.2.1 Array for data structures of the AXES_GROUP_REF type

The data structure AXES_GROUP_REF must exist for each axis group and must be available in all programs pertaining to the tasks of the PLC project. To ensure this, all AXES_GROUP_REF structures are managed in an array named **gAxesGroupRef**.

For an application based on the CoDeSys environment, the library McpBase.lib provides the array **gAxesGroupRef** as global variable.

An application based on the MultiProg environment (KW-Software) must define the array as global variable in a resource.

3.3 Further definitions of PLCopen data structures

The data structures listed below are also included in the PLCopen specifications.

In the CoDeSys environment, no global definitions for these data structures are supplied to the PLC libraries.

In the MultiProg environment (KW-Software), global data need not be created in a resource for these data structures.

Variables of these types are only defined if a PLCopen FB is used that has an input or output pin of these type.

3.3.1 Data structure MC_CAM_ID

This data structure contains a number that is used to identify a cam table. For this reason, this data structure is used as an input for the FB which accesses the cam table and can read or write it (see [MCP-CTRL [▶ 4]]).

3.3.2 Data structure MC_CAM_REF

This data structure is used as reference to a cam table. It is used in conjunction with the FB MC_CamTableSelect. It contains the path to the cam table file and the identification number of the cam table.

3.3.3 Data structure IDENT_IN_GROUP_REF

To identify an axis within an axis group we use the data structure IDENT_IN_GROUP_REF. This reference is always required in the PLC open Part 4 FB when the relation between an axis and an axis group changes or the relation between the two should be checked (see [MCP-P4//Data structure IDENT_IN_GROUP_REF]).

3.3.4 Data structure MC_KIN_REF

Identifies a kinematic model based on a number. This reference is required in conjunction with PLCopen Part4 FBs (see [MCP-P4 [▶ 4]]) to handle kinematic transformations.

3.3.5 Data structure MC_PATH_DATA_REF

This data structure represents a reference to the data of the programmed path which is to be travelled by the axes of the axis group. With the ISG implementation, this is a string which either contains the absolute directory path or only the filename of a file with an NC program. The structure is used in connection with the preparation and execution of a path motion (see [MCP-P4//Data structure MC_PATH_DATA_REF]).

4 PLC library "McpBase" – ISG function blocks

4.1 MCV_PlatformBase

The FB **MCV_PlatformBase** must be instantiated in every PLC application which triggers motion tasks based on PLCopen specifications. This FB assumes the task of initialising axis and axis group references and checking the consistency of the HLI interface at the MCE and PLC ends. Only if this FB has its "Done" output set to TRUE can motion tasks be successfully sent to the MC via the FB with the axis or axis group references as input, as specified in the motion libraries Part 1 and Part 4.

Blockdiagramm



Parameters of the FB

VAR_OUTPUT		
Variable name	Data type	Description
Done	BOOL	Value TRUE indicates that... 1. the simulation of the interface between the MC and the PLC in the PLC HLI library matches the definition of HLI at the MC end. 2. the corresponding area exists on the HLI exists for every defined axis and axis group according to the MC configuration.
Error	BOOL	Indicates whether an error has occurred in the FB.
ErrorID	WORD	Error code.

Behaviour of the FB

- The FB must be invoked at least cyclically until one of the "Done" or "Error" outputs indicates TRUE.

5

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

[4] The PLCopen Compliance Statement V1.0 from ISG can be found on the PLCopen website
(www.plcopen.org).

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