

Festo Synchronized Drive Control

The FestoSynchronizedDriveControl_library offers function blocks and methods to synchronize motion of 2 ore more axis.

FestoSynDrCon

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1 Components/Software used

Typ/Name	Version Software/Firmware	-
CODESYS V3	Version 3.5 SP10 Version 3.5 SP12	
CPX-E-CEC-M1-PN CPX-E-CEC-M1-EP	Version 3.5.12.0 Version 3.5.10.0	
FestoSynchronizedDriveControl_V66.library		
SoftMotion	Version 4.5.0.0	

Table 1.1: Components/Software used

2 Scope of application

In many applications it is necessary to synchronise two or more axes.

This library with the function blocks and the supplied sample project can be used for applications and extended customer-specifically, as well as integrated into your own application. It is a template in the form of a sample project. Festo control and components are required as a basis for this functionality (see chapter 1).

With the library described here axes can be coupled together. A master axis is then actively controlled, and the position of one or more coupled slave axes is synchronously following.

FB_AXIS_CONTROL serves for simple and central control of the basic motion control functions of axes (positioning, referencing,...).

The simplest type of coupling is linear coupling with a fixed ratio of transmission (FB_GEARING).

FB_CAMMING offers the possibility of coupling a slave axis to a master axis by means of a table (electronic cam plate)



Caution

Each function block contains its own visualization with control authority.

The control authority can be switched between visualization and PLC to avoid conflicting control signals. It is the responsibility of the user to implement this function in the code.

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3 Configuration

3.1 Integrate library

1. Select tools.

CODESYS the IEC 61131-3 programming system provided by Festo

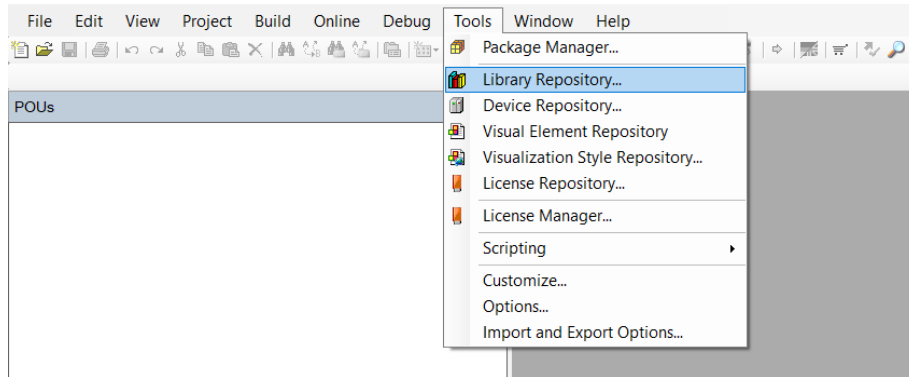


Fig. 1 Tools

2. To integrate the library , select menu library Repository.
 The dialogue box " Library repository " is opened.

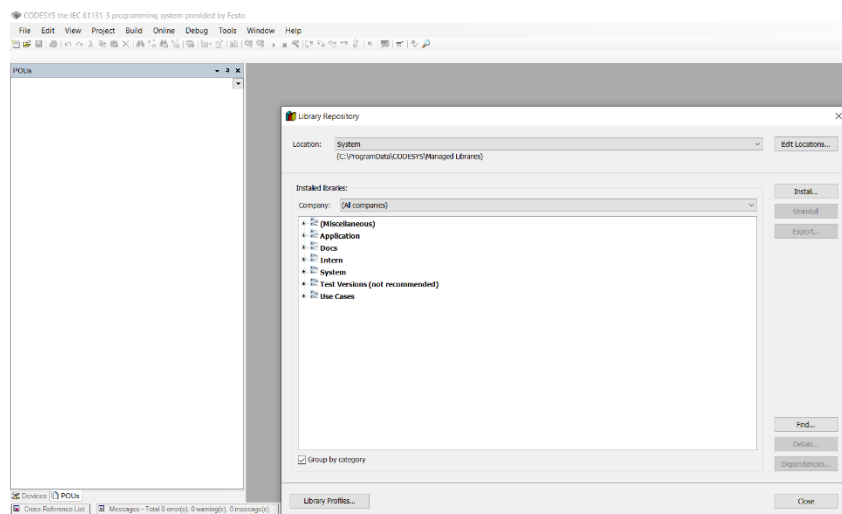


Fig. 2 open Library repository

3. Select install.
4. Select storage location for the library..
5. Select library

4 Library Function blocks

4.1 Function block **FB_AXIS_CONTROL_SM**

4.1.1 Definition

This function block contains essential functions for an axis and is the basis for all other function blocks. It offers a wide range of methods and properties to perform axis manipulations, such as enabling, homing or movements.

The following functionality is offered with the function block:

- Enable / Disable of drive
- Reset of the drive
- Acknowledge of an error
- Jogging (continuous / incremental)
- Velocity controlled movement
- Stop of drive
- Homing
- Relative and absolute positioning
- Superimposed positioning

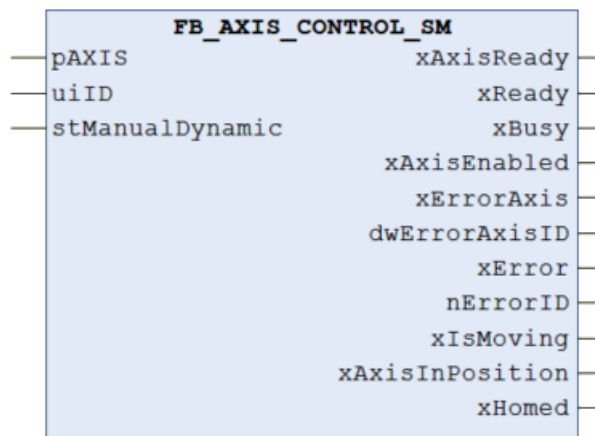


Fig. 3 FB_AXIS_CONTROL_SM

4.1.2 Inputs/Outputs

Range	Name	Datatype	Description
Input	pAXIS	POINTER TO AXIS_REF_SM3	Pointer to AXIS_REF for the axis to control
Input	uiID	UINT	ID of the axis. The ID is used in error management to identify the axis in error code
Input	stManualDynamic	DYNAMIC	Dynamic used for manual operations as jogging
Output	xAxisReady	BOOL	Axis is ready
	xReady	BOOL	Function Block Ready to command
	xBusy		Function Block busy
	xAxisEnabled		Axis enabled
	xErrorAxis	BOOL	Error signal axis
	dwErrorAxisID	BOOL	Error ID axis
	xError	BOOL	Error signal
	nErrorID	UDINT	Error ID
	xisMoving	BOOL	Axis is moving
	xAxisInPosition	BOOL	Axis in position
	xHomed	BOOL	Axis is referenced

Table 3.1: Inputs/Outputs

4.1.3 Methods

Method Acknowledge

Method to acknowledge an error.

METHOD Acknowledge

```
VAR_INPUT
    xAckError      : BOOL;
END_VAR
```

Method Enable

Method to enable/disable axis.

METHOD Enable

```
VAR_INPUT
    xEnableAxis    : BOOL;
END_VAR
```

Method Estop

This method implements a controlled motion stop and transfers the axis to a standstill state. As a result, any processing function block is stopped

METHOD EStop : BOOL

```
VAR_INPUT
    xEStop          : BOOL;      Axis performs stop and comes to standstill
    lrDeceleration  : LREAL;     Deceleration
END_VAR
```

Method Reset

Method to reset axis. The method implements the transition from “ErrorStop” state to the “Standstill” state by resetting all axis and FB internal errors.

METHOD Reset : BOOL

```
VAR_INPUT
    xAxisReset      : BOOL;      Rising edge performs the reset
END_VAR
```

VAR_OUTPUT

```
xDone              : BOOL;      Resetting is done
END_VAR
```

Method ExecHome

Method to home axis. Homing method is configured in the drive configuration. Homing ends at standstill.

METHOD ExecHome

VAR_INPUT

xExecHome	: BOOL;	Starts the motion at a rising edge
lrPosition	: LREAL;	Absolute position when the reference signal is detected

END_VAR

VAR_OUTPUT

xHomed	: BOOL;	Homing completed, velocity is 0
xHomingError	: BOOL;	Indicates that an error occurred

END_VAR

Method ExecMoveVelocity

Method to execute a Move Velocity command with an axis. It controls an "endless" motion at the respectively defined velocity. To end the motion, the function block instance has to be interrupted by another method instance which issues a new command.

METHOD ExecMoveVelocity

VAR_INPUT

xEnableMove	: BOOL;	Starts the motion at rising edge
stMoveVelocityData	: MoveVelocityData;	Structure for MoveVelocity Data

END_VAR

VAR_OUTPUT

xInVelocity	: BOOL;	Target velocity reached
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END_VAR

Method ExecPosition

Method to execute a positioning with the axis. The positioning can be absolute or relative to actual position. The target position is approached with the set dynamic values at the rising edge of xExecute.

METHOD ExecPosition

VAR_INPUT

xExecute	: BOOL;	Starts the positioning at rising edge
STPosData	: PosData;	Structure for Positioning Data
stDyn	: Dynamic;	Dynamic values for positioning

END_VAR

VAR_OUTPUT

xInPosition	: BOOL;	Desired position reached
xStopped	: BOOL;	

END_VAR

Method Jogging

Method to jog in both directions. The movements starts with a rising edge on xJoggPos or xJoggNeg with a slow dynamic. Then after a delay time the movement continues with a faster dynamic. All parameters are settable in the structure ManualData.

METHOD Jogging

VAR_INPUT

xJoggPos	: BOOL;	Axis is moved in positive direction
xJoggNeg	: BOOL;	Axis is moved in negative direction
stManualData	: ManualData;	Structure to define the dynamics of the jog movement

END_VAR

VAR_OUTPUT

xStopped	: BOOL;	Movement is stopped
xBusy	: BOOL;	

END_VAR

Method ReadAxisState

Method to read the axis state continuously.

METHOD ReadAxisState

VAR_OUTPUT

xReady :	: BOOL	Communication established and no pending errors
xError	: BOOL	Function block reports error
nErrorID	: UDINT	Error ID of FB
xErrorAxis	: BOOL	Axis is in errorstate or axis has an error
dwErrorAxisID	: DWORD	Error ID communicated from drive

END_VAR

Method Stepping

Method to step an axis. It causes a gradual motion, which is carried out step by step.

METHOD Stepping

VAR_INPUT

xStepPos	: BOOL	Axis is moving in positive direction and stops at set distance. Axis stops if input is set to false during movement.
xStepNeg	: BOOL	Axis is moving in negative direction and stops at set distance Axis also stops if input is set to false during movement.
rDistance	: : LREAL	Distance to travel
stStepDynamic:	: DYNAMIC	Dynamic settings for the stepping

END_VAR

VAR_OUTPUT

xBusy	: BOOL;	Motion is performed and axis is moving
-------	---------	--

END_VAR

Method xExecPosSuperimposed

Method to perform a superimposed movement. If the axis is already in motion (e.g. MoveVelocity) then this methods causes a relative overlaid motion over a specified distance. The dynamic values of the overlaid movement are additive to the original performed motion. After the superimposed movement is completed, the axis continues with the original movement.

METHOD xExecPosSuperimposed

VAR_INPUT

xExecute : BOOL; Rising edge starts the super imposed movement

STSuperImpData : SuperImpData; Structure for user data

END_VAR

VAR_OUTPUT

xSuperimposedBusy : BOOL; Superimposed motion is in progress

xSuperimposedDone : BOOL; Superimposed motion is complete

xSuperimposedAborted : BOOL; Superimposed motion got aborted

END_VAR

4.1.4 Visualization

The Visualization for „FB_AXIS_CONTROL_SM“ can be added with frame configuration.

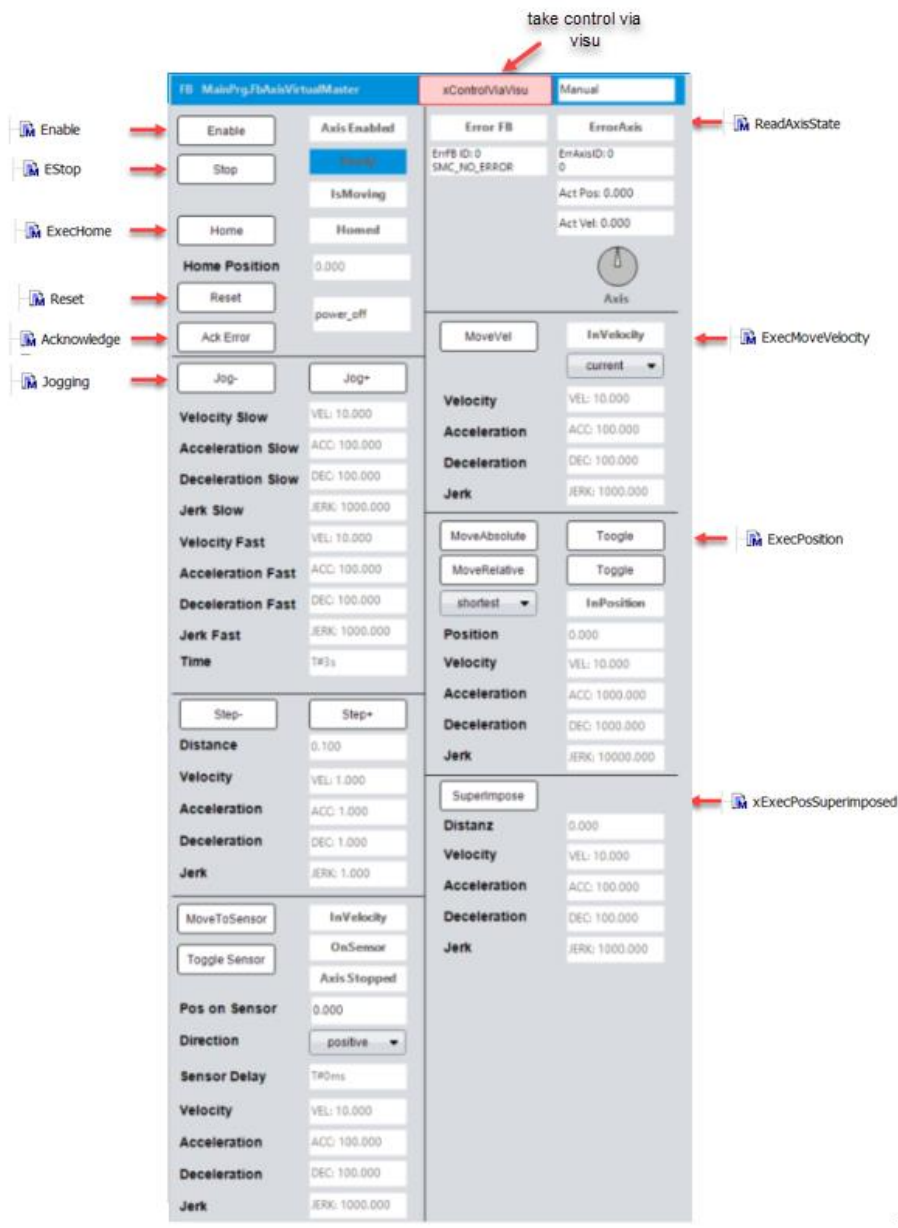


Fig. 4 Visualization FB_AXIS_CONTROL_SM

4.2 Function block FB_CAMMING

4.2.1 Definition

The function block couples or decouples a drive to a Master drive to run a camming table.

The following functionality is included:

- Activation of Master-Slave coupling with camming table (ExecCamIn)
- Deactivation Master-Slave coupling (ExecCamOut)

In addition, all functionalities from FB_AXIS_CONTROL_SM are included.

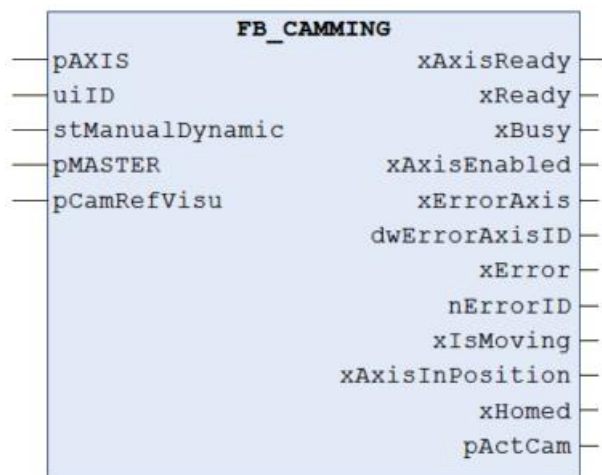


Fig. 5 FB_CAMMING

4.2.2 Inputs/Outputs

Range	Name	Datatype	Description
Input	pAXIS	POINTER TO AXIS_REF_SM3	See FB_AXIS_CONTROL_SM
Input	uiID	UINT	See FB_AXIS_CONTROL_SM
Input	stManualDynamic	DYNAMIC	See FB_AXIS_CONTROL_SM
Input	pMASTER	Pointer to AXIS_REF_SM3	Axis reference for the masteraxis
Input	pCamRefVisu	Pointer to MC_CAM_REF	Pointer to cam reference
Output	xAxisReady	BOOL	See FB_AXIS_CONTROL_SM
	xReady	BOOL	See FB_AXIS_CONTROL_SM
	xBusy	BOOL	See FB_AXIS_CONTROL_SM
	xAxisEnabled	BOOL	See FB_AXIS_CONTROL_SM
	xErrorAxis	BOOL	See FB_AXIS_CONTROL_SM
	dwErrorAxisID	DWORD	See FB_AXIS_CONTROL_SM
	xError	BOOL	See FB_AXIS_CONTROL_SM
	nErrorID	UDINT	See FB_AXIS_CONTROL_SM
	xisMoving	BOOL	See FB_AXIS_CONTROL_SM
	xAxisInPosition	BOOL	See FB_AXIS_CONTROL_SM
	xHomed	BOOL	See FB_AXIS_CONTROL_SM
	pActCam	Pointer to MC_CAM_REF	Pointer to actual cam

Table 4.1: Inputs/Outputs

4.2.3 Methodes

Method ExecCamIn

Method activates master-slave coupling with a certain table

METHOD ExecCamIn

VAR_INPUT

xExecute	: BOOL;	command is executed with rising edge
xCamReset	: LREAL;	reset CamIn error
stCammingData	: CammingData	Dynamic Structure
CamTableID	: MC_CAM_ID	Table ID.

END_VAR

VAR_OUTPUT

xInSync	: BOOL	the coupling was successful
EndOfProfile	: BOOL	Indicates the end of a cam. With periodic cams this output will be pulsed.
xCamError	: BOOL	CamIn Error
xCommandAborted	: BOOL	Coupling aborted
xBusy	: BOOL;	Motion is performed

END_VAR

Method ExecCamOut

Method deactivates a master-slave coupling.

METHOD ExecCamOut

VAR_INPUT

xExecute	: BOOL;	command is executed with rising edge
----------	---------	--------------------------------------

END_VAR

VAR_OUTPUT

xDone	: BOOL	decoupling was successful
xError	: BOOL	Error

END_VAR

4.2.4 Visualization

The Visualization for „FB_CAMMING “ can be added with frame configuration.
The CamTable must be executed, before CamIn can be started.

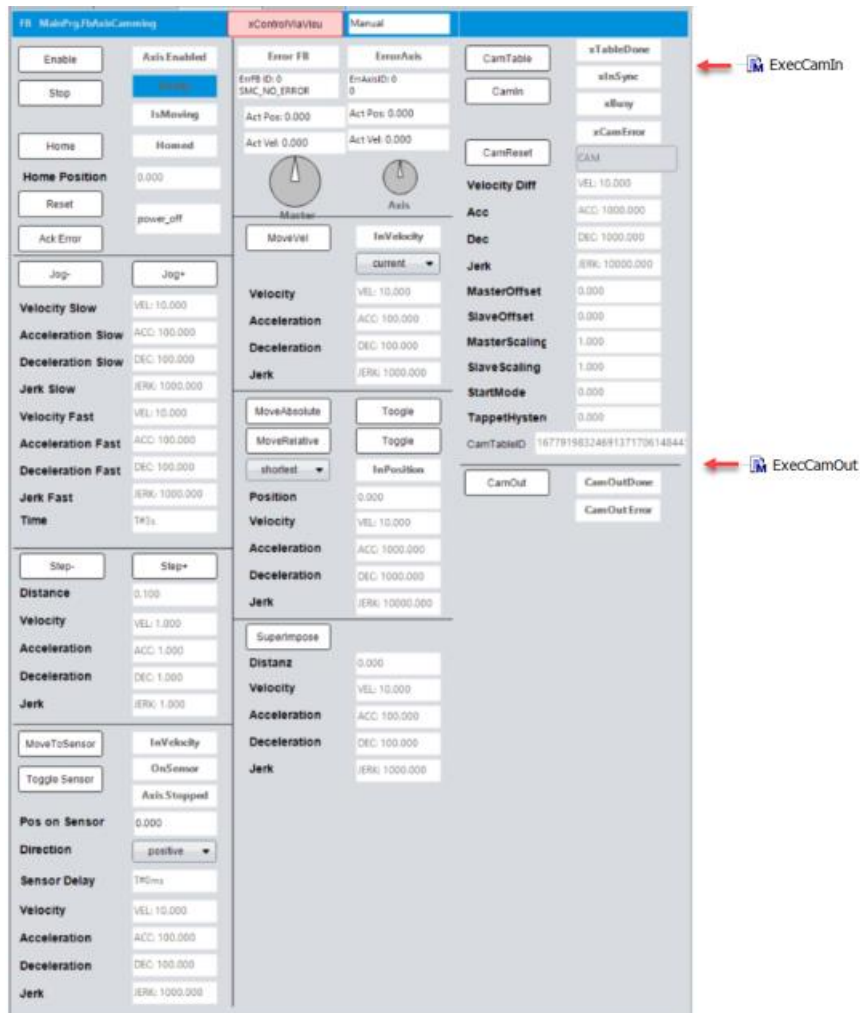


Fig. 6 Visualization FB_CAMMING

4.3 Function block FB_AutoList_InternalCam

4.3.1 Definition

The function block scans all available CAM's from the CAM editor and lists them automatically. The CAM listing can be used for the function blocks FB_CAMMING.

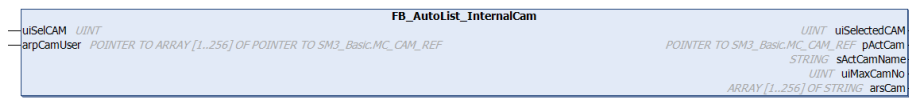


Fig. 7 FB_AutoList_InternalCam



The instance of FB_AutoList_InternalCam must be called before camming block

1.1.1 Inputs/Outputs

Range	Name	Datatype	Description
Input	uiSelCAM	UINT	Selection of the CAM
Input	arpCamUser	Pointer to array [1..256] of pointer MC_CAM_REF	Array, which holds the available CAM's
Output	uiSelectCAM	UINT	CAM Selected
	pActCam	Pointer to MC_CAM_REF	Pointer to the selected CAM
	sActCamName	STRING	Name of the CAM
	uiMaxCamNo	UINT	Total number of available CAM's
	arsCam	Array [1..256] of STRING	Array with all available CAM names

Table 4.2: Inputs/Outputs

4.3.2 Visualization

The Visualization for „FB_AutoList_InternalCam“ can be added with frame configuration.

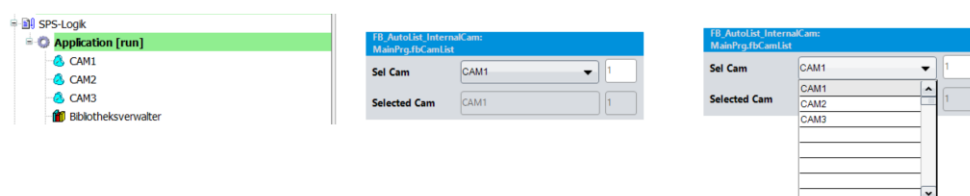


Fig. 8 Visualization FB_AutoList_InternalCam“

4.4 Function block FB_GEARING

4.4.1 Definition

The function block activates gear coupling with a gear ratio.

The following functionality is included:

- Activation of linear Master-Slave coupling (ExecGearIn)
- Deactivation of Master-Slave coupling (ExecGearOut)

In addition, all functionalities from FB_AXIS_CONTROL_SM are included.

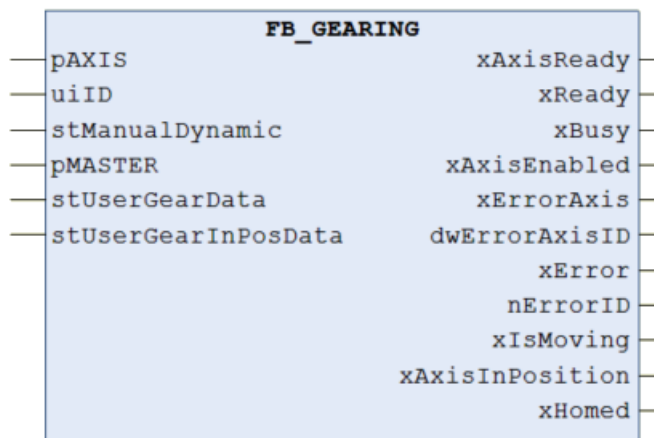


Fig. 9 FB_GEARING

4.4.2 Inputs/Outputs

Range	Name	Datatype	Description
Input	pAXIS	POINTER TO AXIS_REF_SM3	See FB_AXIS_CONTROL_SM
Input	uiID	UINT	See FB_AXIS_CONTROL_SM
Input	stManualDynamic	DYNAMIC	See FB_AXIS_CONTROL_SM
Input	pMASTER	Pointer to AXIS_REF_SM3	Axis reference for the masteraxis
Input	stUserGearData	Struct GearData	Structure GearIn
Input	stUserGearInPosData	Struct GearInPosData	Structure GearInPos
Output	xAxisReady	BOOL	See FB_AXIS_CONTROL_SM
	xReady	BOOL	See FB_AXIS_CONTROL_SM
	xBusy	BOOL	See FB_AXIS_CONTROL_SM
	xAxisEnabled	BOOL	See FB_AXIS_CONTROL_SM
	xErrorAxis	BOOL	See FB_AXIS_CONTROL_SM
	dwErrorAxisID	DWORD	See FB_AXIS_CONTROL_SM
	xError	BOOL	See FB_AXIS_CONTROL_SM
	nErrorID	UDINT	See FB_AXIS_CONTROL_SM
	xisMoving	BOOL	See FB_AXIS_CONTROL_SM
	xAxisInPosition	BOOL	See FB_AXIS_CONTROL_SM
	xHomed	BOOL	See FB_AXIS_CONTROL_SM

Table 4.3: Inputs/Outputs

4.4.3 Methods

Method ExecGearIn

Method activates gear coupling with a gear ratio

METHOD ExecGearIn

VAR_INPUT

xExecute : BOOL; command is executed with rising edge

END_VAR

VAR_OUTPUT

xInGear : BOOL the coupling was successful

xGearError : BOOL GearIn Error

xCommandAborted : BOOL the coupling aborted

xBusy : BOOL; Motion is performed

END_VAR

Method ExecGearInPos

Method synchronizes a slave axis precisely with a master axis

METHOD ExecGearInPos

VAR_INPUT

xExecute : BOOL; command is executed with rising edge

stGearInPosData : GearInPosData; Structure for GearInpos

END_VAR

VAR_OUTPUT

xStartSync : BOOL Start synchronization

xInSync : BOOL Coupling was successfully completed

xCommandAborted : BOOL Coupling aborted

xBusy : BOOL; Motion is performed

END_VAR

Method ExecGearOut

Method releases coupling of the slave axis to the master axis

METHOD ExecGearOut

VAR_INPUT

xExecute : BOOL; command is executed with rising edge

END_VAR

VAR_OUTPUT

xDone : BOOL Decoupling was successful

xGearOutError : BOOL Error

END_VAR

4.4.4 Visualization

The Visualization for „FB_GEARING“ can be added with frame configuration.

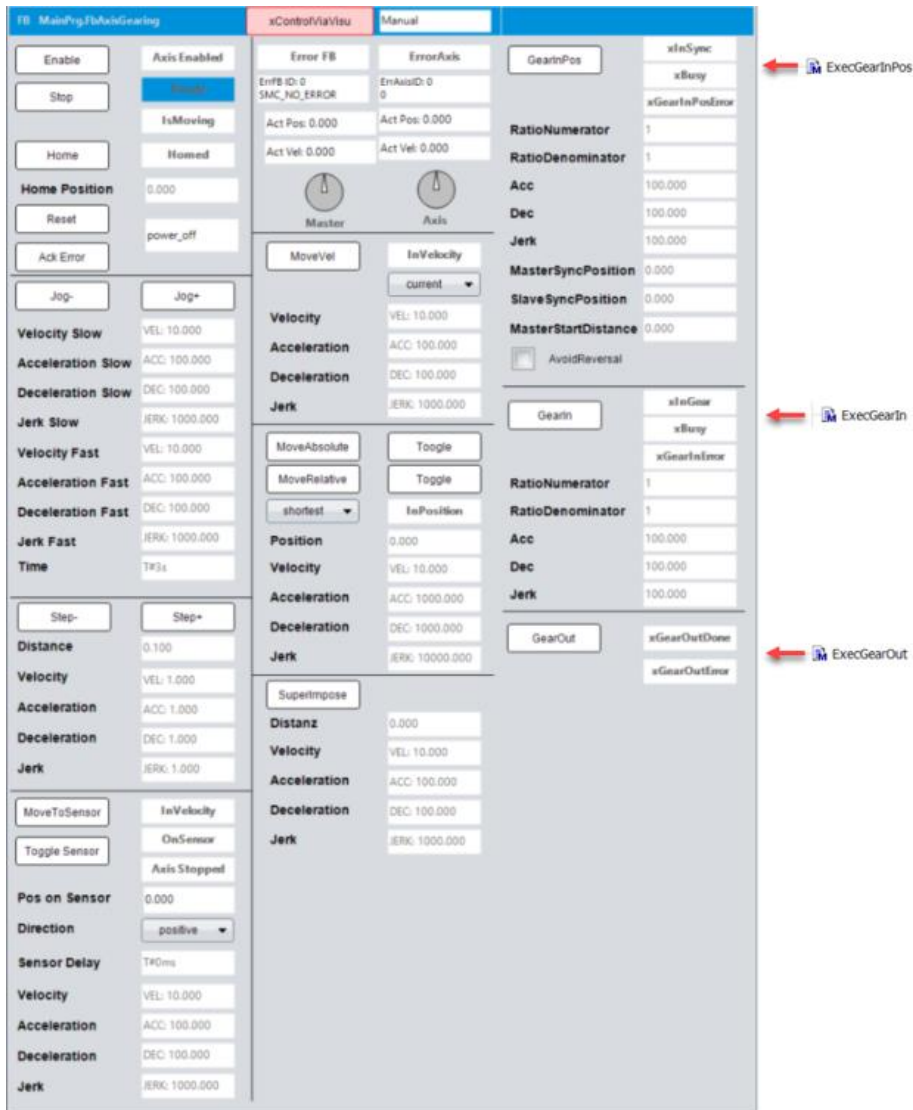


Fig. 10 Visualization FB_GEARING

4.5 Function block FB_ERROR_HANDLING

4.5.1 Definition

This function block takes care of the error handling.

The errors of all function blocks can be collected and dynamically given out and stored.

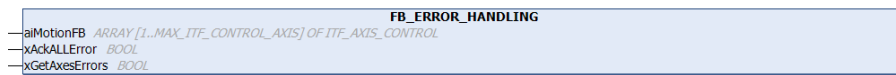


Fig. 11 FB_ERROR_HANDLING

4.5.2 Inputs/Outputs

Range	Name	Datatype	Description
Input	aiMotionFB	Array [1..MAX_ITF_AXIS_CO NTROL] of ITF_AXIS_CONTROL	Interface for flexible access to Axis FBs
Input	xAckAllError	BOOL	Acknowledge all errors
Input	xGetAxesErrors	BOOL	Get Axes errors

Table 4.4: Inputs/Outputs

4.5.3 Visualization

The Visualization for „FB_GEARING“ can be added with frame configuration.

Ack	MSG ID	Hex View	MSG Table	(Text/Hex) Add01	(Hex) Add02	Dev	Sub System	Reaction	Cat	Timestamp
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00
0			0	0	0	0	0	0	0	DT#1970-01-01-00:00:00

AckAllError Get Drive Error Delete Drive Error

Fig. 12 Visualization FB_ERROR_HANDLING