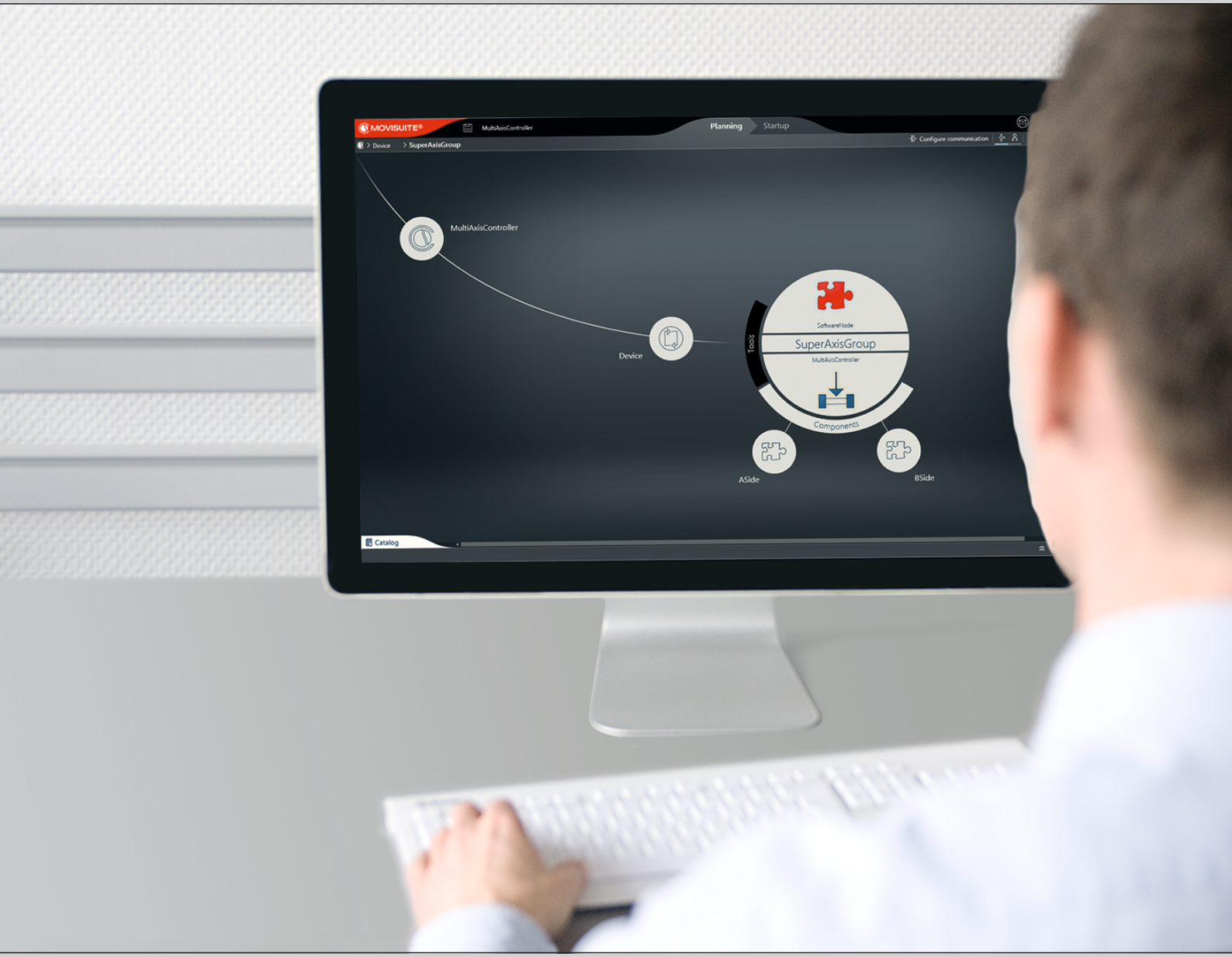
SEW EURODRIVE

Manual



MOVIKIT®

MultiAxisController

Edition 03/2020

29179866/EN

Table of contents

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1 General information

1.1 About this documentation

This documentation is an integral part of the product. The documentation is intended for all employees who perform work on the product.

Make sure this documentation is accessible and legible. Ensure that persons responsible for the systems and their operation as well as persons who work with the product independently have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation, or if you require further information, contact SEW-EURODRIVE.

1.2 Content of the documentation

The descriptions in this documentation apply to the software and firmware versions applicable at the time of publication. These descriptions might differ if you install later software or firmware versions. In this case, contact SEW-EURODRIVE.

1.3 Structure of the safety notes

1.3.1 Meaning of signal words

The following table shows the grading and meaning of the signal words for safety notes.

Signal word	Meaning	Consequences if disregarded
⚠ **DANGER**	Imminent hazard	Severe or fatal injuries
⚠ **WARNING**	Possible dangerous situation	Severe or fatal injuries
⚠ **CAUTION**	Possible dangerous situation	Minor injuries
NOTICE	Possible damage to property	Damage to the product or its environment
INFORMATION	Useful information or tip: Simplifies handling of the product.	

1.3.2 Structure of section-related safety notes

Section-related safety notes do not apply to a specific action but to several actions pertaining to one subject. The hazard symbols used either indicate a general hazard or a specific hazard.

This is the formal structure of a safety note for a specific section:

SIGNAL WORD

Type and source of hazard.

Possible consequence(s) if disregarded.

- Measure(s) to prevent the hazard.

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Meaning of the hazard symbols

The hazard symbols in the safety notes have the following meaning:

Hazard symbol	Meaning
	General hazard

1.3.3 Structure of embedded safety notes

Embedded safety notes are directly integrated into the instructions just before the description of the dangerous action.

This is the formal structure of an embedded safety note:

⚠ **SIGNAL WORD!** Type and source of hazard. Possible consequence(s) if disregarded. Measure(s) to prevent the hazard.

1.4 Decimal separator in numerical values

In this document, a period is used to indicate the decimal separator.

Example: 30.5 kg

1.5 Rights to claim under limited warranty

Read the information in this documentation. This is essential for fault-free operation and fulfillment of any rights to claim under limited warranty. Read the documentation before you start working with the product.

1.6 Product names and trademarks

The brands and product names in this documentation are trademarks or registered trademarks of their respective titleholders.

1.7 Copyright notice

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1.8 Other applicable documentation

Observe the corresponding documentation for all further components.

Always use the latest edition of the documentation and the software.

The SEW-EURODRIVE website (www.sew-eurodrive.com) provides a wide selection of documents for download in various languages. If required, you can also order printed and bound copies of the documentation from SEW-EURODRIVE.

1.9 Short designation

The following short designations are used in this documentation:

Type designation	Short designation
MOVIKIT® MultiAxisController	Software module

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2 Safety notes

2.1 Preliminary information

The following general safety notes serve the purpose of preventing injury to persons and damage to property. They primarily apply to the use of products described in this documentation. If you use additional components, also observe the relevant warning and safety notes.

2.2 Target group

Software specialist

Any work with the software may only be performed by a specialist with suitable training. A specialist in this context is someone who has the following qualifications:

- Appropriate training
- Knowledge of this documentation and other applicable documentation
- SEW-EURODRIVE recommends additional training for products that are operated using this software.

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2.3 Network security and access protection

A bus system makes it possible to adapt electronic drive technology components to the particulars of the machinery within wide limits. There is a risk that a change of parameters that cannot be detected externally may result in unexpected but not uncontrolled system behavior and may have a negative impact on operational safety, system availability, or data security.

Ensure that unauthorized access is prevented, especially with respect to Ethernet-based networked systems and engineering interfaces.

Use IT-specific safety standards to increase access protection to the ports. For a port overview, refer to the respective technical data of the device in use.

2.4 Designated use

MOVIKIT® MultiAxisController is a software license to enable communication according to OPC UA.

Use the device-independent MOVISUITE® engineering software to start up and configure the axes and to download the complete configuration to a MOVI-C® CONTROLLER.

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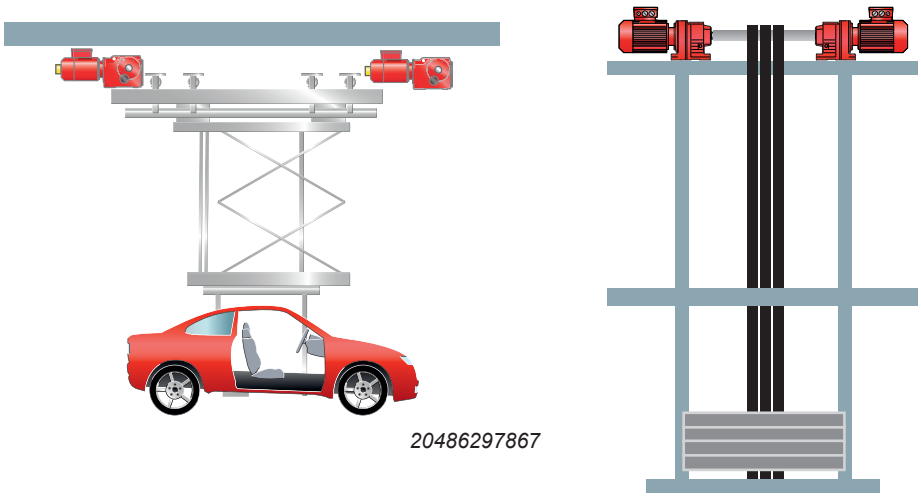
3 System description

3.1 Module description

The MOVIKIT® MultiAxisController is a software module for MOVI-C® CONTROLLER for implementing mechanically coupled drives (loose or rigid coupling). The coupling can be permanent via the mechanical construction (connection via shafts, lift trucks, portals, wheel/rail) or temporary via the product (extruder, sheet unwinding from coil). The coupling may also comprise multiple drives.

The core function of the software module is that several drives are driving a single load together. The drives are matched to each other in such a way that no vibrations occur that could lead to a system failure. Typical master/slave connections are not suitable for this application case or are manageable only with expert knowledge. The software module breaks up this master/slave arrangement and handles each drive at the same level. This eliminates the dead times associated with the master-slave arrangement and provides greater dynamics.



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As the software module operates as a function within an axis group, the following functions are easily implemented:

- Processing multi-axis limit switches
- Multi-axis reference travel
- Multi-axis jog mode
- Multi-axis error handling
- Multi-axis alignment after an error

These functions are a component of the software module and do not have to be reprogrammed with every application. This saves time during startup.

Furthermore, the software module offers the following functions:

- Load distribution

  Load sharing is intended for applications where the load is to be distributed unevenly among the participants. This can be dynamic wheel pressure caused by mass acceleration or static wheel pressure due to differing load. The distribution can be dynamically modified. The advantage can be greater acceleration, for example, which in turn reduces the cycle time.

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- Anti-slip control

  This increases system availability in the wheel/rail drive mode. A slip of the drive wheel may cause the system to shut down; in a worst case scenario, it will cause damage to a wheel or the rail. This may be caused by dirt or an oily spot on the rail. Anti-slip control detects the slip, limits it at a threshold that can be parameterized, and sets the respective bit to indicate the slip to the user. Once the wheel has regained traction, the drive continues to run, without damaging the mechanical systems.

- Electronic differential

  The electronic differential is used when a mobile system is to travel around the curve. In this case, one drive increases its speed while another drive reduces its speed. The software module maintains the system at an average speed.

The software module offers the following operating modes for mapping the various applications:

- "Skew priority" operating mode

  This operating mode is for applications in which skews or misalignments of the structure lead to problems. This may cause faulty positioning or overload with subsequent shutdown.

  Application examples include indoor cranes, parallel feeds, SRS hoists, and dual-column hoists.

- "Torque priority" operating mode

  This operating mode is for applications in which torque control is of prime importance. An important control task here is to allow slip up to a parameterizable value while limiting maximum slip (anti-slip control).

  It is also possible that not all drives travel the same distance in a position-dependent manner. This is the case, for example, during travel along a curve. For this reason, the software module was expanded to include an electronic differential with disabling function.

  There is also integrated load distribution for dynamically distributing torque to the individual drives that can be configured via process data. Using this function, drives can also be deliberately tensioned against one another in order to eliminate clearance, for example.

  It is also possible to compensate for diameter errors.

  Application examples include traction-optimized vehicles, SRS travel drives, SRS units with cornering ability (in preparation), fail-safe and redundant drive systems, slippery or poor-quality tracks, and indexing tables.

The software module can be used in combination with other MOVIKIT® software modules, for example for a double trolley in a storage/retrieval system.

The software module can also be used nested in both operating modes. An example of this is a gantry crane that has multiple drives on the right and on the left. In this case, the "Skew priority" operating mode would control the gantry, and subordinate groups – one each to the right and to the left – would use the "Torque priority" operating mode.

It is also possible to extend the range of functions of the software modules by add-ons. For further information, refer to chapter "Add-ons" (→ 🗎 14).

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3.1.1 Advantages

The software module offers the following advantages:

- Implementation of the individual functions of "Multi-motor drive", "Group drive", and "Synchronous applications" using a single technological function.
- Uniform distribution of the drive task to the drives by means of a coupling without a master/slave relationship.
- Implementation of applications using a fluctuating master/slave relationship.
- Greater dynamics due to the elimination of the master/slave relationship.
- No dead time due to a delayed start of the slaves.

3.2 Functions

Overview of functions:

- Coupling of drives without a master/slave relationship
- Dynamic load distribution
- Anti-slip control
- Electronic differential with disabling function
- Multi-axis alignment after an error
- Compensation for diameter errors
- Tensioning of drives against one another, to eliminate clearance
- Referencing of the axis group members via the axis group

  See chapters "Referencing (Homing)" (→ 🗎 86) and "Referencing an axis group" (→ 🗎 97).
- Limit switch evaluation with the following functions:
  - Logical operation (AND, OR) of connected limit switches
  - Braking operation with emergency stop ramp/application stop when a linked signal is triggered
  - Activating and deactivating individual limit switches at runtime
  - Supply of own hardware limit switch signals

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3.3 Add-ons

INFORMATION

The add-ons are activated in the configuration menu "Basic settings" of the software module in the "Functions used" section. After activation, an additional configuration menu is displayed in the configuration. Please note that a "license" (→ 🗎 21) might be required to use the add-on.

3.3.1 MOVIKIT® MultiAxisController add-on FourAxes

Extends the range of functions by the possibility to control up to 4 axis group members (axes or subordinate instances of the MultiAxisController) with the software module.

3.3.2 MOVIKIT® MultiAxisController add-on Cascading

Extends the range of functions to include the option of using the software module in a nested manner.

Nesting (cascading) is required, for example, if each side of a gantry crane is equipped with 2 drives. The two drives on one side are each to be balanced using the "Torque priority" operating mode. At a higher level, the two sides are to be balanced in "Skew priority" operating mode. Refer to chapter "Operating modes" (→ 🗎 53).

3.3.3 MOVIKIT® Motion add-on AntiSway

INFORMATION

The function is not modulo-capable. Modulo or endless axes must not be operated with this function.

The MOVIKIT® Motion add-on AntiSway extends the range of functions by a function for generating travel profiles to suppress vibrations. For this purpose, the add-on provides various application types for configuration in MOVISUITE®.

For more information, refer to the chapters "Configuration menus" (→ 🗎 46), "IEC programming" (→ 🗎 72) and "Application examples" (→ 🗎 112).

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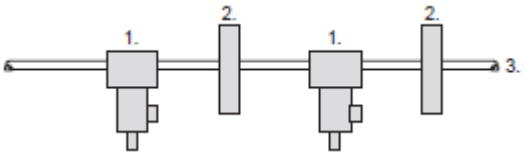
4 Basics

4.1 Multi-motor drive

A multi-motor drive is a drive in which individual motors are mechanically coupled in a slip-free manner and jointly drive a single axis. The individual motors generate the same torque at any given time (in terms of value and direction). All motors in a multi-motor drive must be of the same type and must have the same winding data.

For example: Two gearmotors driving a cardan shaft.



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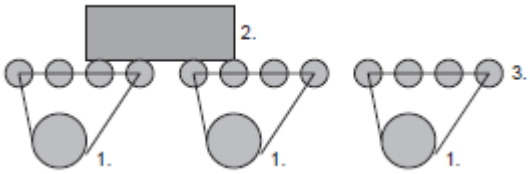
[1] Gearmotor
[2] Load
[3] Cardan shaft

4.2 Group drive

Group drives can be made up of motors with different power ratings that are either not coupled at all or that are mechanically coupled using a coupling subject to slip.

For example: Several motors driving the transport rollers of a roller conveyor. The mechanical coupling is subject to slip and is temporary. It is only established by means of the load.



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[1] Motor
[2] Load
[3] Transport rollers

4.3 Synchronous applications

Two or more drives are controlled to ensure that no differential speeds (or differential revolutions) are built up over any given operating periods. Dynamic deviations in the range of less than 1 motor revolution are permitted. Synchronous operation control using analog controls is not possible due to the long-term condition. Incremental encoders (absolute value encoders) and controllers with difference counters are typically used as controls.

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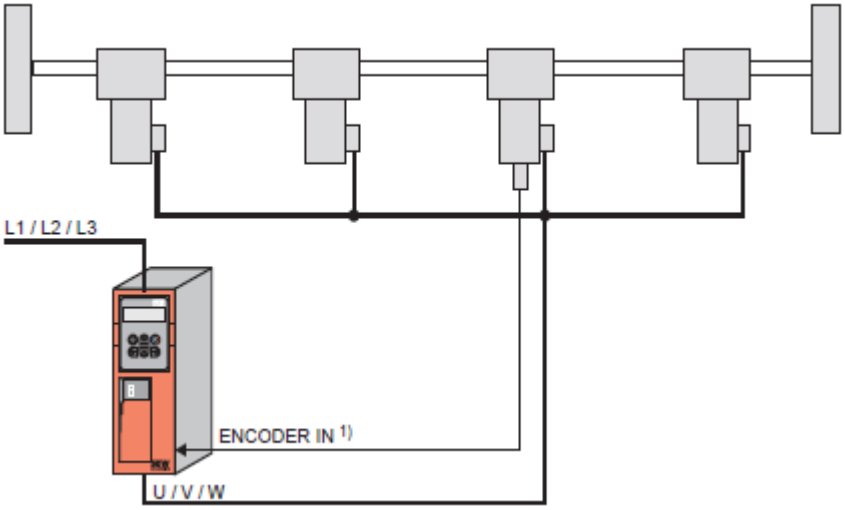
4.4 Parallel connection

A parallel connection is a connection in which several motors are connected to a single inverter.



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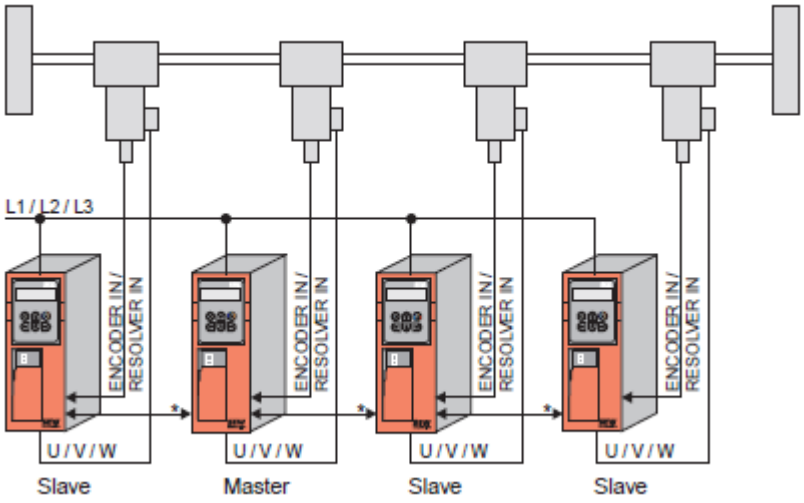
4.5 Master/slave mode

When drives are coupled in master/slave mode, one of the drives has the lead ("master") and transmits a reference value to any downstream drives ("slaves") via an electronic connection (e.g. via a bus system).



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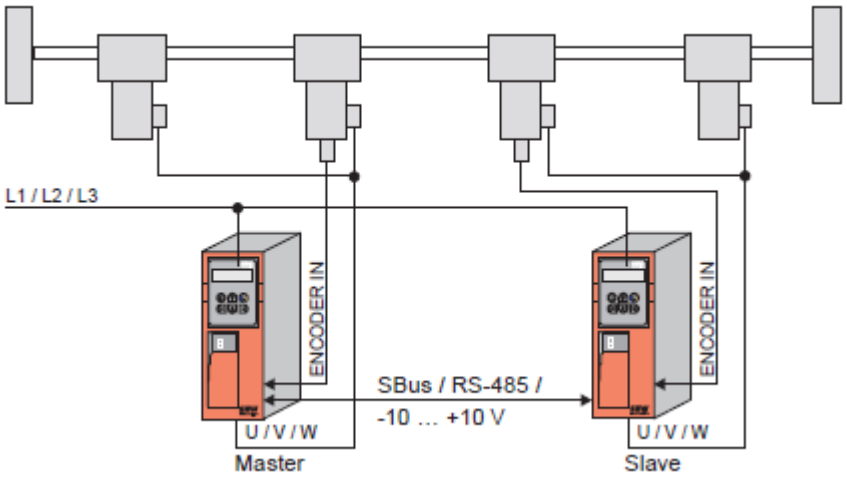
4.6 Mixed mode

Mixed mode is a combination of parallel connection and master/slave mode.



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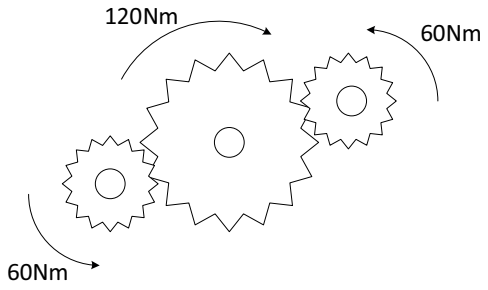
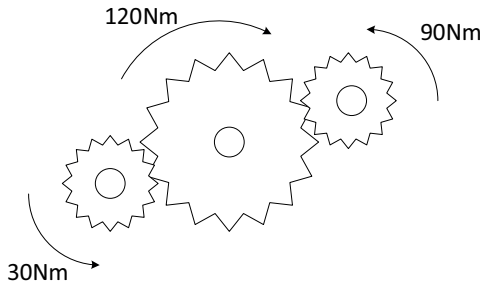
4.7 Torque between axis group members

The torque between two axis group members is explained in detail by means of the schematic view of a gear wheel driven by two axis group members.

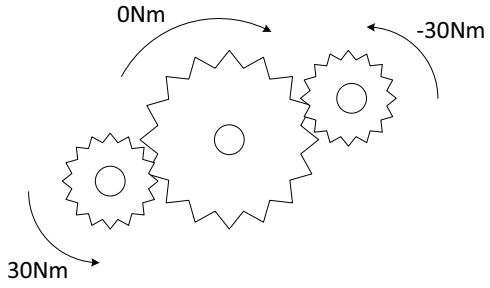
If the torque between the axis group members is set to "0" and a setpoint torque of 120 Nm is required, both axis group members will deliver 60 Nm each.



However, if the torque between the two axis group members is set to 50% of the nominal motor torque, the second axis group member will deliver 90 Nm and the first one only 30 Nm. This means a torque difference of 60 Nm would result as tension based on the assumption that both motors have a nominal torque of 120 Nm each.



The direction of the tension is indicated by the sign of the torque ratio. If a tension of -50 % of the nominal torque is defined without load, the first axis group member would deliver 30 Nm and the second one -30 Nm.



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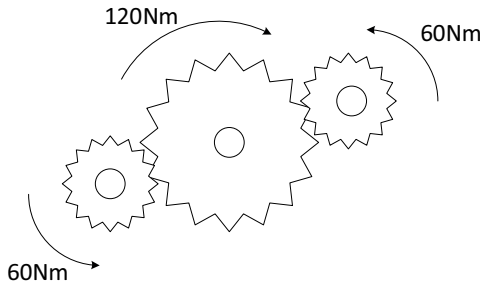
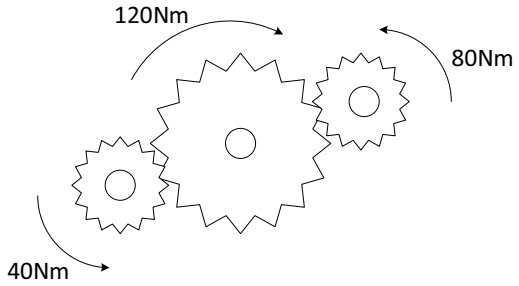
4.8 Torque ratios

The setting options for the torque ratios are explained in detail by means of the schematic view of a gear wheel driven by two axis group members.

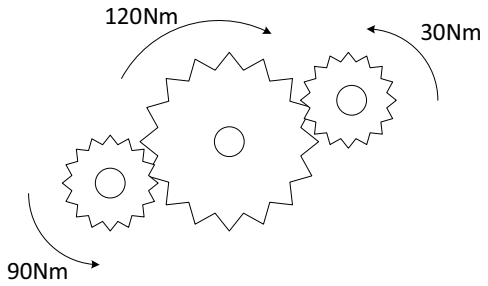
If a torque ratio of 1:1 is set between two axis group members, each drive will deliver 60 Nm if a setpoint torque of 120 Nm is required.



If a torque ratio of 1:2 is set between two axis group members instead, the first axis group member will deliver 40 Nm and the second one twice the torque of the first one (i.e. 80 Nm). The same operating state can also be reached by a ratio of 0.5:1.



With a ratio of 3:1, the first axis group member would deliver 90 Nm and the second one 30 Nm.



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5 Project planning information

5.1 Requirement

Correct project planning and proper installation of the devices are required for successful startup and operation.

For detailed project planning information, refer to the documentation of the respective devices.

5.2 Hardware

The following hardware is required:

- MOVI-C® CONTROLLER of power class "progressive" (UHX65A)

INFORMATION

The cycle time of the MOVI-C® CONTROLLER must be set to 1 ms (default).

- MOVIDRIVE® as an interpolating device

  (Inverter must support the "Interpolated speed control" operating mode)

INFORMATION

Make sure that all drives of the axis group have the same drive train. Otherwise, contact SEW-EURODRIVE.

5.3 Software

The following software is required:

- MOVISUITE® engineering software

  (includes MOVIRUN® flexible, MOVIKIT® MultiMotion, and the IEC Editor)

For more detailed information on the hardware requirements of the individual software components, see the documentation for the respective software.

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5.4 Licensing

The following licenses are available and are required:

- MOVIRUN® flexible

  License for the software platform MOVIRUN® flexible. This license includes the license for MOVIKIT® MultiMotion.

In addition, you will need at least one of the following licenses:

- MOVIKIT® MultiAxisController Torque

  License for the "Torque priority" operating mode
- MOVIKIT® MultiAxisController Skewing

  License for the "Skew priority" operating mode
- MOVIKIT® MultiAxisController TorqueSkewing

  License for the "Torque priority" and "Skew priority" operating modes

Add-on licenses are required to extend the range of functions by means of "expansion modules" (→ 🗎 14). The add-on licenses can be combined as required. The following add-on licenses are available:

- MOVIKIT® MultiAxisController add-on FourAxes

  License for the "FourAxes" add-on
- MOVIKIT® MultiAxisController add-on Cascading

  License for the "Cascading" add-on
- MOVIKIT® Motion add-on AntiSway

  License for the "AntiSway" add-on

  Information: The function is not modulo-capable. Modulo or endless axes must not be operated with this function.

For further information on licensing, refer to the document "MOVI-C® Software Components". You can download the document from the SEW-EURODRIVE website (www.sew-eurodrive.com).

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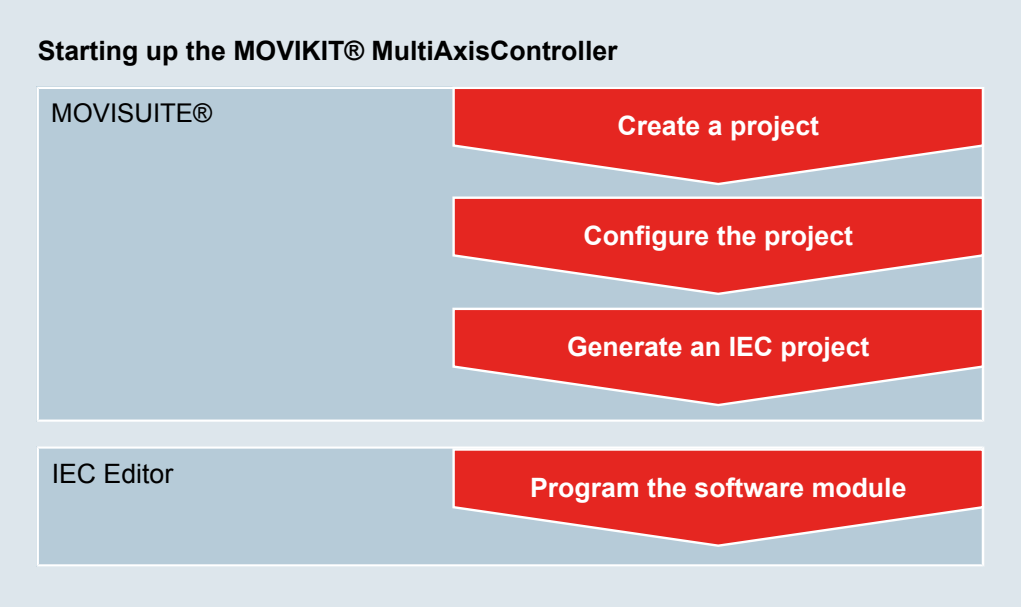
6 Startup

6.1 Requirements

- Check the installation of the inverters and, if installed, also check the encoder connection.
- Observe the installation notes in the documentation of the respective device and software components.
- The devices to be started up are displayed in MOVISUITE®.

6.2 Startup procedure

The schematic diagram below shows the startup procedure:



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The startup steps specific to these software modules are explained in detail in the following chapters of this manual. For startup, also observe the documentation of all the other components in use.

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6.3 Configuring a project

INFORMATION

For detailed information on how to operate the MOVISUITE® engineering software, refer to the corresponding documentation.

✓ A MOVISUITE® project has been created and is open.

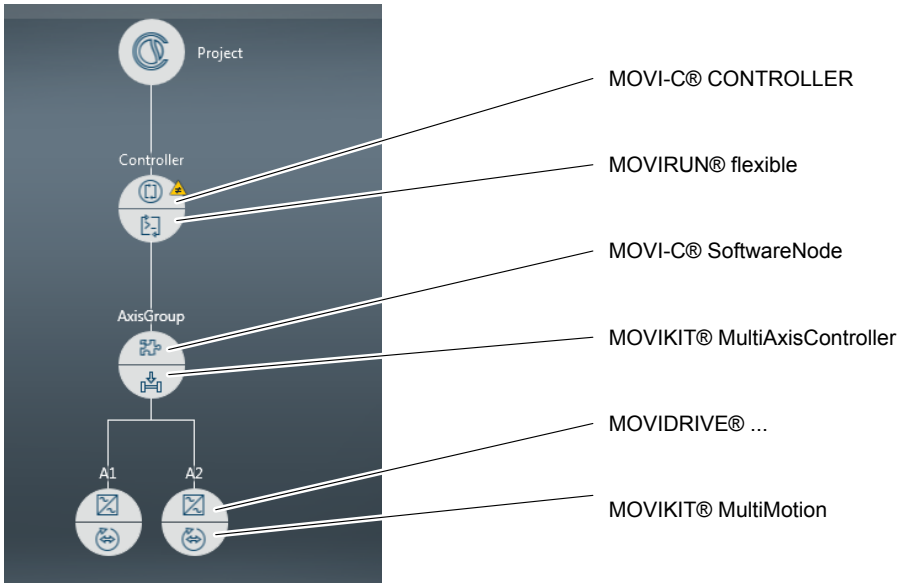
1. Add required device nodes, software nodes (MOVI-C® SoftwareNode) and software modules to the project.

   ⇨ See "Example project".

2. Configure the added devices or software modules. If available, observe the specific notes in the following chapters that apply to MOVIKIT® MultiAxisController. For detailed information on the configuration of devices or other software modules, refer to the respective documentation.

6.3.1 Example project

The following figure shows an example project:



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6.3.2 Configuring MOVIKIT® MultiMotion

The configuration of axis group members that have been created as MultiMotion axes must meet the following requirements for starting up the software module:

- The MultiMotion axes belonging to the software module must have the same user unit.
- The MultiMotion axes belonging to the software module must have identical path references for position, speed, and acceleration.

  INFORMATION: If the application does not allow this setting, contact SEW-EURODRIVE.
- The speed must be specified per second (e.g. m/s), and the acceleration per square second (e.g. m/s²).

For more detailed information on the exact procedure for inserting and configuring MOVIKIT® MultiMotion, refer to the corresponding manual.

6.3.3 Adding MOVIKIT® MultiAxisController

INFORMATION

For detailed information on how to operate the MOVISUITE® engineering software, refer to the corresponding documentation.

✓ A MOVISUITE® project has been created and is open.

1. Click on the empty software module section of the required node.
   ⇨ The catalog section opens and displays the available software modules.
2. In the catalog section, click on MOVIKIT® MultiAxisController.
   ⇨ A context menu opens.
3. Select the version from the respective drop-down list in the context menu and confirm your selection with [Apply].

⇨ The MOVIKIT® MultiAxisController is assigned to the node, the configuration is created, and the basic settings are performed.

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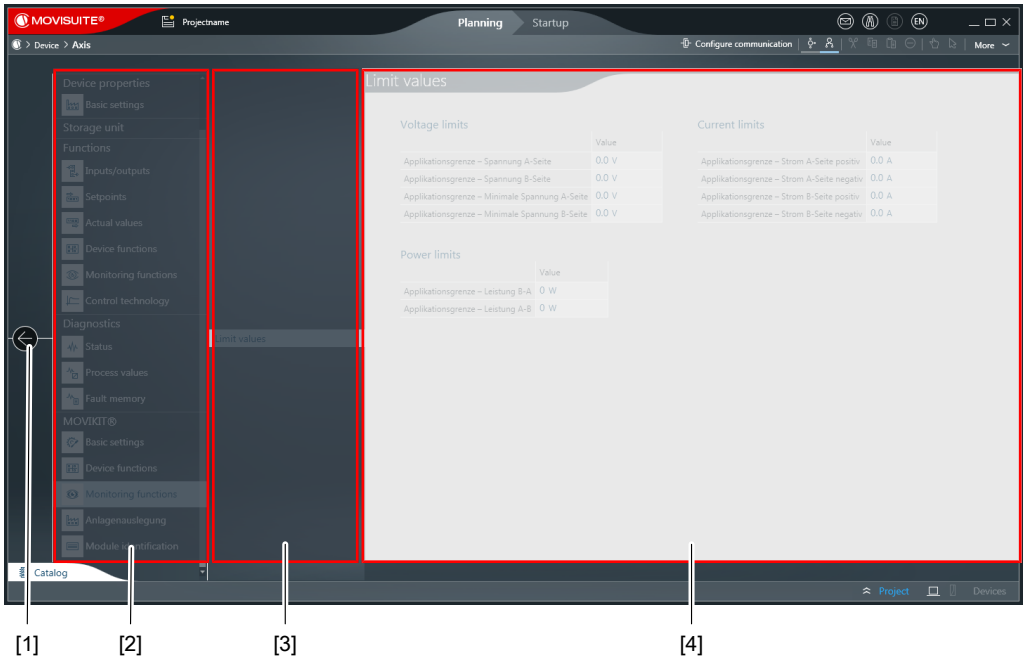
6.3.4 Configuring MOVIKIT® MultiAxisController

INFORMATION

For detailed information on how to operate the MOVISUITE® engineering software, refer to the corresponding documentation.

1. In MOVISUITE®, click on MOVIKIT® MultiAxisController.
   ⇨ The configuration menus of the software module are displayed. The configuration menus are explained in the following subchapters.



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[1] Button to return to the project overview
[2] Main menu of the software module configuration (MOVIKIT® section)
[3] Submenus of the configuration
[4] Setting fields of the respective submenu

2. Configure the software module using the respective setting fields.
3. Click button [1] after having completed the configuration.
   ⇨ The project overview is displayed.

INFORMATION

For the changes made to the configuration to take effect, you have to update the configuration data. To do so, click [Update configuration data] in the respective notification at the node or in the context menu of the MOVI-C® CONTROLLER. The MOVI-C® CONTROLLER is stopped and restarted for updating the configuration data.

Basic settings

Parameter name	Description
Calculation basis	
Module name	Name of the module that is used as the basis for calculation.
	Index: 50010.255
	IEC name: -
IEC name	Name of the software module in the IEC Editor used as the basis for calculation.
	Index: 50010.253
	IEC name: -
Basic settings	
Associated axis group members of the MOVIKIT® MultiAxisController	Specify associated axis group members by means of a decimal value (bit coding) or by setting the respective bits using sliders.
	Index: 50010.1
	IEC name: Controller.Config.uiAssociatedAGMembers
Take account of external encoders	Define external encoders via sliders.
	Index: 50010.60-50010.63
	IEC name: Controller.Config.EnableExternalEncoder.xAGMember1-4
Functions used	
Torque priority of the compensation See "Functional description" (→ 🗎 53)	Activation or deactivation of the "Torque priority" torque mode. • **On** • Off
	Index: 50010.103
	IEC name: _fbController._stConfig.stOptionalModes.xTorqueLeveling
Skew priority of the compensation See "Functional description" (→ 🗎 55)	Activation or deactivation of the "Skew priority" skewing mode • On • **Off**
	Index: 50010.104
	IEC name: _fbController._stConfig.stOptionalModes.xSkewLeveling

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Parameter name	Description
Activation of up to 4 axis group members	Activation or deactivation of the control of up to 4 axis group members. If this function is deactivated, 2 axis group members can be controlled. • On • **Off**
	Index: 50010.105
	IEC name: _fbController._stConfig.stOptionalModes.xAddonFourAxes
Cascading	Activation or deactivation of the option to use the software module in a cascade (nesting) above another instance of the same software module. • On • **Off**
	Index: 50010.106
	IEC name: _fbController._stConfig.stOptionalModes.xAddonCascade
Anti-sway control **Information:** "Configuration menu" (→ 🗎 46) becomes visible when activated.	Activation or deactivation of the option to configure vibration suppression measures. • On • **Off**
	Index: 50010.108
	IEC name: _fbController._stConfig.stOptionalModes.xAddonAntiSway
Combined encoder evaluation See "Configuration menu" (→ 🗎 44)	Activation or deactivation of the option to evaluate a high-resolution encoder and a low-resolution encoder together. • On • **Off**
	Index: 50010.107
	IEC name: _fbController._stConfig.stOptionalModes.xAdvancedEncoderEvaluation

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Monitoring functions

Software limit switches

Parameter name	Value
Software limit switches	
Monitoring negative SW limit switch	• On Activate monitoring for negative software limit switch(es) • **Off** Deactivate monitoring for negative software limit switch(es)
	Index: 8572.3
	IEC name: LimitSwitchEvaluation.SoftwareLimit-Switch.In.xActivateMonitoringNegative
SW limit switch negative	Position of the negative software limit switch (in user units)
	Index: 8572.4
	IEC name: LimitSwitchEvaluation.SoftwareLimit-Switch.In.lrLimitNegative
Monitoring positive SW limit switch	• On Activate monitoring for positive software limit switch(es) • **Off** Deactivate monitoring for positive software limit switch(es)
	Index: 8572.5
	IEC name: LimitSwitchEvaluation.SoftwareLimit-Switch.In.xActivateMonitoringPositive
SW limit switch positive	Position of the positive software limit switch (in user units)
	Index: 8572.6
	IEC name: LimitSwitchEvaluation.SoftwareLimit-Switch.In.lrLimitPositive

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Hardware limit switches

INFORMATION

Wire the hardware limit switches to the digital inputs DI 02 (positive) and DI 03 (negative) of the inverter. Also select "No function" for digital inputs DI 02 and DI 03 in the "Inputs/outputs" configuration menu of the inverter.

Parameter name	Value
Hardware limit switches	
Logical operation of HW limit switches	• **OR operation** • AND operation
	Index: 50015.1
	IEC name: LimitSwitchEvaluation.Config.eOperation
Debouncing time	Debouncing time for the limit switches in [s] **Default value: 0.2**
	Index: 50015.3
	IEC name: LimitSwitchEvaluation.Config.lrLimitSwitchDebouncingTime
Fault response	
Fault response	• **Not active** • Active
	Index: 50015.2
	IEC name: LimitSwitchEvaluation.Config.eReaction
Activation of applicable HW limit switches	
Select the positive and negative hardware limit switches that are applicable to monitoring.	
Index: negative: 50015.11-18; positive: 50015.21-28	
IEC name: LimitSwitchEvaluation.Config.axActivateLSNegative[1]...[4] LimitSwitchEvaluation.Config.axActivateLSPositive[1]...[4]	
Activation of applicable programmable limit switches	
Select the positive and negative programmable limit switches that are applicable to monitoring.	
Index: negative: 50015.15-18; positive: 50015.25-28	
IEC name: LimitSwitchEvaluation.Config.axActivateLSNegative[5]...[8] LimitSwitchEvaluation.Config.axActivateLSPositive[5]...[8]	

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Limit values

Parameter name	Value
Limit values	
Skew error window	Position window for the permitted skew error between the axis group members (in user units). If this window is exceeded, an error will be issued and the set fault response will be performed. **Default value: 0**
	Index: 50011.24
	IEC name: Controller.MAC.Config.SkewLeveling.lrSkewErrorWindow
Lag error window	Window of the actual lag error (in user units). No lag error is created when the setting is "0". **Default value: 0**
	Index: 50012.03
	IEC name: Controller.PositionController.Config.lrLagErrorWindow

Limit values calculation basis

Parameter name	Value
Application limits	
Positive speed	Limits the maximum positive speed permitted for moving the system. (in user units)
	Index: 8357.10
	IEC name: ConfigHandling._stAxisConfig.lrAppLimitVelocityPositive
Negative speed	Limits the maximum negative speed permitted for moving the system. (in user units)
	Index: 8357.11
	IEC name: ConfigHandling._stAxisConfig.lrAppLimitVelocityNegative
Acceleration	Limits the maximum acceleration permitted for accelerating the system. (in user units)
	Index: 8357.12
	IEC name: ConfigHandling._stAxisConfig.lrAppLimitAcceleration

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Parameter name	Value
Deceleration	Limits the maximum deceleration permitted for braking the system. (in user units)
	Index: 8357.13
	IEC name: ConfigHandling._stAxisConfig.lrAppLimitDeceleration
Jerk time	Limits the jerk time in [ms] The jerk time takes effect in torque control (FCB 07), speed control (FCB 05), and positioning control (FCB 09), as well as in manual mode. The positioning process extends to twice the set jerk time.
	Index: 8357.14
	IEC name: ConfigHandling._stAxisConfig.lrAppLimitJerkTime
Torque	Limits the maximum torque that may be applied to the system in [Nm]
	Index: 8357.15
	IEC name: -
Limits	
Emergency stop deceleration	Deceleration for the ramp that is activated during an emergency stop (in user units). An emergency stop can be programmed as a response to a fault.
	Index: 8357.20
	IEC name: ConfigHandling._stAxisConfig.lrRapidStopDeceleration
Cycle limit	
Modulo minimum	Lower modulo limit for handling process data (in user units). This limit is required for handling process data with a limited range of values.
	Index: 8357.30
	IEC name: ConfigHandling._stAxisConfig.lrModuloMin
Modulo maximum	Upper modulo limit for handling process data (in user units). This limit is required for handling process data with a limited range of values.
	Index: 8357.31
	IEC name: ConfigHandling._stAxisConfig.lrModuloMax
Lag error	
Lag error window	Lag error from which drive train 1 signals a fault (in user units).
	Index: 8510.4
	IEC name: -

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Parameter name	Value
Limit values from startup	
Maximum speed at motor shaft	Maximum permitted speed at the motor shaft calculated from motor and gear unit data during startup in [1/min]
	Index: 8360.9
	IEC name: -
Maximum torque at motor shaft	Maximum permitted torque at the motor shaft calculated from motor and gear unit data during startup in [Nm]
	Index: 8360.11
	IEC name: -

Drive functions

Scaling

Parameter name	Value
Extended drive train data	
Gear unit ratio	Total gear unit ratio of the configured gear unit and the additional transmission
	Index: 50010.20
	IEC name: _fbController._stConfig.stConfigDriveTrain.lrGearRatio
Effective radius	Radius of a theoretically configured drive wheel for reducing the drive train in [m]
	Index: 50010.21
	IEC name: _fbController._stConfig.stConfigDriveTrain.lrRadius_Pulley
Inverter scaling	
Displays numerator, denominator, number of decimal places, as well as the unit for position, speed, and acceleration	
Index: 8554.1-4 (position), 8557.1-4 (speed), 8560.1-4 (acceleration)	
IEC name: -	
Recommended resolution	
Displays the recommended number of decimal places for position, speed, and acceleration	
Index: -	
IEC name: -	

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Controller functions

Basic settings

Parameter name	Description
Basic settings	
Fault response	Behavior of profile generation in the event of a fault in the axis assigned to it: • Stop without ramps The profile generator abruptly freezes at the current target position. • Stop at application limit The profile generator creates a stop profile with the deceleration specified in the application limits. • Stop with emergency stop deceleration The profile generator creates a stop profile with the specified emergency stop deceleration. • Following the axis The profile generator creates a stop profile based on the course of the actual position of the axis.
	Index: 50000.11
	IEC name: ProfileGeneration.Config.eErrorReaction

Reference travel

Parameter name	Value
Reference travel	
Reference travel type **Information:** When selecting the reference travel types with limit switches, make sure that the limit switch evaluation configured in the configuration menu "Hardware limit switches" (→ 🗎 29) is used.	• **Deactivated** • Reference cam – negative end • Reference cam – positive end • Positive limit switch • Negative limit switch • Referencing without reference travel with enable • Reference cam flush – limit switch positive • Reference cam flush – limit switch negative
	Index: 50007.1
	IEC name: ProfileGeneration.Homing.Config.eReferenceTravelType
Reference offset	Setting the reference offset (in user units). Is required, for example, when the cam is not located at machine zero.
	Index: 50007.2
	IEC name: ProfileGeneration.Homing.Config.lrReferenceOffset

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Parameter name	Value
Search speed	Search speed of reference travel (in user units)
	Index: 50007.4
	IEC name: ProfileGeneration.Homing.Config.lrSearchVelocity
Retraction speed	Retraction speed of reference travel (in user units)
	Index: 50007.5
	IEC name: ProfileGeneration.Homing.Config.lrClearVelocity
Acceleration	Acceleration of reference travel (in user units)
	Index: 50007.6
	IEC name: ProfileGeneration.Homing.Config.lrAcceleration
Deceleration	Deceleration of reference travel (in user units)
	Index: 50007.7
	IEC name: ProfileGeneration.Homing.Config.lrDeceleration
Advanced settings	
Go to home position	Activates or deactivates homing
	Index: 50007.9
	IEC name: ProfileGeneration.Homing.Config.xMoveToStartPosition
Home position	Position that is approached automatically after referencing (in user units)
	Index: 50007.10
	IEC name: ProfileGeneration.Homing.Config.lrStartPosition
Homing speed	Speed for approaching the home position after referencing (in user units)
	Index: 50007.11
	IEC name: ProfileGeneration.Homing.Config.lrStartPosVelocity
Jerk	Jerk that is effective during referencing and homing (in user units)
	Index: 50007.11
	IEC name: ProfileGeneration.Homing.Config.lrStartPosVelocity

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Parameter name	Value
Encoder referencing	Activation or deactivation of encoder referencing. • **Yes** • No
	Index: 50007.8
	IEC name: ProfileGeneration.Homing.Config.HomingAG.xActivateEncoderHoming
Readjustment	
Readjustment	• **Not active** • Active If readjustment is active, and depending on the logical operation of the HW limit switches, an additional limit switch is approached or the system moves clear. **INFORMATION:** Readjustment is only possible with two axis group members and in the reference travel types "Positive limit switch" and "Negative limit switch".
	Index: 50010.30
	IEC name: ProfileGeneration.Homing.Config.HomingAG.Readjustment.xActivate
Monitoring time	Time permitted for readjustment in [s] If this time period is exceeded, an error is displayed. To deactivate the function, specify a value of "0". **Default value: 0**
	Index: 50010.31
	IEC name: ProfileGeneration.Homing.Config.HomingAG.Readjustment.lrSafetyTime
Monitoring distance	Distance permitted for readjustment (in user units) If this distance is exceeded, an error is displayed. To deactivate the function, specify a value of "0". **Default value: 0**
	Index: 50010.32
	IEC name: ProfileGeneration.Homing.Config.HomingAG.Readjustment.lrSafetyDistance
Selection of HW limit switches for readjusting axis group members	
Select which of the positive and negative limit switches is to apply for readjustment of the respective axis group members.	
Index: 50010.40-43	
IEC name: ProfileGeneration.Homing.Config.HomingAG.Readjustment.usiLSNegativeAGMember1-2/usiLSPositiveAGMember1-2	

Speed specification

Parameter name	Value
Speed setpoint	
Stop at position	• **Off** When the operating mode is stopped, the drive stops directly at its position. • Absolute When the operating mode is stopped, the drive moves to a certain absolute position. • Relative When the operating mode is stopped, the drive moves on from its current position again by the values specified at the stop position.
	Index: 50002.1
	IEC name: ProfileGeneration.Velocity.Config.stStopAtPosition.eStopMode
Stop position	Stop position that is approached when the operating mode is stopped (in user units).
	Index: 50002.2
	IEC name: ProfileGeneration.Velocity.Config.stStopAtPosition.lrStopPosition

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Absolute positioning

Parameter name	Value
Absolute positioning	
Without referenced encoder	• Yes Allow positioning if the inverter has not yet been referenced. • **No** Do not allow positioning if the inverter has not yet been referenced.
	Index: 50003.1
	IEC name: ProfileGeneration.Positioning.Config.xWithoutReferencedEncoder
Target position monitoring	• On Check whether the target position is within the set software limit switches. If the target position is outside the set software limit switches, the motion is not started and an error is displayed. • **Off** Do not check whether the target position is within the set software limit switches.
	Index: 50003.2
	IEC name: ProfileGeneration.Positioning.Config.xTargetPositionMonitoring

Relative positioning

Parameter name	Value
Relative positioning	
Continue relative movement	• Yes Continue an interrupted relative positioning if the axis has meanwhile left the interpolating operating mode, e.g. due to enable being canceled. • **No** Do not continue triggered relative positioning after interruption.
	Index: 50004.1
	IEC name: ProfileGeneration.PositioningRelative.Config.xContinueRelativeMove

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Parameter name	Value
Behavior on target position change	• **Off** The target position cannot be changed during movement. • Based on start position The target position can be changed during ongoing movement. The new target position refers to the original start position. • Based on actual position The target position can be changed during ongoing movement. The new target position refers to the current position of profile generation. • Based on target position The target position can be changed during ongoing movement. The new target distance is based on the last target position and is applied with a positive edge change of input signal *xAcceptNewDistance* (and a pending start signal).
	Index: 50004.2
	IEC name: ProfileGeneration.PositioningRelative.Config.eMode
Target position monitoring	• Yes Before traveling to the target position, check whether the target position is within the set software limit switches. If the target position is outside the set software limit switches, the motion is not started and an error is displayed. • **No** Before traveling to the target position, do not check if the target position is within the set software limit switches.
	Index: 50004.3
	IEC name: ProfileGeneration.PositioningRelative.Config.xTargetPositionMonitoring

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Direct coupling

Parameter name	Value
Tracking	
Master source	• **User program** Depending on this setting, the automatic code generation creates a master-slave connection in the action *SEW_PRG.LinkInterfaces*. The structure *MasterUserProgram* from the global variable *Interface_AxisName* is used as the master source. The user must provide the master values to this structure in the cyclic task. • Configured axis The setpoints of the slave axis are adopted from the axis selected under "Master axis name". • EncoderInterface The setpoints of the slave axis are adopted from the EncoderInterface selected under "EncoderInterface name". • None
	Index: 50005.5
	IEC name: -
Master axis name **Information:** Visible with master source "Configured axis".	Selects the master axis.
	Index: 50005.1
	IEC name: -
EncoderInterface name **Information:** Visible with master source "EncoderInterface".	Selection of the EncoderInterface
	Index: 50005.11
	IEC name: -
Settings of the master source	
Modulo minimum	Modulo limit minimum (in user units)
	Index: 50005.4
	IEC name: ProfileGeneration.Tracking.Config.lrMasterModuloMin
Modulo maximum	Modulo limit maximum (in user units)
	Index: 50005.3
	IEC name: ProfileGeneration.Tracking.Config.lrMasterModuloMax
Number of decimal places	Number of decimal places of the master signal
	Index: 50005.8
	IEC name: ProfileGeneration.Tracking.Config.uiMasterResolution

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Parameter name	Value
Time factor for speed	Time base applicable to the speed of the master signal: • **min**$^{-1}$ • 1/s
	Index: 50005.9
	IEC name: ProfileGeneration.Tracking.Config.stTimeBaseFactor.eVelocity
Time factor for acceleration	Time base applicable to the acceleration of the master signal: • min^{-1} • 1/(min*s) • 1/s^2
	Index: 50005.10
	IEC name: ProfileGeneration.Tracking.Config.stTimeBaseFactor.eAcceleration
Master/slave gear ratio	
Numerator	Numerator value of the gear ratio between master and slave in user units of the slave axis
	Index: 50005.6
	IEC name: ProfileGeneration.Tracking.In.diTracking-Numerator
Denominator	Denominator value of the gear ratio between master and slave in user units of the master axis
	Index: 50005.7
	IEC name: ProfileGeneration.Tracking.In.diTracking-Denominator

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MultiAxisController control function

Parameter name	Description
Operating mode setting	
Balancing priority	• **Torque** • Skewing • Skew without overload guard • User-defined speed correction values
	Index: 50011.11
	IEC name: Controller.MAC.Config.ePriority

Depending on the selected operating mode, additional configuration options are available.

Balancing priority: Torque

Parameter name	Description
Operating mode setting	
P gain	Factor for increasing torque balancing
	Index: 50011.15
	IEC name: Controller.MAC.Config.TorqueLeveling.lrScaleFactor
Slip limiter	Enable anti-slip control. • Not active • **Active**
	Index: 50011.12
	IEC name: Controller.MAC.Config.TorqueLeveling.xSlipVelLimiterON
Maximum slip speed	Speed limitation for the slip limiter (in user units) This option is shown when the slip limiter is activated.
	Index: 50011.13
	IEC name: Controller.MAC.Config.TorqueLeveling.lrSlipVelMaxMin
Torque ratios	
The ratio between the torque of one axis group member and the torque of the remaining axis group members	
Index: 50011.1-4	
IEC name: Controller.Config.TorqueRelation.lrAGMember1-4	
Torque between axis group members	
Torque difference (preload) between the respective axis group members in [%/Nm]	
Index: 50011.5-8	

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Parameter name	Description
IEC name: Controller.Config.TorqueBetween.IrAGMember1_2 Controller.Config.TorqueBetween.IrAGMember2_3 Controller.Config.TorqueBetween.IrAGMember3_4 Controller.Config.TorqueBetween.IrAGMember4_1	

Balancing priority: Skew with/without overload guard

Parameter name	Description
Operating mode setting	
Allow skew balancing	• Manual • With setpoints active – skew correction starts automatically when the inverters switch to control.
	Index: 50011.25
	IEC name: Controller.MAC.Config.SkewLeveling.eEnableSkewing
P gain	Factor for increasing skew balancing
	Index: 50011.18
	IEC name: Controller.MAC.Config.SkewLeveling.IrPGain
Encoder source of skew balancing	• **Motor encoder** Mean position value for the motors • External encoders Mean position value for the external encoders • Motor encoders and external encoders Mean position value for the motors and external encoders
	Index: 50011.16
	IEC name: Controller.MAC.Config.SkewLeveling.eEncSelector

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Parameter name	Description
Speed source for calculating the overload guard (This field is omitted with balancing priority "Skew without overload guard".)	• **Motor encoder** Actual speed of the motors • External encoders Actual speed of the external encoders • Motor encoders and external encoders Actual speed, motors and external encoders combined • External encoders filtered Actual speed of the external encoder filtered by the time constant of encoder evaluation (*IrInputFilterTime_ExtEnc*).
	Index: 50011.17
	IEC name: Controller.MAC.Config.SkewLeveling.eOverloadGuard_EncSelector
Limit speed and limit deceleration for skew balancing	Limit the speed and deceleration of the "Skew priority" operating mode (*IrSkewMaxMin* and *IrAccDecSkewMaxMin*) • Not active • **Active**
	Index: 50011.19
	IEC name: Controller.MAC.Config.SkewLeveling.xVelDecLimiterON
Limit acceleration for skew balancing	Activation of limit acceleration of skew balancing • Not active • **Active**
	Index: 50011.20
	IEC name: Controller.MAC.Config.SkewLeveling.xAccLimiterON
Maximum balancing acceleration/deceleration	Acceleration or deceleration limitation for skew balancing (in user units)
	Index: 50011.21
	IEC name: Controller.MAC.Config.SkewLeveling.IrAccDecMaxMin
Maximum balancing speed	Speed limitation for skew balancing (in user units)
	Index: 50011.22
	IEC name: Controller.MAC.Config.SkewLeveling.IrVelMaxMin

Position controller

Parameter name	Description
Position controller	

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Parameter name	Description
Position controller	Switching on/off the position controller
	Index: 50012.1
	IEC name: Controller.PositionController.Config.xDisable
P gain	Position controller gain for minimizing lag errors
	Index: 50012.2
	IEC name: Controller.PositionController.Config.lrP-Gain

Encoder evaluation

INFORMATION

Bear in mind that the modulo reference could be lost when acknowledging an encoder fault.

Parameter name	Description
Encoder evaluation	
Encoder type	Encoder type selection: • **Motor encoder** • External encoder • Motor encoder and external encoder • Motor encoder and low-resolution EtherCAT® encoder • High-resolution EtherCAT® encoder • Low-resolution EtherCAT® encoder • High and low-resolution EtherCAT® encoders
	Index: 50013.1
	IEC name: Controller.EncoderEvaluation.Config.eActPos_EncSelector
New initialization of encoder when changing encoder source	Enable encoder re-initialization when changing encoder source • **Yes** • No
	Index: 50013.6
	IEC name: Controller.EncoderEvaluation.Config.xDontInitializeAtEncSelectorChange
Time constant	Integral time for encoder adjustment in [s] **Default value: 0.1**
	Index: 50013.3
	IEC name: Controller.EncoderEvaluation.Config.lrInputFilterTime_ExtEnc

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Parameter name	Description
Dead time	Dead time of the external encoder in [s] Contact SEW-EURODRIVE or the manufacturer of the external encoder to obtain the relevant value. **Default value: 0**
	Index: 50013.4
	IEC name: Controller.EncoderEvaluation.Config.lrDeadtime_ExtEnc
Filter of the low-resolution EtherCAT® encoder	Switching on/off the low-resolution EtherCAT® encoder
	Index: 50013.5
	IEC name: Controller.EncoderEvaluation.Config.xInterpolationFilterOn
Advanced settings	
P gain Option only visible with combined encoder evaluation.	Amplification factor of encoder evaluation
	Index: 50013.2
	IEC name: _fbController._fbEncoderEvaluation.stConfig.lrActPos_EncSelector

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Anti-sway control

INFORMATION

Only included if the function is activated in the "Basic settings" configuration menu under "Functions used".

Anti-sway control

Parameter name	Value
Anti-sway control	
Application type	Selection of the application type • No sway • Tower sway • Pendulum sway (in preparation) • Belly sway (in preparation) • Fluid sway (in preparation) • Spring sway (in preparation)
	Index: 50014.1
	IEC name: Controller.AntiSway.Config.eApplicationType
Conversion factor for user units in meter	Position relationship between the user unit from the drive train and one meter. If the value is set to "0", the user unit corresponds to one meter. For all other values, one meter is the product of the user unit and the specified value.
	Index: 50014.2
	IEC name: Controller.AntiSway.Config.lrUserUnitToMeter
Setpoint correction selection	• Off • Anti-sway • Bandstop • Tension build-up time filter
	Index: 50014.30
	IEC name: Controller.AntiSway.Config.SetpointCorrection.eSelector
Source of lifting height	• **No master** Use "Distance between lifting and traveling trolley" as source • Axis group • Axis
	Index: 50014.13
	IEC name: -
Basic settings (setting fields visible depending on application type)	

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Parameter name	Value
Height of the tower	Tower height in [m]
	Index: 50014.10
	IEC name: Controller.AntiSway.Config.DriveTrain.lrHeightTower
Distance between lifting and traveling trolley	Distance from lifting axis to travel axis in [m]
	Index: 50014.11
	IEC name: Controller.AntiSway.Config.DriveTrain.lrDistanceHoistToCar
Mass of the trolley	Mass of the lifting gear without payload mass and without shuttle in [kg]
	Index: 50014.13
	IEC name: Controller.AntiSway.Config.DriveTrain.lrMassHoist
Mass of the payload	Mass of the payload in [kg] The shuttle is included in the payload.
	Index: 50014.14
	IEC name: Controller.AntiSway.Config.DriveTrain.lrMassPayload
Mass of the mast	Mass of the tower without trolley, lifting gear, load mass and shuttle in [kg]
	Index: 50014.15
	*IEC name: Controller.AntiSway.Config.DriveTrain.*lrMassTower
Support for parameter determination See "Configuration menu" (→ 🗎 48)	Activation of the support to determine the parameters "spring stiffness between tower and trolley" and "damping between tower and trolley". If support is enabled, the additional configuration menu "Support for parameter determination" is displayed. • **Not active** • Active Information: The calculations in the configuration menu "Support for parameter determination" (→ 🗎 48) are based, among others, on the values entered in this configuration menu.
	Index: 50014.250
	IEC name: -
Spring stiffness between tower and trolley	Spring constant between tower and trolley in [Nm/wheel]
	Index: 50014.16
	*IEC name: Controller.AntiSway.Config.DriveTrain.*lrSpringTowerToCar

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Parameter name	Value
Damping between tower and trolley	Damping constant between tower and trolley in [Nm/(wheel/s)]
	Index: 50014.17
	IEC name: Controller.AntiSway.Config.DriveTrain.lrDampTowerToCar
Time window	
Jerk time tension build-up	Jerk time for the mechanical tension build-up in [s] Maximum ≤ 2000 * PLC cycle time
	Index: 50014.40
	IEC name: Controller.AntiSway.Config.SetpointCorrection.TensionTimes.lrJerkTime
Ramp time tension build-up	Ramp time for the mechanical tension build-up in [s] Maximum ≤ 2000 * PLC cycle time
	Index: 50014.41
	IEC name: Controller.AntiSway.Config.SetpointCorrection.TensionTimes.lrRampTime

Support for parameter determination

INFORMATION

Only included if "Support for parameter determination" is activated in the "Anti-sway control" configuration menu.

Parameter name	Value
Damping	
Oscillation amplitude	First peak of the oscillation amplitude
	Index: 50014.110
	IEC name: -
Oscillation amplitude	Second peak of the oscillation amplitude
	Index: 50014.111
	IEC name: -
Oscillation period	Time between first and second oscillation amplitude
	Index: 50014.112
	IEC name: -
Degree of damping between tower and trolley	Damping behavior of the oscillation in [Nm/(Rad/s)]
	Index: 50014.20
	IEC name: Controller.AntiSway.Config.DriveTrain.lrDampRatioTowerToCar
Basic settings (setting fields visible depending on application type)	

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Parameter name	Value
Spring stiffness between tower and trolley	Spring constant between tower and trolley in [Nm/wheel]
	Index: 50014.16
	*IEC name: Controller.AntiSway.Config.DriveTrain.*lrSpringTowerToCar
Resonant frequency	
Resonant frequency	Frequency at which the oscillating system can oscillate with maximum amplitude
	Index: 50014.55
	IEC name: -
General data	
Maximum acceleration	Acceleration for deflection calculation in [m/s]
	Index: 50014.113
	IEC name: -
Auxiliary tower mass	Resulting size from all other parameters in [kg]
	Index: 50014.127
	IEC name: -
Auxiliary tower height	Resulting size from all other parameters in [m]
	Index: 50014.126
	IEC name: -
Auxiliary deflection	Resulting size from all other parameters in [rad]
	Index: 50014.128
	IEC name: -
Deflection at lifting height	Deflection at lifting height calculated from the parameter setting in [m]. This value is used for the plausibility check against reality and construction calculations. If the deflection is not plausible, an incorrect parameterization can be assumed.
	Index: 50014.114
	IEC name: -

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Advanced settings

Parameter settings

Parameter name	Value
Delivery state	
Factory setting	Initialize the software module with default values or suggested values. A possibly configured readjustment will be overwritten. All the other configurations of the "controller functions" (→ 🗎 33) remain unchanged.
Suggested values	
Apply all suggested values	Overwrite all values in the configuration of the software module to which a suggested value is assigned with the corresponding suggested value.

System settings

Parameter name	Value
System settings	
Total mass moment of inertia	Sum of the inertia of motor and brake, and of the inertia on the motor shaft. The inertia on the motor shaft is specified when the drive train is started up.
	Index: -
	IEC name: _fbController._stConfig.stDevice.lrInteriaTotal

Module identification

Parameter group	Description
Module identification	Includes name and version for identifying the software module.

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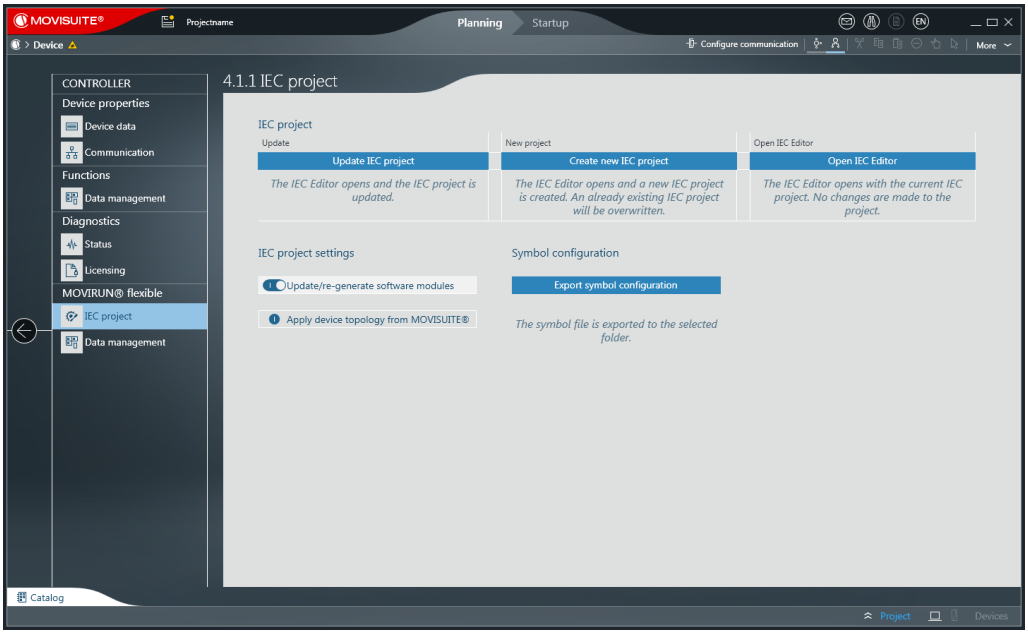
6.4 Generating an IEC project

Carry out the following steps to create an IEC project using automatic code generation and based on the configuration settings in MOVISUITE®.

✓ Configuration of the MOVISUITE® project has been completed.

1. In the function view of MOVISUITE®, click the software module section of the MOVI-C® CONTROLLER.

   ⇨ The "IEC project" menu opens.



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INFORMATION

If you have carried out the configuration in MOVISUITE® using the "Startup" mode and the message "Device cannot be reached" appears, proceed as follows:

- If the MOVI-C® CONTROLLER is not available via the network, switch over to "Planning" mode.
- If the MOVI-C® CONTROLLER is available via the network, carry out a network scan and connect the MOVI-C® CONTROLLER in the network view with the MOVI-C® CONTROLLER in the function view.

2. Click [Create new IEC project].

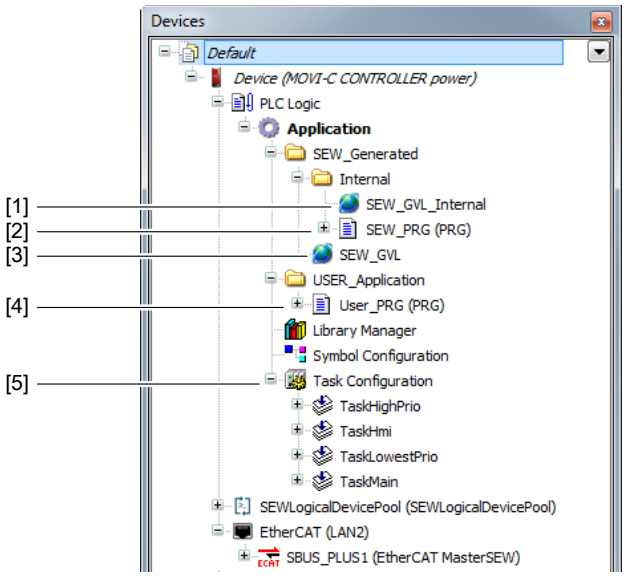
   ⇨ The IEC Editor opens and a new IEC project is created.

INFORMATION

If changes are made to the project structure, to inverter data sets, or to a software module configuration after the IEC project is generated for the first time, a notification symbol is displayed on the MOVI-C® CONTROLLER node. Click on the message icon for more information about the change, and to update the IEC project.

6.4.1 IEC project structure

The IEC project has the following basic structure:



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No.	Name	Description
[1]	SEW_GVL_Internal	The SEW_GVL_Internal global list of variables contains the instances that correspond to the software module used. These variables may not be written to from the user program. In addition, the structure contains an instance as a communication buffer for controlling or monitoring the software module by means of a monitor.
[2]	SEW_PRG	Program that contains all the important instance calls. Automatic code generation recreates this program in accordance with the configuration made in MOVISUITE® each time the IEC project is created, thereby overwriting the previous version. Therefore, you should not make any changes to this program.
[3]	SEW_GVL	The SEW_GVL global list of variables is the interface for accessing the software module features.
[4]	User_PRG	The user program is created once, initially, by automatic code generation. Since the program is not overwritten with each subsequent creation, this is the appropriate place for integrating user programs. The program is divided into five actions. These actions differ in the time at which they are called during the program sequence.
[5]	Task configuration	The list of tasks created in the project. Automatic code generation initially adds tasks that differ in how they are prioritized. The user can add additional programs to existing tasks or create new tasks. It is the responsibility of the user to design the capacity utilization of the tasks to enable the tasks to be processed within the required cycle time. Moving beyond the cyclical tasks, in particular, prevents setpoints for the interpolating axes being generated in time, which means that these axes cannot be operated properly.

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7 Functional description

7.1 Operating modes

To meet the requirements of the different applications, the software module offers several operating modes. The operating modes differ in whether priority for balancing the axis group members is placed on skewing or on the torque. These operating modes cannot be combined.

Frictional connections (e.g. vehicles) are preferably operated using "Torque priority" operating mode. For positive connections, the operating mode depends on the mechanical connection.

The following functions are available across all operating modes:

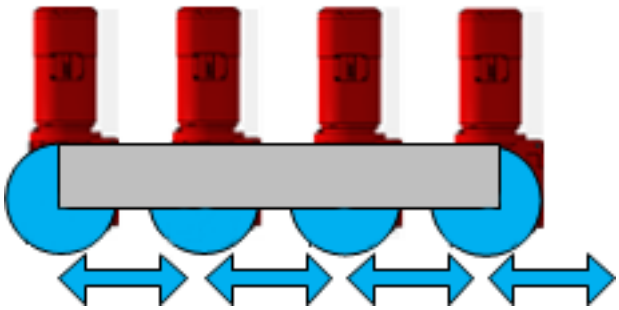
- Central control, referencing, and troubleshooting of an axis group
- Central position control (slip compensation also possible via an external encoder)
- Use of a virtual master
- Support for MultiMotion functions (e.g. positioning and speed specification)

7.1.1 Torque priority

In "Torque priority" operating mode, the torque is balanced between axis group members. This operating mode is used when the connection of the drives allows one drive to exert considerable force on the other drives. These framework conditions apply to connections between drives that have no clearance and a high level of stiffness or rigidity (e.g. traction-optimized vehicles, SRS travel drives, SRS units with cornering ability, fail-safe and redundant drive systems, slippery or poor-quality tracks, and indexing tables).

Application example

The following application illustration shows an example setup for "Torque priority" operating mode:



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One vehicle is moved by 4 drives. The drives are connected to the vehicle via drive suspensions. The floor provides a frictional, rigid connection between the drives. When the drives move synchronously, each axis group member is subject to different loads due to the inhomogeneity of the real system (wheel diameter, friction coefficient, etc). In "Torque priority" operating mode, the software module compensates for this difference in load.

Further applications

The following applications and functions are implemented using this operating mode:

- Torque distribution

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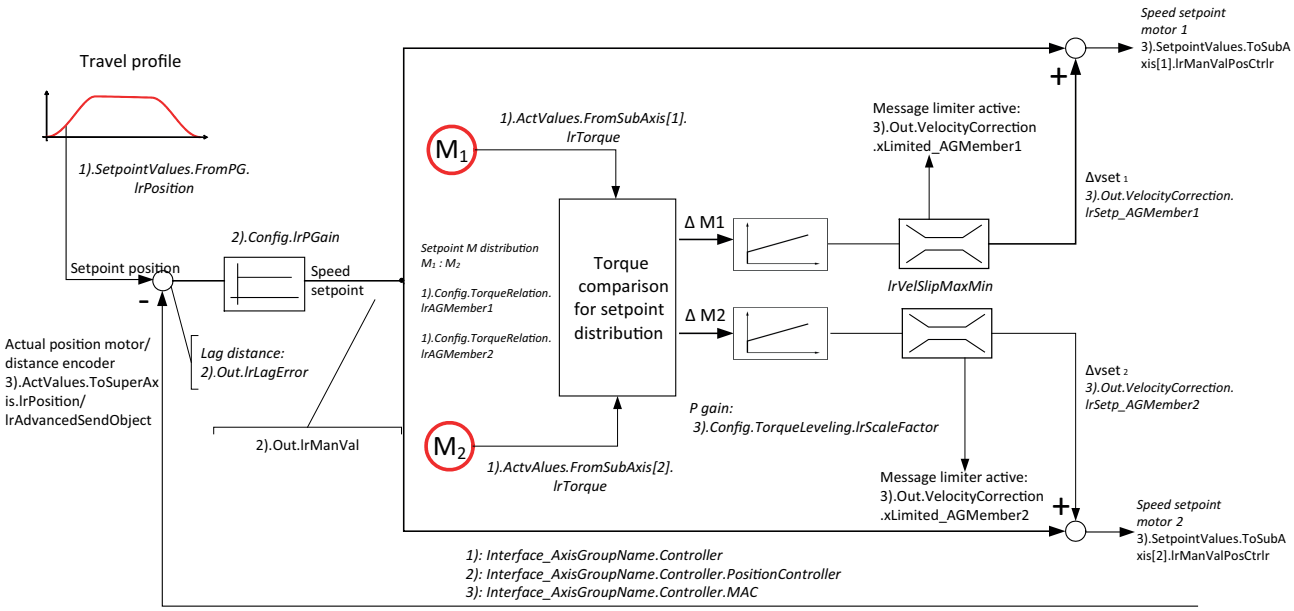
- Synchronization with torque distribution
- Load distribution
- Rigid coupling of the drives, formerly "torque slave"
- Load balancing, formerly "master/slave"
- Speed synchronism (turn off position controller and balance controller)
- Torque follower
- Torque decoupling
- Drive tension can be configured online (electronic differential)
- Parameterizable differential lock
- ASR (replaces the generation B ASR software)
- Redundant drive systems due to very easy deactivation of any group member during maintenance.
- Traction-optimization (e.g. in the case of poor-quality tracks or high dynamics)

Default values

The schematic diagram below shows how the default values work:



Version 4.0

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- The profile generator of the axis group specifies a position setpoint. The position setpoint is compared to the current position of the motor encoder or the external encoder and forms the lag error for the axis group.
- This lag error is transferred to the position controller of the axis group that specifies the speed setpoint for the individual axis group members.

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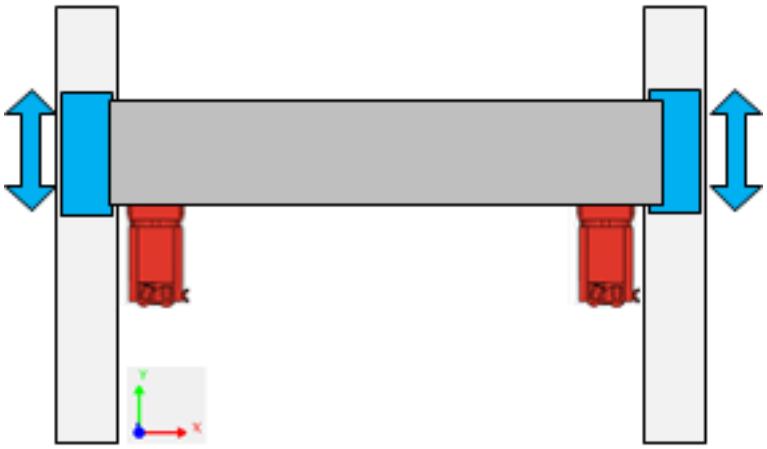
- The software module compares the torques of the individual axis group members. If the torque distribution is not equal to the required distribution, a speed correction value is applied to the axis group member. In addition, this value can be kept to a realistic level using a limiter.
- The sum of the speed setpoint and the speed correction value is transferred to the axis group member.

7.1.2 Skew priority

In "Skew priority" operating mode, the position is balanced between axis group members. This operating mode is used when the connection of the drives does not allow one drive to exert force on the other drives, or only to a small extent. These framework conditions apply to connections between drives that have clearance and a low level of stiffness or rigidity (e.g. dual-column hoists, SRS hoists, indoor cranes, and parallel feeds).

Application example

The following application illustration shows an example setup for "Skew priority" operating mode:



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One vehicle is moved by 2 drives that are connected to the vehicle via drive suspension. Sliding rails provide a rigid connection between the drives. To establish a fixed reference between the drive position and its surroundings, the sliding rails are designed in the form of a toothed rail or equipped with an external encoder. In such structures, skews or misalignments between axis group members may cause damage. This is why the position between the A-side and the B-side needs to be level. In "Skew priority" operating mode, the software module compensates for positional differences (e.g. due to drive overload, slipping of a drive, freewheel of a drive, etc.) by using a configurable compensation movement.

Further applications

The following applications and functions are implemented using this operating mode:

- Phase-synchronous operation
- Speed synchronism (turn off position controller and balance controller)
- Loosely coupled drives
- Adjustment function can be used continuously
- OverloadGuard: prevents asynchronicity in case of a catastrophic failure

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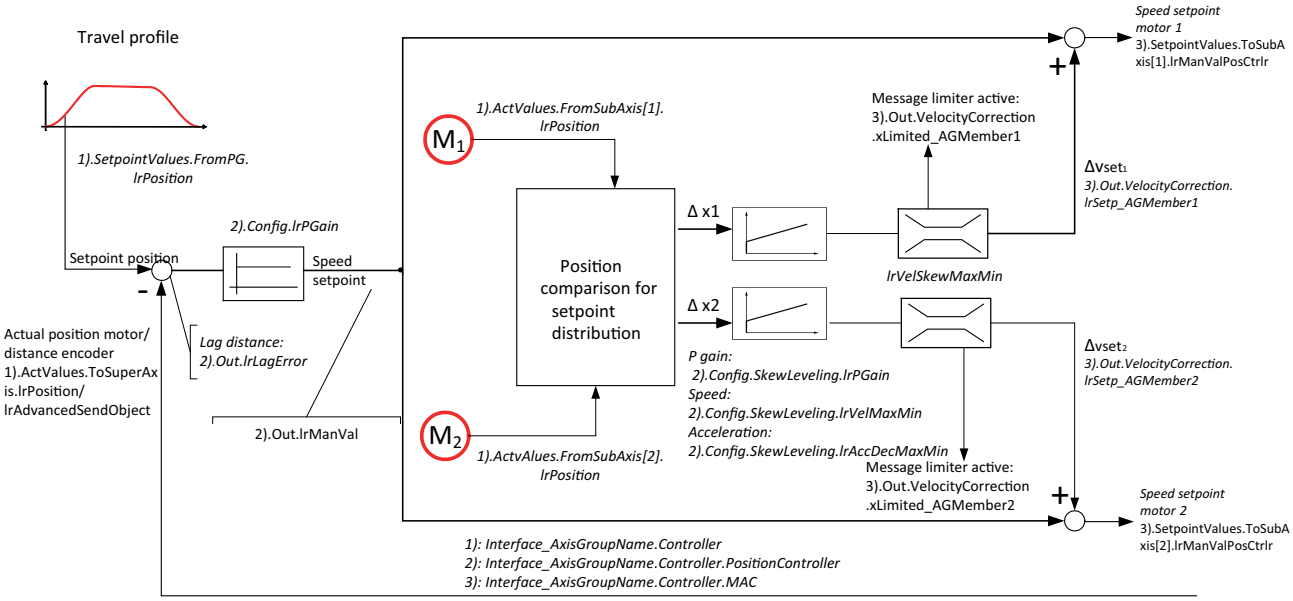
- Master/slave synchronous operation (1:1 gear ratio)
- Double spindle drives that tilt or jam quickly when in a different position
- FCB 22 Multi-drive
- SyncCrane – Functional replacement (in preparation)
- DriveSync – Functional replacement for a gear ratio of 1:1 (in preparation)

Default values

The schematic diagram below shows how the default values work:



Version 4.0

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- The profile generator of the axis group specifies a position setpoint. The position setpoint is compared to the current position of the motor encoder or the external encoder and forms the lag error for the axis group.
- This lag error is transferred to the position controller of the axis group, which specifies the speed setpoint for the individual axis group member.
- The software module compares the positions of the individual axis group members. If the position does not correspond, a speed correction value is applied to the axis group member. In addition, this value can be kept to a realistic level using a limiter.
- The sum of the speed setpoint and the speed correction value is transferred to the axis group member.

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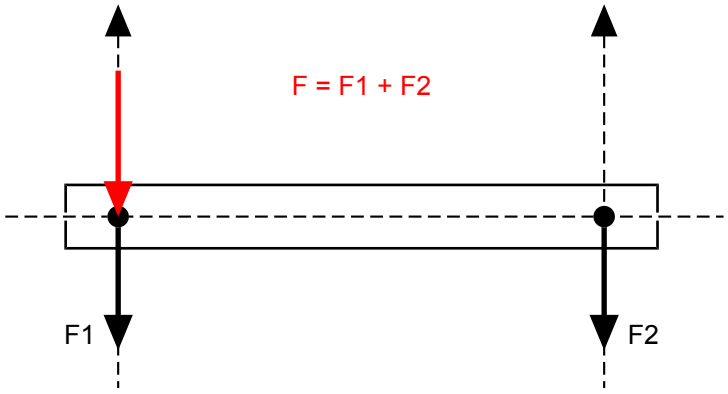
7.1.3 Operating mode selection

The following figure illustrates the transmission of force from one motor to another in rigidly coupled motors:



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Explanation: At 2 motors rigidly coupled via a beam (shown as a dot in the figure), an external force (F) acts on motor 1. Due to the rigid coupling of the motors, motor 2 must compensate part of the force acting on motor 1. The ratio between the force acting on motor 1 (F1) and the force acting on motor 2 (F2) is therefore decisive for selecting the operating mode.

The following table shows which operating mode is used with which force ratio:

Force ratio F1/F2	Operating mode
0 to 0.1	Skew priority
0.1 to 0.25	Determine the operating mode by a test
0.25 to 1	Torque priority

Applications

Torque priority	Skew priority
• Indexing table • Extruder • Calender • Vehicle • SRS units with cornering ability (in preparation) • Port crane • SRS anti-oscillation drive • Gripper • Centering unit • Sheet metal coil • FFS feed	• Port crane • Gantry crane • Indoor crane • Gantry • Dual-column hoist • Parallel feed • Pallet transfer shuttle

The following functions are not (yet) supported:

- Cam switch (decentralized solution required for the inverter)

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- Brake test and diagnostics (currently not supported)
- SRS units with cornering ability, asymmetrical velocity/speed control (not yet available)
- Torque control in the inverter (not possible)

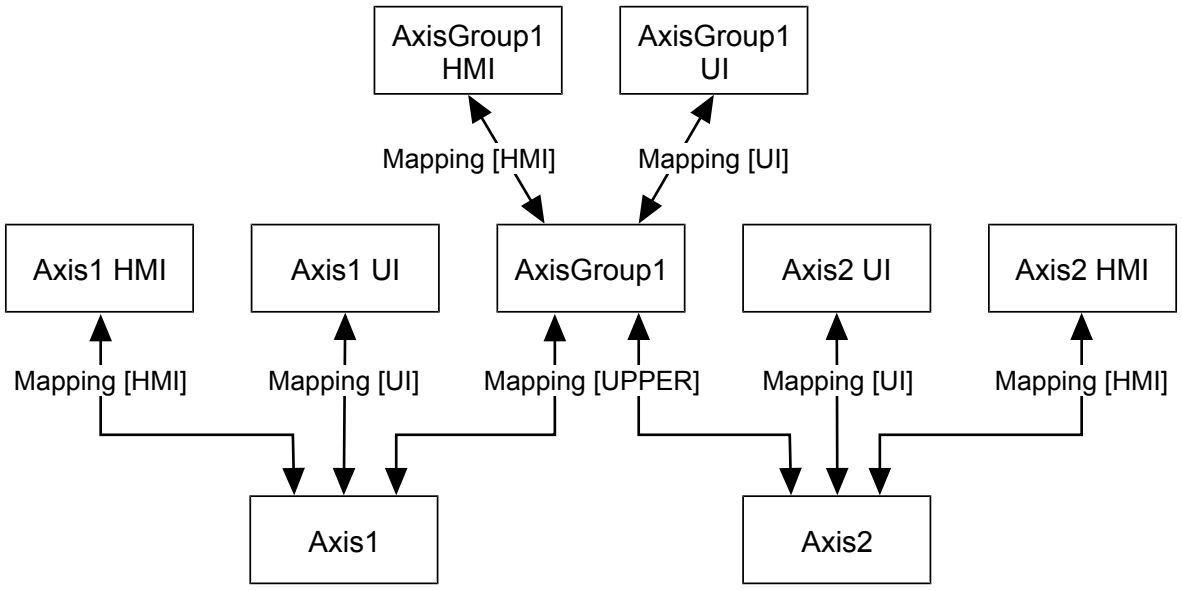
  However, many applications that have not previously been operated in this control mode can be implemented in "Torque priority" operating mode using the MultiAxisController if the dynamics of the MultiAxisController is sufficient.
- Joining processes that were previously carried out in "Positioning" operating mode using the "Torque limiting" function can now be implemented using the MultiAxisController in "Torque priority" operating mode. The software module, however, cannot be limited to the sum of the axis group members; instead, each axis group member has to limit itself separately.

7.2 Access management

The access management system controls which control signal source may access the user interface of the software module.

Each control signal source may request access and receives a corresponding feedback message as to whether access is possible.

For the software module, the control signal sources of HMI, UI, and UPPER are available. This order corresponds to the priority of the control signal sources regarding access.



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A separate access management system exists for each single axis. If access is granted via UI or HMI for a single axis, the software module cannot access it.

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7.3 Fault acknowledgment

When acknowledging a skew error in the operating mode "skew priority", the following cases are distinguished:

INFORMATION

Incorrect use of automatic adjustment can cause damage to the equipment.

- **Exceeding the skew error window < 20%**

  Perform a simple error reset. This includes automatic adjustment so that the skew error is corrected.

- **Exceeding the skew error window > 20%**

  Perform referencing or set the skew error window to "0". Setting the skew error window to "0" initiates an automatic adjustment.

7.4 Connecting a high-resolution/low-resolution EtherCAT® encoder

The following link commands are available for connecting a high-resolution and/or low-resolution EtherCAT® encoder:

```
Axis1.fbController.LinkILowResolutionEC_Encoder2(itfQueryInter-
faceSEW := _fbSyncExtSource);
```

```
Axis1.fbController.LinkIHighResolutionEC_Encoder2(itfQueryIn-
terfaceSEW := _fbSyncExtSource);
```

The MOVIKIT® EncoderInterface is used for connection. For more information, refer to the corresponding manual.

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8 IEC programming

8.1 Opening the IEC project

- If an IEC project has already been generated, select the entry [IEC Editor] under "Tools" from the context menu of the MOVI-C® CONTROLLER in MOVISUITE®.
- If no IEC project has been generated, follow the steps described in the "Generating an IEC project" (→ 🗎 51) chapter.

8.2 User interface

The user interface is implemented in the IEC program by an instance in the global variable list *SEW_GVL*.

The following figure shows the interface in the IEC Editor:

Controller	SEW_Ctrlr.ControllerAG_UI	
Config	ST_ConfigMultiAxis	
MAC	MAC_UI	
PositionController	PositionController_UI	
EncoderEvaluation	EncoderEvaluation_UI	
ActualValues	ST_ActualValuesAG_UI	
SetpointValues	ST_SetpointValuesAG_UI	
LimitSwitchEvaluation	SEW_LSEval.LimitSwitchEvaluation_UI	
xError	BOOL	FALSE
xWarning	BOOL	FALSE
Message	SEW_IErr.ST_Message	
xReset	BOOL	FALSE
In	SEW_ILSEval.ST_LimitSwitchIn	
Config	SEW_ILSEval.ST_LimitSwitchConfig	
Out	SEW_ILSEval.ST_LimitSwitchOut	
StateOfHardwareLimitSwitches	SEW_ILSEval.ST_LimitSwitchState	
SoftwareLimitSwitch	SEW_SWLS.SoftwareLimitSwitch_UI	

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Following this variable structure, the individual variables are described in more detail in the following chapters.

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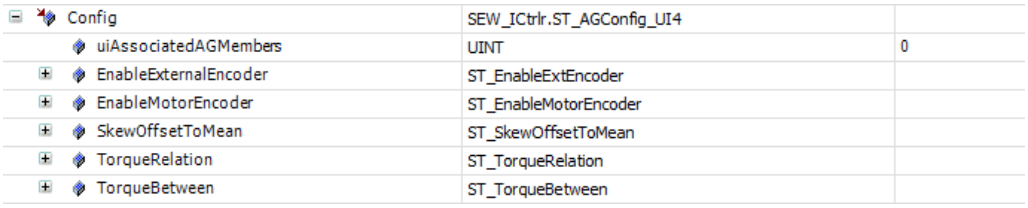
8.3 MultiAxisController settings (Controller)

8.3.1 Basic settings (Config)

Interface in the IEC Editor



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Variable name	Description
uiAssociatedAGMembers	Data type: UINT
	Axis group members included in the control process

EnableExternalEncoder

Variables for setting which external encoders (encoder 2) are considered.

Variable name	Description
xAGMember1	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 1 • FALSE – Do not take account of encoder of axis group member 1
xAGMember2	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 2 • FALSE – Do not take account of encoder of axis group member 2
xAGMember3	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 3 • FALSE – Do not take account of encoder of axis group member 3
xAGMember4	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 4 • FALSE – Do not take account of encoder of axis group member 4

EnableMotorEncoder

Variables for setting which motor encoders (encoder 1) are considered.

Variable name	Description
xAGMember1	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 1 • FALSE – Do not take account of encoder of axis group member 1

Variable name	Description
xAGMember2	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 2 • FALSE – Do not take account of encoder of axis group member 2
xAGMember3	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 3 • FALSE – Do not take account of encoder of axis group member 3
xAGMember4	Data type – BOOL
	• TRUE – Take account of encoder of axis group member 4 • FALSE – Do not take account of encoder of axis group member 4

SkewOffsetToMean

INFORMATION

Only a symmetrical misalignment between the participants is possible.

Variable name	Description
lrAGMember1	Data type: LREAL – Floating-point number
	Position offset between the first axis group member and the mean value of the remaining axis group members
lrAGMember2	Data type: LREAL – Floating-point number
	Position offset between the second axis group member and the mean value of the remaining axis group members
lrAGMember3	Data type: LREAL – Floating-point number
	Position offset between the third axis group member and the mean value of the remaining axis group members
lrAGMember4	Data type: LREAL – Floating-point number
	Position offset between the fourth axis group member and the mean value of the remaining axis group members

TorqueRelation

Variable name	Description
lrAGMember1	Data type: LREAL – Floating-point number
	Ratio between the torque of the first axis group member and the torque of the remaining axis group members
lrAGMember2	Data type: LREAL – Floating-point number
	Ratio between the torque of the second axis group member and the torque of the remaining axis group members

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Variable name	Description
lrAGMember3	Data type: LREAL – Floating-point number
	Ratio between the torque of the third axis group member and the torque of the remaining axis group members
lrAGMember4	Data type: LREAL – Floating-point number
	Ratio between the torque of the fourth axis group member and the torque of the remaining axis group members

TorqueBetween

Variable name	Description
lrAGMember1_2	Data type: LREAL – Floating-point number
	Torque difference (preload) between axis group members 1 and 2
lrAGMember2_3	Data type: LREAL – Floating-point number
	Torque difference (preload) between axis group members 2 and 3
lrAGMember3_4	Data type: LREAL – Floating-point number
	Torque difference (preload) between axis group members 3 and 4
lrAGMember4_1	Data type: LREAL – Floating-point number
	Torque difference (preload) between axis group members 4 and 1

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8.3.2 Multi-axis control (MAC)

Interface in the IEC Editor

MAC	MAC_UI	
In	ST_MACIn_UI2	
xResetAndDisable	BOOL	FALSE
SetpUserDefinedVelCorrect...	ST_SetpUserDefinedVelCorrection	
Config	ST_MACConfig_UI2	
ePriority	E_PRIORITY	TorqueLeveling
TorqueLeveling	ST_TorqueLeveling_UI	
lrScaleFactor	LREAL	0
lrTimeConstant	LREAL	0
xSlipVelLimiterON	BOOL	FALSE
lrSlipVelMaxMin	LREAL	0
SkewLeveling	ST_SkewLeveling_UI	
lrPGain	LREAL	0
xVelDecLimiterON	BOOL	FALSE
xAccLimiterON	BOOL	FALSE
lrAccDecMaxMin	LREAL	0
lrVelMaxMin	LREAL	0
eEncSelector	E_SKEWLEVELING_ENCSELECTOR	MotorEncoders
eOverloadGuard_EncS...	E_SKEWLEVELINGOLGUARD_ENCSELECTOR	MotorEncoders
Out	ST_MACOut_UI2	
ActDiffMeanToPosition	ST_ActDiffMeanToPosition	
ActDiffMeanToTorque	ST_ActDiffMeanToTorque	
VelocityCorrection	ST_VelocityCorrection	
lrSetp_AGMember1	LREAL	0
xLimited_AGMember1	BOOL	FALSE
lrSetp_AGMember2	LREAL	0
xLimited_AGMember2	BOOL	FALSE
lrSetp_AGMember3	LREAL	0
xLimited_AGMember3	BOOL	FALSE
lrSetp_AGMember4	LREAL	0
xLimited_AGMember4	BOOL	FALSE
SkewLevelingOverloadGuard	ST_OverloadGuard	
lrManVal	LREAL	0
xManVal_Limted	BOOL	FALSE

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IN

Variable name	Description
xResetAndDisable	Data type – BOOL
	• TRUE – Reset balance control (I components, filters, etc.) If the TRUE signal is permanent, the balance controller is deactivated. • FALSE – Do not reset balance control
xIgnoreSkewError	Data type – BOOL
	• TRUE – Ignore skew error • FALSE – Do not ignore skew error
xEnableSkewing	Data type – BOOL
	• TRUE – Enable skew correction • FALSE – Disable skew correction

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SetpUserDefinedVelCorrection

Variable name	Description
lrAGMember1	Data type: LREAL – Floating-point number
	Correction value for the speed of the first axis group member (in user units)
lrAGMember2	Data type: LREAL – Floating-point number
	Correction value for the speed of the second axis group member (in user units)
lrAGMember3	Data type: LREAL – Floating-point number
	Correction value for the speed of the third axis group member (in user units)
lrAGMember4	Data type: LREAL – Floating-point number
	Correction value for the speed of the fourth axis group member (in user units)

Config

Variable name	Description
ePriority	Data type: LREAL – Floating-point number
	Balancing priority: • TorqueLeveling Torque balancing • SkewLeveling Skew balancing • SkewLevelingWithoutOverloadGuard Skew balancing without overload guard • UserDefinedVelCorrection User-defined speed correction values (*lrSetpVelCorrection1-4*)

TorqueLeveling

Variable name	Description
lrScaleFactor	Data type: LREAL – Floating-point number
	Factor for increasing torque balancing ("TorqueLeveling") 6 – Maximum dynamic behavior 0.0001 – Slow behavior
lrTimeConstant	Data type: LREAL – Floating-point number
	Integral time for TorqueLeveling in [s]
xSlipVelLimiterON	Data type – BOOL
	• TRUE – Activate anti-slip control • FALSE – Deactivate anti-slip control

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Variable name	Description
lrSlipVelMaxMin	Data type: LREAL – Floating-point number
	Speed limitation for anti-slip control (in user units)

SkewLeveling

Variable name	Description
lrPGain	Data type: LREAL – Floating-point number
	Factor for increasing skew balancing
eEnableSkewing	Data type – E_EnableSkewing
	• Manually: *xEnableSkewing* enables skew correction. • WithSetpointActive: Skew correction starts automatically when the inverters switch to control.
xVelDecLimiterON	Data type – BOOL
	Limits the balance controller correction values for speed and deceleration: • TRUE – Limit the speed and deceleration of "Skew priority" operating mode using *lrSkewMaxMin* and *lrAccDecSkew-MaxMin*. • FALSE – Do not limit the speed and deceleration of "Skew priority" operating mode.
xAccLimiterON	Data type – BOOL
	Limits the balance controller correction values for acceleration: • TRUE – Limit acceleration using *lrAccDecSkewMaxMin* • FALSE – Do not limit acceleration.
lrAccDecMaxMin	Data type: LREAL – Floating-point number
	Acceleration or deceleration limitation of the correction values of the balance controller (in user units)
lrVelMaxMin	Data type: LREAL – Floating-point number
	Speed limitation of the balance controller correction values (in user units)
eEncSelector	Data type – E_SKEWLEVELING_ENCSELECTOR
	Position source for "Skew priority" operating mode: • MotorEncoders – Mean position value of the motors • ExternalEncoders — Mean position value of the external encoders • MotorAndExternalEncoders – Mean position value of the motors and external encoders

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Variable name	Description
eOverload-Guard_EncSelector	Data type: E_SKEWLEVELINGOLGUARD_ENCSELECTOR
	Speed source for overload protection: • **MotorEncoders** – Speed of the motors • ExternalEncoders – Speed of the external encoders • MotorAndExternalEncoders –Speed combined of motors and external encoders • ExternalEncodersFiltered – Speed of external encoder filtered by *lrInputFilterTime_ExtEnc* (integral time of encoder evaluation)
lrSkewErrorWindow	Data type: LREAL – Floating-point number
	Window of the skew error (in user units) When the value is set to "0", the skew error window is disabled.

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ActDiffMeanToPosition

Variable name	Description
lrAGMember1	Data type: LREAL – Floating-point number
	Difference between the actual position of the first axis group member and the mean value of all axis group members (in user units)
lrAGMember2	Data type: LREAL – Floating-point number
	Difference between the actual position of the second axis group member and the mean value of all axis group members (in user units)
lrAGMember3	Data type: LREAL – Floating-point number
	Difference between the actual position of the third axis group member and the mean value of all axis group members (in user units)
lrAGMember4	Data type: LREAL – Floating-point number
	Difference between the actual position of the fourth axis group member and the mean value of all axis group members (in user units)

ActDiffMeanToTorque

Variable name	Description
lrAGMember1	Data type: LREAL – Floating-point number
	Difference between the actual torque of the first axis group member and the mean value of all axis group members in [1/Mn]

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Variable name	Description
lrAGMember2	Data type: LREAL – Floating-point number
	Difference between the actual torque of the second axis group member and the mean value of all axis group members in [1/Mn]
lrAGMember3	Data type: LREAL – Floating-point number
	Difference between the actual torque of the third axis group member and the mean value of all axis group members in [1/Mn]
lrAGMember4	Data type: LREAL – Floating-point number
	Difference between the actual torque of the fourth axis group member and the mean value of all axis group members in [1/Mn]

VelocityCorrection

Variable name	Description
lrSetp_AGMember1	Data type: LREAL – Floating-point number
	Speed correction value of the first axis group member (in user units)
xLimited_AGMember1	Data type: BOOL
	• TRUE – Limitation of the speed correction value of the first axis group member is active. • FALSE – Limitation of the speed correction value of the first axis group member is not active.
lrSetp_AGMember2	Data type: LREAL – Floating-point number
	Speed correction value of the second axis group member (in user units)
xLimited_AGMember2	Data type – BOOL
	• TRUE – Limitation of the speed correction value of the second axis group member is active. • FALSE – Limitation of the speed correction value of the second axis group member is not active.
lrSetp_AGMember3	Data type: LREAL – Floating-point number
	Speed correction value of the third axis group member (in user units)
xLimited_AGMember3	Data type – BOOL
	• TRUE – Limitation of the speed correction value of the third axis group member is active. • FALSE – Limitation of the speed correction value of the third axis group member is not active.
lrSetp_AGMember4	Data type: LREAL – Floating-point number
	Speed correction value of the fourth axis group member (in user units)

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Variable name	Description
xLimited_AGMember4	Data type – BOOL
	• TRUE – Limitation of the speed correction value of the fourth axis group member is active. • FALSE – Limitation of the speed correction value of the fourth axis group member is not active.

SkewLevelingOverloadGuard

Variable name	Description
lrManVal	Data type: LREAL – Floating-point number
	Controller correcting value that handles skew and overload (in user units)
xManVal_Limted	Data type: BOOL
	• TRUE – Limitation of the controller correcting value that handles skew and overload is active. • FALSE – Limitation of the controller correcting value that handles skew and overload is not active.

SkewLeveling

Variable name	Description
lrSkewError	Data type: LREAL – Floating-point number
	Current skew error (in user units)
xSkewError	Data type – BOOL
	• TRUE – Skew window exceeded • FALSE – Skew window not exceeded

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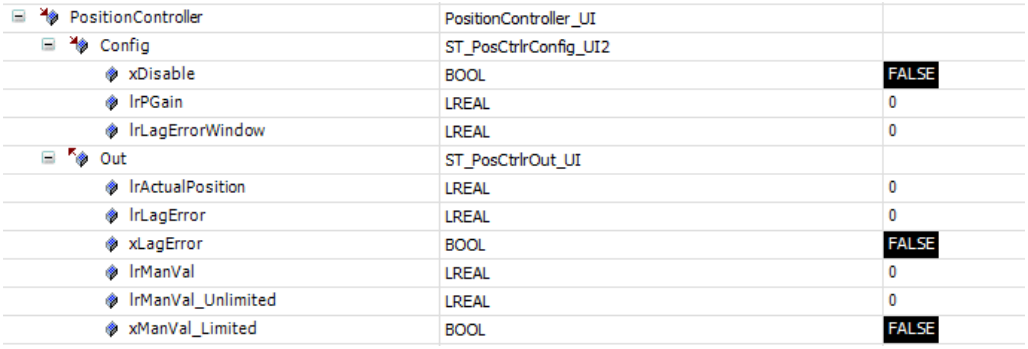
8.3.3 Position controller (PositionController)

Interface in the IEC Editor



PositionController	PositionController_UI	
Config	ST_PosCtrlrConfig_UI2	
xDisable	BOOL	FALSE
lrPGain	LREAL	0
lrLagErrorWindow	LREAL	0
Out	ST_PosCtrlrOut_UI	
lrActualPosition	LREAL	0
lrLagError	LREAL	0
xLagError	BOOL	FALSE
lrManVal	LREAL	0
lrManVal_Unlimited	LREAL	0
xManVal_Limited	BOOL	FALSE

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Config

Variable name	Description
xDisable	Data type – BOOL
	• TRUE – Switch off position controller • FALSE – Switch on position controller
lrPGain	Data type: LREAL – Floating-point number
	Position controller gain for minimizing lag errors Deactivated when the setting is "0".
lrLagErrorWindow	Data type: LREAL – Floating-point number
	Window of the actual lag error (in user units) Deactivated when set to "0"

OUT

Variable name	Description
lrActualPosition	Data type: LREAL – Floating-point number
	Actual position transferred to the position controller (in user units)
lrLagError	Data type: LREAL – Floating-point number
	Current lag error (in user units)
xLagError	Data type – BOOL
	• TRUE – Lag error present • FALSE – No lag error present
lrManVal	Data type: LREAL – Floating-point number
	Correcting value of the position controller (in user units)
lrManVal_Unlimited	Data type: LREAL – Floating-point number
	Correcting value of the position controller without limitation (in user units)

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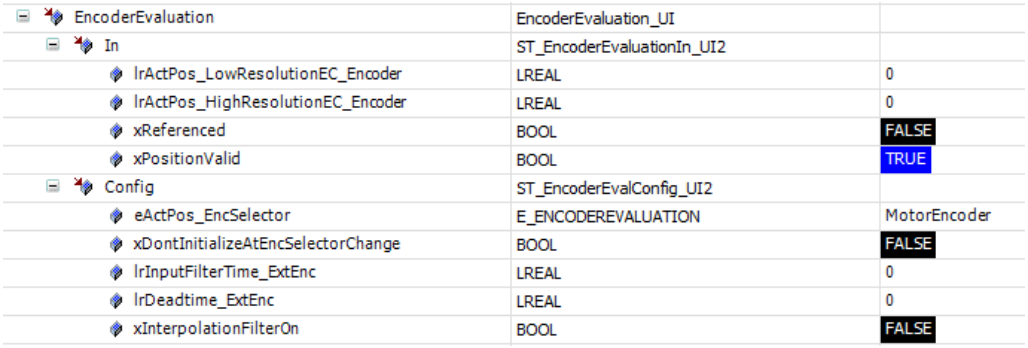
Variable name	Description
xManVal_Limited	Data type – BOOL
	• TRUE – Position controller correction value limited • FALSE – Position controller correction value not limited

8.3.4 Encoder evaluation (EncoderEvaluation)

Interface in the IEC Editor



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Config

INFORMATION

Bear in mind that the modulo reference could be lost when acknowledging an encoder fault.

Variable name	Description
eActPos_EncSelector	Data type: E_ENCODEREVALUATION
	Source for actual position: • MotorEncoder – Motor encoder • ExternalEncoder – External encoder • MotorAndExternalEncoder – Motor encoder and external encoder • MotorAndLowResolutionEC_Encoder – Motor encoder and low-resolution EtherCAT® encoder • HighResolutionEC_Encoder – High-resolution EtherCAT® encoder • LowResolutionEC_Encoder – Low-resolution EtherCAT® encoder • HighAndLowResolutionEC_Encoder – High and low-resolution EtherCAT® encoders
xDontInitializeAtEncSelectorChange	Data type – BOOL
	• TRUE – Initialize modulo and all filters when changing the encoder selection. • FALSE – Do not initialize modulo and all filters when changing the encoder selection (required for "on-the-fly" changes).

Variable name	Description
lrInputFilterTime_ExtEnc	Data type: LREAL – Floating-point number
	Integral time for encoder adjustment in [s] **Default value: 0.1**
lrDeadtime_ExtEnc	Data type: LREAL – Floating-point number
	Dead time of the external encoder in [s] **Default value: 0**
xInterpolationFilterOn	Data type – BOOL
	• TRUE – Filter external and low-resolution encoders • FALSE – Do not filter external and low-resolution encoders.

8.3.5 Anti-sway control (AntiSway)

Input variables (In)

Variable name	Description
lrSensorSignal	Data type: LREAL – Floating-point number
	Position of the master from external source in user units

Configuration (Config)

Structure with input variables to control the function.

Variable name	Description
eApplicationType	Data type – E_APPLICATIONTYPE
	Application type of anti-sway control: • NoAntiSway • TowerSway • PendulumSway (in preparation) • BellySway (in preparation) • FluidSway (in preparation) • SpringSway (in preparation) **Default value: 1**
lrUserUnitToMeter	Data type – E_APPLICATIONTYPE
	Position relationship between the user unit from the drive train and one meter in [m/user units] If the value is set to "0", the user unit corresponds to the unit [m]. If the value is not "0", the formula user unit*lrUserUnitToMeter = meter applies. The computing time is longer in this case. **Default value: 0**

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Setpoint correction (SetPointCorrection)

Structure with variables for configuring setpoint correction

Variable name	Description
eSelector	Data type – E_SETPOINTCORRECTIONSELECTOR
	• Off • AntiSway • Bandstop • TensionTimes
xStart	Data type – BOOL
	• TRUE – Start positioning Must be maintained until *Out.xBusy* has the value "FALSE". • FALSE – Stop positioning Is used when *eSelector* is "Bandstop" and *eApplicationType* is "TowerSway", "SpringSway" or "BellySway". For these types of application, the bandstop has residual inaccuracies when approaching the target. These inaccuracies are eliminated when the profile is below *BandStop.lrAdjustWindow* and is finished when the residual accuracy is less than 0.0001. Is used when *eSelector* is set to "AntiSway" and the application type is "BellySway". The application type "BellySway" has residual inaccuracies when the target is approached. These inaccuracies are eliminated when the profile is stopped and the target deviation is less than 0.0001.
xAdjustEnable	Data type – BOOL
	• TRUE – Allow residual inaccuracy movement • FALSE – Do not allow residual inaccuracy movement

Delay (TensionTimes)

The original motion profile is delayed by the sum of *lrJerkTime* and *lrRampTime*. During these times, the mechanical tension is built up which corresponds to the desired acceleration.

Variable name	Description
lrJerkTime	Data type: LREAL – Floating-point number
	Jerk time for the mechanical tension build-up in [s] Maximum <= 2000*PLC CycleTime **Default value: 0.05**
lrRampTime	Data type: LREAL – Floating-point number
	Ramp time for the mechanical tension build-up in [s] Maximum <= 2000*PLC CycleTime **Default value: 0.3**

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Bandstop (BandStop)

If *eSelector* is "Bandstop" and *eApplicationType* "TowerSway", "SpringSway" or "BellySway, there will be little residual inaccuracy when approaching the target. The inaccuracies are corrected if the profile has a deviation greater than 0.0001, the target position is only away from the target within a specified window, and the speed and acceleration in the standard profile are less than 10^{-6}. The dynamic values for sensor-based positioning are configured in the following parameters.

The tension can be built up by configuring *lrMassPayload*. This tension is built up using the dynamic values configured in the following parameters. Activation starts with *xStart* and *xAdjustEnable*.

Variable name	Description
lrAdjustVelocity	Data type: LREAL – Floating-point number
	Speed in [m/s] **Default value: ApplicationLimitVelocity**
lrAdjustAccDec	Data type: LREAL – Floating-point number
	Acceleration in [m/s^2] **Default value: ApplicationLimitVelocity**
lrAdjustGain	Data type: LREAL – Floating-point number
	P gain **Default value: 40**
lrAdjustWindow	Data type: LREAL – Floating-point number
	Window for starting sensor-based positioning in [m] Sensor-based positioning is performed when the profile is only away from the target within the window defined here. The process is terminated as soon as the deviation is ≤ 0.0001 m, the speed of the preset profile is ≤ 10^{-6} m/s, and the acceleration of the preset profile is ≤ 10^{-6} m/s^2. **Default value: 0.001**

Configuration of the trolley (DriveTrain)

Variable name	Description
lrHeightTower	Data type: LREAL – Floating-point number
	Tower height in [m] **Default value: 1**
lrDistanceHoistToCar	Data type: LREAL – Floating-point number
	Distance from lifting axis to travel axis in [m] **Default value: 1**
lrSpringTowerToCar	Data type: LREAL – Floating-point number
	Spring constant between tower and trolley in [Nm/wheel] **Default value: 1**

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Variable name	Description
lrMassCar	Data type: LREAL – Floating-point number
	Mass of the trolley without tower and lifting gear in [kg] **Default value: 1**
lrMassHoist	Data type: LREAL – Floating-point number
	Mass of the lifting gear without payload mass and without shuttle in [kg] **Default value: 1**
lrMassTower	Data type: LREAL – Floating-point number
	Mass of the tower without trolley, lifting gear, load mass and shuttle in [kg] **Default value: 1**
lrMassPayload	Data type: LREAL – Floating-point number
	Mass of the payload; shuttle is counted as payload in [kg] **Default value: 1**

Status (Out)

Variable name	Description
xBusy	Data type: LREAL – Floating-point number
	For *eApplicationType* "TowerSway", "BellySway" or "SpringSway": • FALSE – Anti-sway control inactive • TRUE – Anti-sway control active xBusy detects all changes triggered by anti-sway control compared to the original travel profile. **Default value: 0**
lrMaschineState	Data type: LREAL – Floating-point number
	For *eApplicationType* "TowerSway" or "SpringSway" and *eSelector* "Bandstop" **or** for *eApplicationType* "BellySway": • 0 – Sensor-based positioning inactive • 1 – Sensor-based positioning active For *eApplicationType* "SpringSway and without *eSelector* "Bandstop": • 0 – SpringSway inactive • 1 – SpringSway active **Default value: 0**

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AntiSway correcting values (ManipulatedValues)

Variable name	Description
lrPosition	Data type: LREAL – Floating-point number
	Position (in user units) **Default value: 0**
lrVelocity	Data type: LREAL – Floating-point number
	Speed (in user units) **Default value: 0**
lrAccDec	Data type: LREAL – Floating-point number
	Acceleration (in user units) **Default value: 0**

AntiSway setpoints (ModifiedSetpoints)

Setpoints sent to the controller following the AntiSway function.

Variable name	Description
lrPosition	Data type: LREAL – Floating-point number
	Position (in user units) **Default value: 0**
lrVelocity	Data type: LREAL – Floating-point number
	Speed (in user units) **Default value: 0**
lrAccDec	Data type: LREAL – Floating-point number
	Acceleration (in user units) **Default value: 0**

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8.3.6 Actual values (ActualValues)

Interface in the IEC Editor

ActualValues	ST_ActualValuesAG_UI2	
FromSubAxis	ARRAY [1..gc_usiMaxIndexOfController] OF ST_ActualValues	
FromSubAxis[1]	ST_ActualValues_VelocityInterpolated	
xActive	BOOL	FALSE
lrPosition	LREAL	0
lrVelocity	LREAL	0
lrIntegralVelCtrlr	LREAL	0
lrAcceleration	LREAL	0
lrTorque	LREAL	0
lrAdvancedSendObject	LREAL	0
xReferenced	BOOL	FALSE
xSetpointActive	BOOL	FALSE
FromSubAxis[2]	ST_ActualValues_VelocityInterpolated	
FromSubAxis[3]	ST_ActualValues_VelocityInterpolated	
FromSubAxis[4]	ST_ActualValues_VelocityInterpolated	
ToSuperAxis	SEW_IDM.ST_ActualValues_VelocityInterpolated	
xActive	BOOL	FALSE
lrPosition	LREAL	0
lrVelocity	LREAL	0
lrIntegralVelCtrlr	LREAL	0
lrAcceleration	LREAL	0
lrTorque	LREAL	0
lrAdvancedSendObject	LREAL	0
xReferenced	BOOL	FALSE
xSetpointActive	BOOL	FALSE
ToPG	SEW_IDM.ST_ActualValues_PositioningInterpolated	
xActive	BOOL	FALSE
lrPosition	LREAL	0
lrVelocity	LREAL	0
lrAcceleration	LREAL	0
lrTorque	LREAL	0
xReferenced	BOOL	FALSE
xSetpointActive	BOOL	FALSE

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FromSubAxis[1..4]

Actual values that are transmitted to the axis group by subordinate axis group members.

The dynamic parameters are scaled in user units.

Variable name	Description
xActive	Data type – BOOL
	• TRUE – Activated • FALSE – Not activated
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocity	Data type: LREAL – Floating-point number
	Speed (velocity)
lrIntegralVelCtrlr	Data type: LREAL – Floating-point number
	I component of the speed controller
lrAcceleration	Data type: LREAL – Floating-point number
	Acceleration

Variable name	Description
lrTorque	Data type: LREAL – Floating-point number
	Current torque of the nominal motor torque in percent (1.0 = 100% M_N)
lrAdvancedSendObject	Data type: LREAL – Floating-point number
	Actual position sent to the axis or axis group from an external source
xReferenced	Data type – BOOL
	• TRUE – All relevant encoders are referenced • FALSE – Not all the relevant encoders are referenced
xSetpointActive	Data type – BOOL
	• TRUE – Setpoints are processed • FALSE – Setpoints are not processed

ToSuperAxis

Mean value of the actual values of all related axis group members transmitted to the higher-level axis group member via the *VelocityInterpolated* interface.

BOOLEAN variables are linked by logical operator AND.

The dynamic parameters are scaled in user units.

Variable name	Description
xActive	Data type – BOOL
	• TRUE – Activated • FALSE – Not activated
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocity	Data type: LREAL – Floating-point number
	Speed (velocity)
lrIntegralVelCtrlr	Data type: LREAL – Floating-point number
	I component of the speed controller
lrAcceleration	Data type: LREAL – Floating-point number
	Acceleration
lrTorque	Data type: LREAL – Floating-point number
	Current torque of the nominal motor torque in percent (1.0 = 100% M_N)
lrAdvancedSendObject	Data type: LREAL – Floating-point number
	Actual position sent to the axis or axis group from an external source
xReferenced	Data type – BOOL
	• TRUE – All relevant encoders are referenced • FALSE – Not all the relevant encoders are referenced

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Variable name	Description
xSetpointActive	Data type – BOOL
	• TRUE – Setpoints are processed • FALSE – Setpoints are not processed

ToPG

Mean value of the actual values of all subordinate axis group members transmitted to the profile generator via the *PositioningInterpolated* interface.

The dynamic parameters are scaled in user units.

Variable name	Description
xActive	Data type – BOOL
	• TRUE – Activated • FALSE – Not activated
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocity	Data type: LREAL – Floating-point number
	Speed (velocity)
lrAcceleration	Data type: LREAL – Floating-point number
	Acceleration
lrTorque	Data type: LREAL – Floating-point number
	Current torque of the nominal motor torque in percent (1.0 = 100% M_N)
xReferenced	Data type – BOOL
	• TRUE – All relevant encoders are referenced • FALSE – Not all the relevant encoders are referenced
xSetpointActive	Data type – BOOL
	• TRUE – Setpoints are processed • FALSE – Setpoints are not processed

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8.3.7 Setpoints (SetpointValues)

Interface in the IEC Editor

SetpointValues	ST_SetpointValuesAG_UI	
FromPG	SEW_IDM.ST_SetpointValues_PositioningInterpolated	
xActivate	BOOL	FALSE
lrPosition	LREAL	0
lrVelocityPrecontrol	LREAL	0
lrAccelerationPrecontrol	LREAL	0
lrTorquePrecontrol	LREAL	0
lrInertiaScale	LREAL	0
lrTorqueLimit	LREAL	32.767
FromSuperAxis	SEW_IDM.ST_SetpointValues_VelocityInterpolated	
xActivate	BOOL	FALSE
lrPosition	LREAL	0
lrVelocity	LREAL	0
lrAccelerationPrecontrol	LREAL	0
lrTorquePrecontrol	LREAL	0
lrManValPosCtrlr	LREAL	0
lrInertiaScale	LREAL	0
lrTorqueLimit	LREAL	32.767
ToSubAxis	ARRAY [1..gc_usiMaxIndexOfController] OF SEW_IDM.ST_SetpointValues	
ToSubAxis[1]	SEW_IDM.ST_SetpointValues_VelocityInterpolated	
xActivate	BOOL	FALSE
lrPosition	LREAL	0
lrVelocity	LREAL	0
lrAccelerationPrecontrol	LREAL	0
lrTorquePrecontrol	LREAL	0
lrManValPosCtrlr	LREAL	0
lrInertiaScale	LREAL	0
lrTorqueLimit	LREAL	32.767
ToSubAxis[2]	SEW_IDM.ST_SetpointValues_VelocityInterpolated	
ToSubAxis[3]	SEW_IDM.ST_SetpointValues_VelocityInterpolated	
ToSubAxis[4]	SEW_IDM.ST_SetpointValues_VelocityInterpolated	

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FromPG

Setpoints transmitted by the profile generator via the *PositioningInterpolated* interface. The dynamic parameters are scaled in user units.

Variable name	Description
xActivate	Data type – BOOL
	• TRUE – Activate • FALSE – Stop – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" ≤ 0, the operating mode stops at the last setpoint position, and speed and acceleration go to zero. – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" is > 0, profile generation stops with the deceleration *lrStopDeceleration* and the set jerk *lrStopJerk*.
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocityPrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of speed

Variable name	Description
lrAccelerationPrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of acceleration
lrTorquePrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of torque in [1/M_n]
lrIntertiaScale	Data type: LREAL – Floating-point number
	Inertia scaling in [kg*m^2]
lrTorqueLimit	Data type: LREAL – Floating-point number
	Torque limit (1.0 = 100% M_N)

FromSuperAxis

Setpoints transmitted by the higher-level axis group member via the *VelocityInterpolated* interface.

The dynamic parameters are scaled in user units.

Variable name	Description
xActivate	Data type – BOOL
	• TRUE – Activate • FALSE – Stop – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" ≤ 0, the operating mode stops at the last setpoint position, and speed and acceleration go to zero. – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" is > 0, profile generation stops with the deceleration *lrStopDeceleration* and the set jerk *lrStopJerk*.
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocity	Data type: LREAL – Floating-point number
	Speed (velocity)
lrAccelerationPrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of acceleration
lrTorquePrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of torque in [1/M_n]
lrIntertiaScale	Data type: LREAL – Floating-point number
	Inertia scaling in [kg*m^2]
lrTorqueLimit	Data type: LREAL – Floating-point number
	Torque limit (1.0 = 100% M_N)

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ToSubAxis[1..4]

Setpoints transmitted by the axis group to the subordinate axis group members via the *VelocityInterpolated* interface.

The dynamic parameters are scaled in user units.

Variable name	Description
xActivate	Data type – BOOL
	• TRUE – Activate • FALSE – Stop – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" ≤ 0, the operating mode stops at the last setpoint position, and speed and acceleration go to zero. – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" is > 0, profile generation stops with the deceleration *lrStopDeceleration* and the set jerk *lrStopJerk*.
lrPosition	Data type: LREAL – Floating-point number
	Position
lrVelocity	Data type: LREAL – Floating-point number
	Speed (velocity)
lrAccelerationPrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of acceleration
lrTorquePrecontrol	Data type: LREAL – Floating-point number
	Precontrol value of torque in [$1/M_n$]
lrManVal	Data type: LREAL – Floating-point number
	Correcting value of the position controller
lrIntertiaScale	Data type: LREAL – Floating-point number
	Inertia scaling in [$kg*m^2$]
lrTorqueLimit	Data type: LREAL – Floating-point number
	Torque limit (1.0 = 100% M_N)

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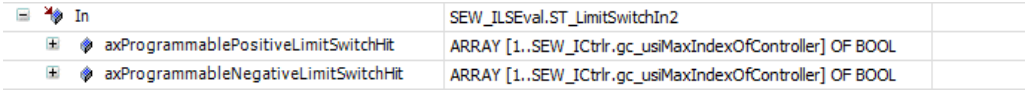
8.4 Limit switch evaluation (LimitSwitchEvaluation)

8.4.1 Input variables (In)

Input variables for user-specific hardware limit switches

Interface in the IEC Editor



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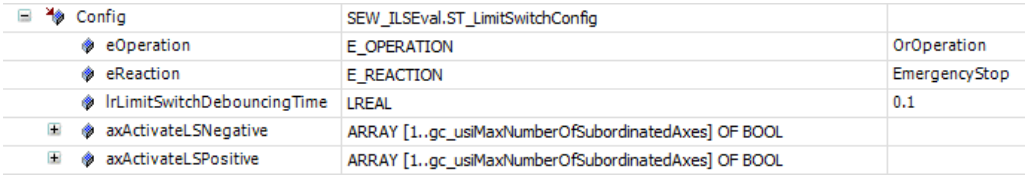
Variable name	Description
axProgrammable-NegativeLimitSwitch-Hit	Data type: Array of BOOL
	• TRUE – Programmable limit switch hit in negative direction • FALSE – Programmable limit switch not hit in negative direction
axProgrammable-PositiveLimitSwtich-Hit	Data type: Array of BOOL
	• TRUE – Programmable limit switch hit in positive direction • FALSE – Programmable limit switch not hit in positive direction

8.4.2 Configuration (Config)

Interface in the IEC Editor



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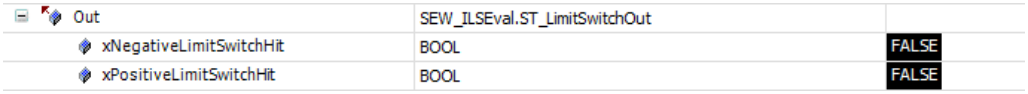
Variable name	Description
eOperation	Data type: E_Operation
	Logical operation of the hardware limit switches: • OrOperation • AndOperation
eReaction	Data type: LREAL – E_Reaction
	Select the fault response when *xNegativeLimitSwitchHit* and/or *xPositiveLimitSwitchHit* are set to "TRUE". • NoReaction • EmergencyStop • EmergencyStopWithSelfReset (in preparation)
lrLimitSwitch DebouncingTime	Data type: LREAL – Floating-point number
	Debouncing time for the limit switches in [s] **Default value: 0.2**
axActivateLSNegative	Data type: Array of BOOL
	• TRUE – Include negative limit switch in the logical operation. • FALSE – Do not include negative limit switch in the logical operation.

Variable name	Description
axActivateLSPositive	Data type: Array of BOOL
	• TRUE – Include positive limit switch in the logical operation. • FALSE – Do not include positive limit switch in the logical operation.

8.4.3 Status (Out)

Interface in the IEC Editor



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Variable name	Description
xNegativeLimit-SwitchHit	Data type: BOOL
	• TRUE – Hardware limit switch is approached in a negative direction. • FALSE – Hardware limit switch is not approached in a negative direction.
xPositiveLimit-SwitchHit	Data type: BOOL
	• TRUE – Hardware limit switch is approached in a positive direction. • FALSE – Hardware limit switch is not approached in a positive direction.

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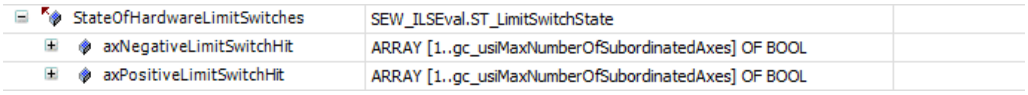
8.4.4 Hardware limit switches (StateOfHardwareLimitSwitches)

Interface in the IEC Editor



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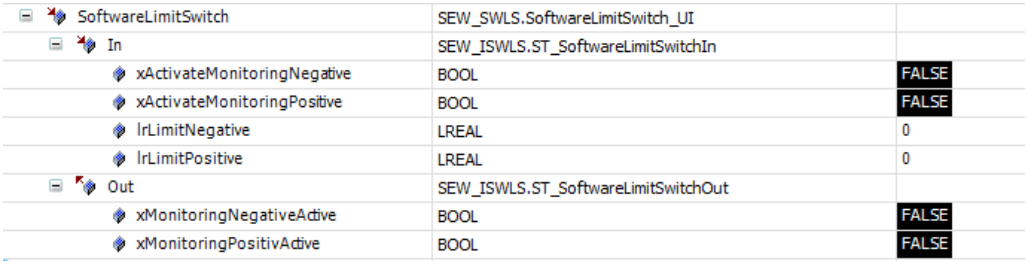
Variable name	Description
axNegativeLimit-SwitchHit	Data type: Array of BOOL
	• TRUE – Negative hardware limit switch is approached. • FALSE – Negative hardware limit switch is not approached.
axPositiveLimit-SwitchHit	Data type: Array of BOOL
	• TRUE – Positive hardware limit switch is approached. • FALSE – Positive hardware limit switch is not approached.

8.4.5 Software limit switches (SoftwareLimitSwitch)

The *SoftwareLimitSwitch* structure contains the control and status variables of the software limit switches.

Interface in the IEC Editor



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IN

Variable name	Description
xActivateMonitoring-Negative	Data type – BOOL
	• TRUE – Activate monitoring of software limit switch in negative direction • FALSE – Deactivate monitoring of software limit switch in negative direction
xActivateMonitoring-Positive	Data type – BOOL
	• TRUE – Activate monitoring of software limit switch in positive direction • FALSE – Deactivate monitoring for a software limit switch in a positive direction.
lrLimitNegative	Data type: LREAL – Floating-point number
	Position of the software limit switch in negative direction (in user units)
lrLimitPositive	Data type: LREAL – Floating-point number
	Position of the software limit switch in positive direction (in user units)

OUT

Variable name	Description
xMonitoringNegativeActive	Data type – BOOL
	• TRUE – Monitoring for software limit switch in a negative direction is active. • FALSE – Monitoring for software limit switch in negative direction is not active
xMonitoringPositiveActive	Data type: BOOL
	• TRUE – Monitoring for software limit switch in a positive direction is active. • FALSE – Monitoring for software limit switch in a positive direction is not active.

8.5 Referencing (Homing)

Interface in the IEC Editor

Homing	HomingAxisGroup_UI	
In	SEW_IMAC.ST_HomingIn_UI	
xActivate	BOOL	FALSE
xStart	BOOL	FALSE
xReferenceCam	BOOL	FALSE
Config	SEW_IMAC.ST_HomingConfig_UI	
eReferenceTravelType	E_REFSTRATEGY	Deactivated
lrReferenceOffset	LREAL	0
lrLimitSwitchDebouncingTime	LREAL	0
lrSearchVelocity	LREAL	0
lrClearVelocity	LREAL	0
lrAcceleration	LREAL	0
lrDeceleration	LREAL	0
lrJerk	LREAL	0
xMoveToStartPosition	BOOL	FALSE
lrStartPosition	LREAL	0
lrStartPosVelocity	LREAL	0
HomingAG	ST_HomingConfigAG2_UI	
xActivateEncoderHoming	BOOL	FALSE
Readjustment	ST_Readjustment	
Out	SEW_IMAC.ST_HomingOut_UI	
lrSetpPosition	LREAL	0
lrDeltaPosition	LREAL	0
lrSetpVelocity	LREAL	0
lrSetpAcceleration	LREAL	0
xDone	BOOL	FALSE
xInPosition	BOOL	FALSE
xModeActive	BOOL	FALSE
xProfileActive	BOOL	FALSE
xStopped	BOOL	FALSE
eHomingState	E_HOMINGSTATE	Init

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8.5.1 Input variables (In)

Variable name	Description
xActivate	Data type – BOOL
	• TRUE – Activate • FALSE – Stop – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" ≤ 0, the operating mode stops at the last setpoint position, and speed and acceleration go to zero. – If *xActivate* is set to "FALSE" and *lrStopDeceleration*" is > 0, profile generation stops with the deceleration *lrStopDeceleration* and the set jerk *lrStopJerk*.
xStart	Data type – BOOL
	• TRUE – Start function • FALSE – Stop function
xReferenceCam	Data type – BOOL
	Input of the reference cam For reference travel types that evaluate this input, the user will need to connect the input in an appropriate manner. • TRUE – Travel to limit switch • FALSE – Do not travel to limit switch

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8.5.2 Configuration (Config)

The dynamic parameters are scaled in user units.

Variable name	Description
eReferenceTravelType	Data type: E_REFSTRATEGY
	Reference travel types: • Deactivated Reference travel deactivated • ZeroPulseNegDir (not supported) Zero pulse – negative direction • RefCamNegEnd Reference cam – negative end • RefCamPosEnd Reference cam – positive end • LimitSwitchPos Positive limit switch • LimitSwitchNeg Negative limit switch • ReferencingWithoutRefTravel Referencing without reference travel • RefCamFlushLimitSwitchPos Reference cam flush – limit switch positive • RefCamFlushLimitSwitchNeg Reference cam flush – limit switch negative • ReferencingWithoutRefTravelRT8 (not supported) Referencing without reference travel • FixedStopPos (not supported) Fixed stop positive • FixedStopNeg (not supported) Fixed stop negative
lrReferenceOffset	Data type: LREAL – Floating-point number
	Reference offset
lrSearchVelocity	Data type: LREAL – Floating-point number
	Search speed for reference travel
lrClearVelocity	Data type: LREAL – Floating-point number
	Retraction speed for reference travel
lrAcceleration	Data type: LREAL – Floating-point number
	Acceleration
lrDeceleration	Data type: LREAL – Floating-point number
	Deceleration

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Variable name	Description
lrJerk	Data type: LREAL – Floating-point number
	Jerk
xMoveToStartPosition	Data type – BOOL
	• TRUE – Perform homing immediately after referencing • FALSE – Do not perform homing immediately after referencing
lrStartPosition	Data type: LREAL – Floating-point number
	Target position of homing
lrStartPosVelocity	Data type: LREAL – Floating-point number
	Homing speed

HomingAG

Variable name	Description
xActivateEncoder-Homing	Data type – BOOL
	• TRUE – Perform encoder referencing in FCB 12 using reference travel type "Referencing without reference travel". • FALSE – Do not perform encoder referencing

Readjustment

Variable name	Description
xActivate	Data type – BOOL
	• TRUE – Activate readjustment • FALSE – Deactivate readjustment
usiLSNegativeAG-Member1	Data type: USINT
	Select which negative limit switch is to apply to readjustment of the first axis group member.
usiLSPositiveAG-Member1	Data type: USINT
	Select which positive limit switch is to apply to readjustment of the first axis group member.
usiLSNegativeAG-Member2	Data type: USINT
	Select which negative limit switch is to apply to readjustment of the second axis group member.
usiLSPositiveAG-Member2	Data type: USINT
	Select which positive limit switch is to apply to readjustment of the second axis group member.
lrSafetyDistance	Data type: LREAL – Floating-point number
	Distance permitted for readjustment (in user units). If this distance is exceeded, an error is displayed. To deactivate the function, specify a value of "0". **Default value: 0**

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Variable name	Description
lrSafetyTime	Data type: LREAL – Floating-point number
	Time permitted for readjustment in [s] If this time period is exceeded, an error is displayed. To deactivate the function, specify a value of "0". **Default value: 0**

8.5.3 Status (Out)

The dynamic parameters are scaled in user units.

Variable name	Description
lrSetpPosition	Data type: LREAL – Floating-point number
	Setpoint position
lrDeltaPosition	Data type: LREAL – Floating-point number
	Position difference to the last PLC cycle in PLC units
lrSetpVelocity	Data type: LREAL – Floating-point number
	Target speed
lrSetpAcceleration	Data type: LREAL – Floating-point number
	Setpoint acceleration
xDone	Data type – BOOL
	• TRUE – Process is complete • FALSE – Process is not complete
xInPosition	Data type – BOOL
	• TRUE – Specified position is reached The *xInPosition* variable can only be "TRUE" if homing has been carried out. • FALSE – Specified position is not reached
xModeActive	Data type – BOOL
	• TRUE – Operating mode is activated • FALSE – Operating mode is not activated
xProfileActive	Data type – BOOL
	• TRUE – Profile generation is active • FALSE – Profile generation is not active
xStopped	Data type – BOOL
	• TRUE – Profile generation is stopped • FALSE – Profile generation is active

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Variable name	Description
eHomingState	Data type – E_HOMINGSTATE
	Referencing step. • Init • AlignEncoder • Homing • WriteConfigToAxesForReadjustment • Readjustment • ZeroiseEncoderPosition • ZeroisePGAndTravelToHomePosition

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9 Diagnostics

9.1 Monitor

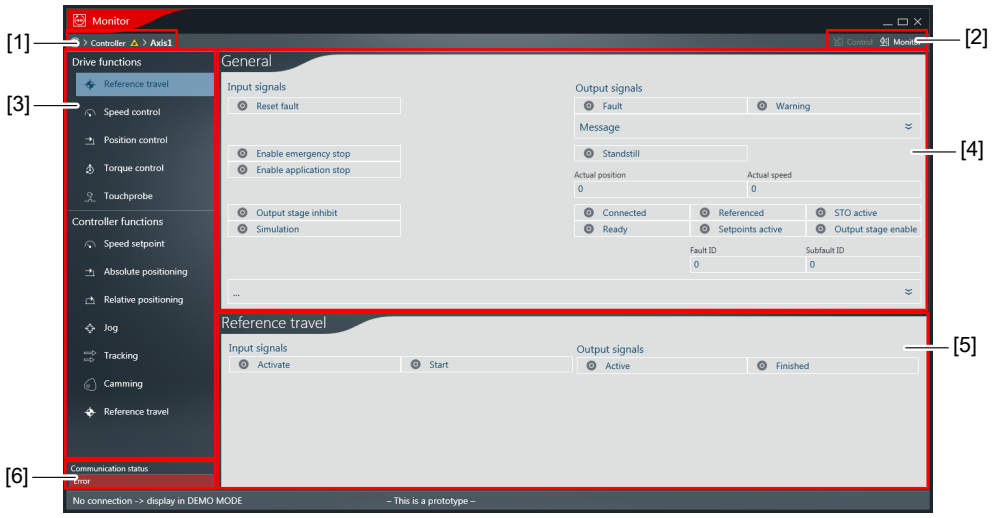
INFORMATION

Only available with "Advanced" permission level.

The MultiMotion monitor is a tool in the MOVISUITE® engineering software for monitoring and controlling axes or axis groups.

In MOVISUITE®, click [Monitor] in the Tools menu to open the tool from the context menu of a specific node.

The user interface of the MultiMotion monitor includes the following areas:



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No.	Area	Description
[1]	Device path and name	Path and name of the axis/axis group
[2]	Mode switching	• "Control" mode: Operating mode for setting control bits and control values. Control via the IEC program is ignored. • "Monitor" mode: Operating mode for monitoring the input and output values. In this mode, the monitor only has read-only rights and displays the values set by the controller.
[3]	Main menu	Main menu for opening the configuration menus of the functions available in each case, such as drive functions, controller functions, or functions of software modules.
[4]	General	Input and output signals of general settings
[5]	Functions	Depending on the function selected from the main menu, this area displays the corresponding input and output signals.
[6]	Communication status	Status of the communication link

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10 Application examples

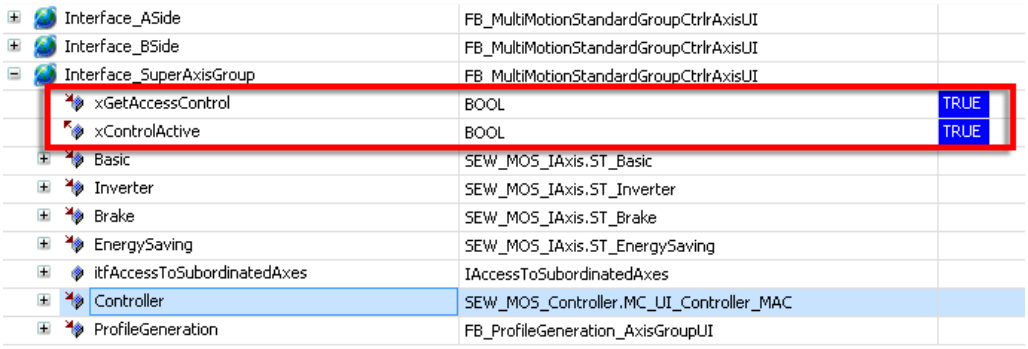
The following application examples are based on implementation using a demo unit comprising the MOVI-C® CONTROLLER power, a double axis with two CMP50S motors, and a single axis with a DRS71S motor.

10.1 Using one axis group

The following application example for the software module illustrates use with one axis group. Access management, in particular, is explained in more detail. In addition, the example shows how access management can be used to remove individual group members from a cascade at runtime.

10.1.1 Requesting access and enabling the axis group

1. Set the *xGetAccessControl* variable of the *SuperAxisGroup* to "TRUE" to request access to the user interface of the axis group.



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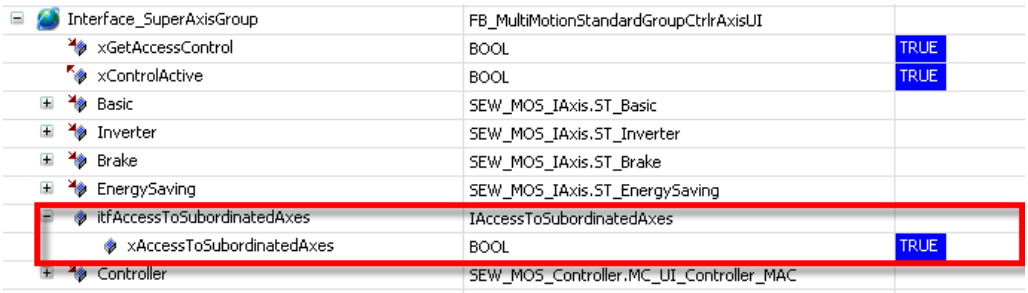
⇨ If the request was successful, the *xControlActive* variable provides the value "TRUE".

⇨ If the request was not successful, access was also requested by an instance with a higher priority. For the priority assignment, refer to chapter "Access management" (→ 🖹 58).

INFORMATION

If access to an axis group was requested via the user interface, the axis group requests access from its subordinate group members. If access is granted by all group members, the *xAccessToSubordinatedAxes* variable provides the value "TRUE".



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2. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE" to enable the axis group.

Interface_ASide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Interface_BSide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Interface_SuperAxisGroup	FB_MultiMotionStandardGroupCtrlrAxisUI	
xGetAccessControl	BOOL	TRUE
xControlActive	BOOL	TRUE
Basic	SEW_MOS_IAxis.ST_Basic	
IN	ST_Basic_IN	
xEnable_EmergencyStop	BOOL	TRUE
xEnable_ApplicationStop	BOOL	TRUE
xReset	BOOL	FALSE
OUT	ST_Basic_OUT	
Inverter	SEW_MOS_IAxis.ST_Inverter	
Brake	SEW_MOS_IAxis.ST_Brake	
EnergySaving	SEW_MOS_IAxis.ST_EnergySaving	
itfAccessToSubordinatedAxes	IAccessToSubordinatedAxes	
Controller	SEW_MOS_Controller.MC_UI_Controller_MAC	
ProfileGeneration	FB_ProfileGeneration_AxisGroupUI	

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⇨ The 3 inverters switch to DeviceMode "VelocityInterpolated" (The inverter's display shows FCB 6, and the *eActualInverterMode* variable in the *Inverter.OUT* structure of the *SuperAxisGroup* provides the value "Velocity-Interpolated").

Interface_ASide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Interface_BSide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Interface_SuperAxisGroup	FB_MultiMotionStandardGroupCtrlrAxisUI	
xGetAccessControl	BOOL	TRUE
xControlActive	BOOL	TRUE
Basic	SEW_MOS_IAxis.ST_Basic	
Inverter	SEW_MOS_IAxis.ST_Inverter	
IN	ST_Inverter_IN	
OUT	ST_Inverter_OUT	
xConnected	BOOL	TRUE
xPowered	BOOL	TRUE
xReady	BOOL	TRUE
xReferenced	BOOL	FALSE
xSetpointActive	BOOL	TRUE
xSafeStop	BOOL	FALSE
wDigitalInputs	WORD	0
lrActualTorque	LREAL	-0.00125
eActualInverterMode	E_INVERTERMODE	VelocityInterpolated

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INFORMATION

If the value "Unknown" is shown, not all group members are using the same operating mode.

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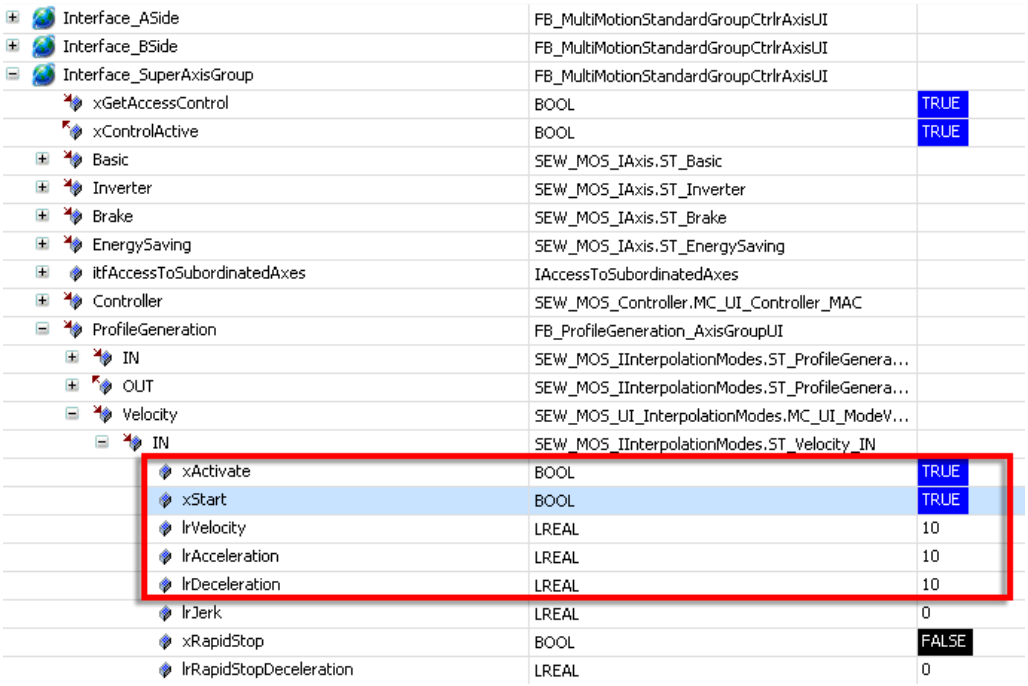
10.1.2 Moving the axis group

1. In the *ProfileGeneration.Velocity.IN* structure of the *SuperAxisGroup*, enter the appropriate values for the *lrVelocity*, *lrAcceleration*, and *lrDeceleration* variables.
2. Set the *xActivate* and *xStart* variables to "TRUE" to carry out a movement.



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⇨ The 3 motors carry out the specified movement.

10.1.3 Removing group members from a cascade

In this step of the application example, the "ASide" axis group is removed from the cascade. The resulting effects are explained in more detail.

1. Using the *Interface_SuperAxisGroup* instance, carry out the steps for "SuperAxis-Group" as described in chapter "Requesting access and enabling the axis group" (→ 🗎 93).
2. Using the *Interface_ASide* instance, carry out the steps for "ASide" as described in chapter "Requesting access and enabling the axis group" (→ 🗎 93).
3. Using the *Interface_ASide* instance, carry out the steps for "ASide" as described in chapter "Moving the axis group" (→ 🗎 95).

Interface_ASide	FB_MultiMotionStandardGroupCtrlrAxisUI	
xGetAccessControl	BOOL	TRUE
xControlActive	BOOL	TRUE
Basic	SEW_MOS_IAxis.ST_Basic	
IN	ST_Basic_IN	
xEnable_EmergencyStop	BOOL	TRUE
xEnable_ApplicationStop	BOOL	TRUE
xReset	BOOL	FALSE
OUT	ST_Basic_OUT	
Inverter	SEW_MOS_IAxis.ST_Inverter	
Brake	SEW_MOS_IAxis.ST_Brake	
EnergySaving	SEW_MOS_IAxis.ST_EnergySaving	
itfAccessToSubordinatedAxes	IAccessToSubordinatedAxes	
Controller	SEW_MOS_Controller.MC_UI_Controller_MAC	
ProfileGeneration	FB_ProfileGeneration_AxisGroupUI	
IN	SEW_MOS_IInterpolationModes.ST_ProfileGenera...	
OUT	SEW_MOS_IInterpolationModes.ST_ProfileGenera...	
Velocity	SEW_MOS_UI_InterpolationModes.MC_UI_ModeV...	
IN	SEW_MOS_IInterpolationModes.ST_Velocity_IN	
xActivate	BOOL	TRUE
xStart	BOOL	TRUE
lrVelocity	LREAL	1
lrAcceleration	LREAL	10
lrDeceleration	LREAL	10
lrJerk	LREAL	0
xRapidStop	BOOL	FALSE
lrRapidStopDeceleration	LREAL	0

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⇨ While the "ASide" is moving, the "BSide" travels in the opposite direction. The reason for this behavior is that the higher-level position controller tries to keep both axis groups in their position. However, since the "SuperAxisGroup" has no impact on the "ASide", no compensation movement can take place to cause the "ASide" to go into standstill.

4. Set the enable signals of the SuperAxisGroup to "FALSE", and then back to "TRUE" once in standstill.

INFORMATION

When the enable signals are set to "TRUE", both the profile generator and the controller are reset.

⇨ The position of the "SuperAxisGroup" is reinitialized when the enable signals are set to "TRUE" in standstill.

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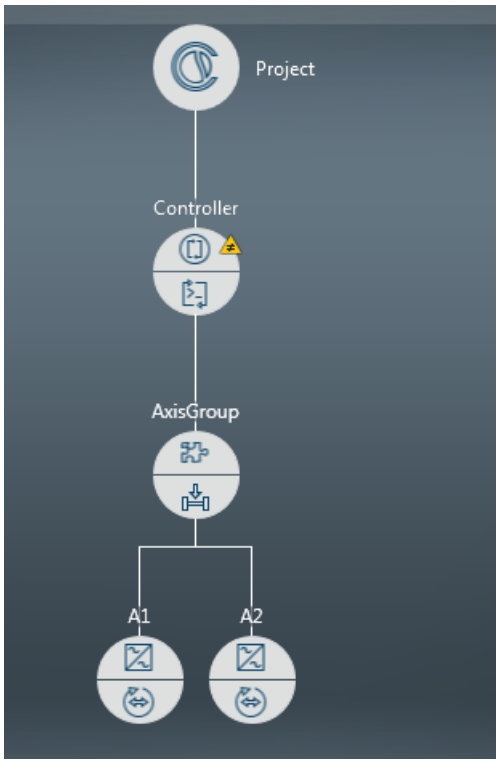
10.1.4 Referencing an axis group

This chapter describes the referencing of an axis group controlled by the software module.

Referencing is based on the following project structure:



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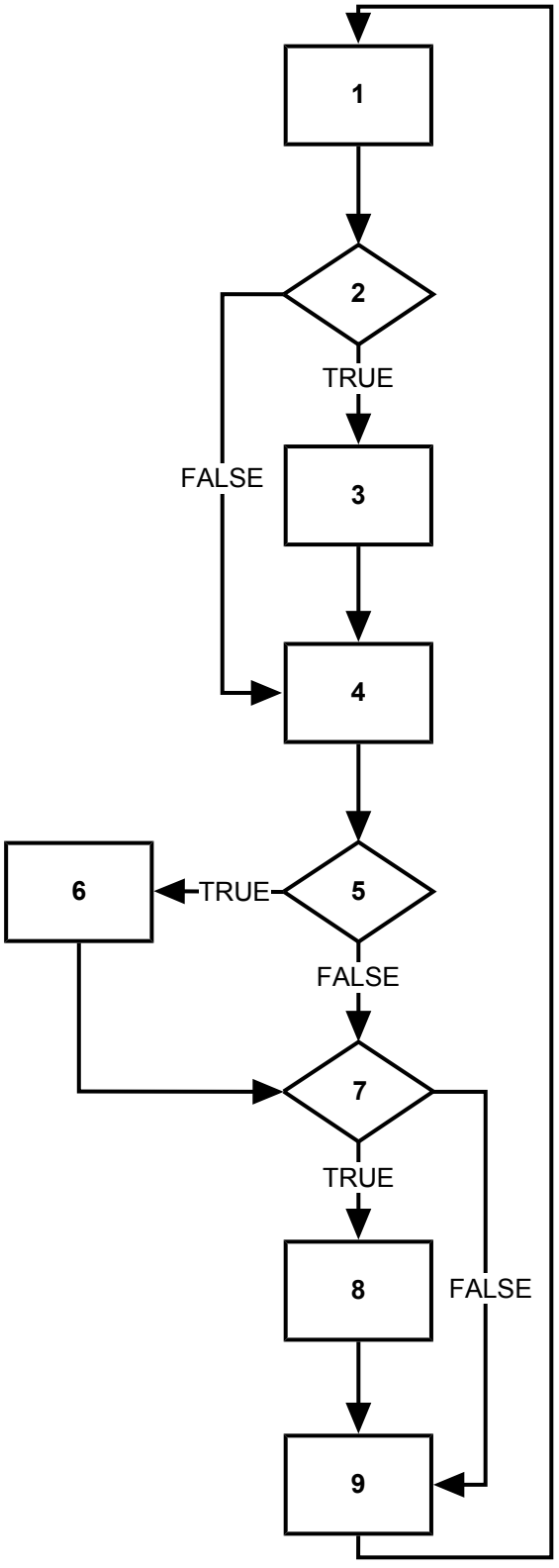
Referencing follows the following procedure:

1. Wait for referencing of the axis group to start. The system always skips to this step after the sequence of steps has completed.
2. Query as to whether referencing of the motor encoder has been configured. If this is the case, step 3 is carried out. If this is not the case, the system skips to step 4.
3. Reference the motor encoders of the axis group members. In the example project, the motor encoders of axis group members "A1", "A2", and "A3" would be referenced if "SuperAxisGroup" referencing was selected. A decentralized referencing (FCB12) of type "Referencing without reference travel" is carried out.
4. Using the reference travel type selected, carry out the profile generation of the axis group.
5. Query as to whether alignment of the axis group members has been configured. If this is the case, step 6 is carried out. If this is not the case, the system skips to step 7. **INFORMATION:** Only possible with two axis group members and in the reference travel types "Positive limit switch" and "Negative limit switch". Applied to the example project, this means that the only axis groups aligned are the "ASide" and "BSide" axis groups. The individual axis group members "A1" and "A2" are not simultaneously aligned when "SuperAxisGroup" referencing is selected.
6. Align the subordinate group members. Depending on the logical operations of the limit switches, either the "ASide" or the "BSide" is aligned. With a logical AND operation, the group member aligned is the one that has not yet left its limit switch. With an OR operation, the group member aligned is the one that has not yet reached its limit switch.
7. Query as to whether referencing of the motor encoder has been configured. If this is the case, step 8 is carried out. If this is not the case, the system skips to step 9.
8. Reference the motor encoders of the axis group members. In the example project, the motor encoders of axis group members "A1", "A2", and "A3" would be referenced if "SuperAxisGroup" referencing was selected. A decentralized referencing (FCB12) of type "Referencing without reference travel" is carried out.
9. Reference the profile generator of the axis group using reference travel type "Referencing without reference travel". This is followed by the system traveling to its home position.



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10.2 SRS trolley (torque priority)

The following application example for the software module illustrates the use of "Torque priority" operating mode.

10.2.1 Setting a preload/pretension

INFORMATION

A better illustration of this process can be provided by coupling the drives, e.g. using a toothed belt drive.

The software module offers the option of setting a preload/pretension between certain group members. This ensures, for example, that a belt always remains tensioned with the same force.

1. Set the *MAC.Config.ePriority* variable of the *ASide* to *TorqueLeveling* to activate "Torque priority" operating mode.
2. Set the *xGetAccessControl* variable of the *ASide* to "TRUE" to request access to the user interface of the axis group member.
   ⇨ If the request was successful, the *xControlActive* variable provides the value "TRUE.
3. In the *Controller.CONFIG* structure of the *ASide*, enter the value "0.5 "(half the nominal torque) for the *lrTorqueBetweenAxis1_2* variable.

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4. Set the *xActivate* and *xStart* variables to "TRUE" to carry out a movement.

Interface_ASide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Status	SEW_IError.ST_Status	
xStatusReset	BOOL	FALSE
xGetAccessControl	BOOL	TRUE
xControlActive	BOOL	TRUE
Basic	SEW_MOS_IAxis.ST_Basic	
IN	ST_Basic_IN	
xEnable_EmergencyStop	BOOL	TRUE
xEnable_ApplicationStop	BOOL	TRUE
xReset	BOOL	FALSE
OUT	ST_Basic_OUT	
Inverter	SEW_MOS_IAxis.ST_Inverter	
Brake	SEW_MOS_IAxis.ST_Brake	
EnergySaving	SEW_MOS_IAxis.ST_EnergySaving	
itfAccessToSubordinatedAxes	IAccessToSubordinatedAxes	
ProfileGeneration	SEW_MOS_MultiMotionStandardAxis.FB_ProfileGeneration_MultiMotion	
Controller	SEW_MOS_Controller.MC_UI_Controller_MAC	
IN	ST_BasicValues_IN	
eControlSource	E_CONTROLSOURCE	USERINTERFACE
OUT	ST_BasicValues_OUT	
CONFIG	ST_ConfigMultiAxis	
uiAssociatedAxes	UINT	3
lrTorqueRelationAxis1	LREAL	1
lrTorqueRelationAxis2	LREAL	1
lrTorqueRelationAxis3	LREAL	1
lrTorqueRelationAxis4	LREAL	1
lrTorqueBetweenAxis1_2	LREAL	0.5
lrTorqueBetweenAxis2_3	LREAL	0
lrTorqueBetweenAxis3_4	LREAL	0
lrTorqueBetweenAxis4_1	LREAL	0
AntiSway	MC_UI_AntiSway	
MAC	MC_UI_MAC	
PositionController	MC_UI_PositionController	
EncoderEvaluation	MC_UI_EncoderEvaluation	
ActualValues	ST_ActualValues_UI_MAC	
SetpointValues	ST_SetpointValues_UI_MAC	

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⇨ The two drives move in opposite directions.

5. Block each drive, one after the other.

⇨ Half the nominal torque is now set for each of the two drives. The only difference is the mathematical sign.

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10.2.2 Setting the load distribution

The software module offers the option of setting a load distribution between certain group members. This setting allows you to assign a certain torque ratio between each of the 4 group members and the other group members.

1. Set the *MAC.Config.ePriority* variable of the *ASide* to *TorqueLeveling* to activate "Torque priority" operating mode.
2. Set the *xGetAccessControl* variable of the *ASide* to "TRUE" to request access to the user interface of the axis group member.
   ⇨ If the request was successful, the *xControlActive* variable provides the value "TRUE.
3. In the *Controller.CONFIG* structure of the *ASide*, enter the value "0.65" for the *TorqueRelation.lrAGMember1* variable and the value "0.433" for the *TorqueRelation.lrAGMember2* variable.
4. Set the *xActivate* and *xStart* variables to "TRUE" to carry out a movement.

Interface_ASide	FB_MultiMotionStandardGroupCtrlrAxisUI	
Status	SEW_IError.ST_Status	
xStatusReset	BOOL	FALSE
xGetAccessControl	BOOL	TRUE
xControlActive	BOOL	TRUE
Basic	SEW_MOS_IAxis.ST_Basic	
IN	ST_Basic_IN	
xEnable_EmergencyStop	BOOL	TRUE
xEnable_ApplicationStop	BOOL	TRUE
xReset	BOOL	FALSE
OUT	ST_Basic_OUT	
Inverter	SEW_MOS_IAxis.ST_Inverter	
Brake	SEW_MOS_IAxis.ST_Brake	
EnergySaving	SEW_MOS_IAxis.ST_EnergySaving	
itfAccessToSubordinatedAxes	IAccessToSubordinatedAxes	
ProfileGeneration	SEW_MOS_MultiMotionStandardAxis.FB_ProfileGeneration_MultiMotion	
Controller	SEW_MOS_Controller.MC_UI_Controller_MAC	
IN	ST_BasicValues_IN	
eControlSource	E_CONTROLSOURCE	USERINTERFACE
OUT	ST_BasicValues_OUT	
CONFIG	ST_ConfigMultiAxis	
uiAssociatedAxes	UINT	3
lrTorqueRelationAxis1	LREAL	0.65
lrTorqueRelationAxis2	LREAL	0.433
lrTorqueRelationAxis3	LREAL	1
lrTorqueRelationAxis4	LREAL	1
lrTorqueBetweenAxis1_2	LREAL	0
lrTorqueBetweenAxis2_3	LREAL	0
lrTorqueBetweenAxis3_4	LREAL	0
lrTorqueBetweenAxis4_1	LREAL	0
AntiSway	MC_UI_AntiSway	
MAC	MC_UI_MAC	
PositionController	MC_UI_PositionController	
EncoderEvaluation	MC_UI_EncoderEvaluation	
ActualValues	ST_ActualValues_UI_MAC	
SetpointValues	ST_SetpointValues_UI_MAC	

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⇨ Group member 1 delivers a torque of 0.65 Nm and group member 2 a torque of 0.433 Nm. The ratio can be set either by configuring a value between 0 and 100% or by specifying the torque.

5. Turn A1 until it sets a torque of 50% of the nominal torque (corresponds to a torque of 0.65 Nm).
6. Hold A2 firmly.
   ⇨ A torque of 33% of the nominal torque is set (corresponds to a torque of 0.433 Nm).

GVL_User.Interface_A1.Inverter.OUT.lrActualTorque	PLC.Application	LREAL	-0.487
GVL_User.Interface_A2.Inverter.OUT.lrActualTorque	PLC.Application	LREAL	-0.25

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INFORMATION

Note that you cannot manually set the torques with great precision.

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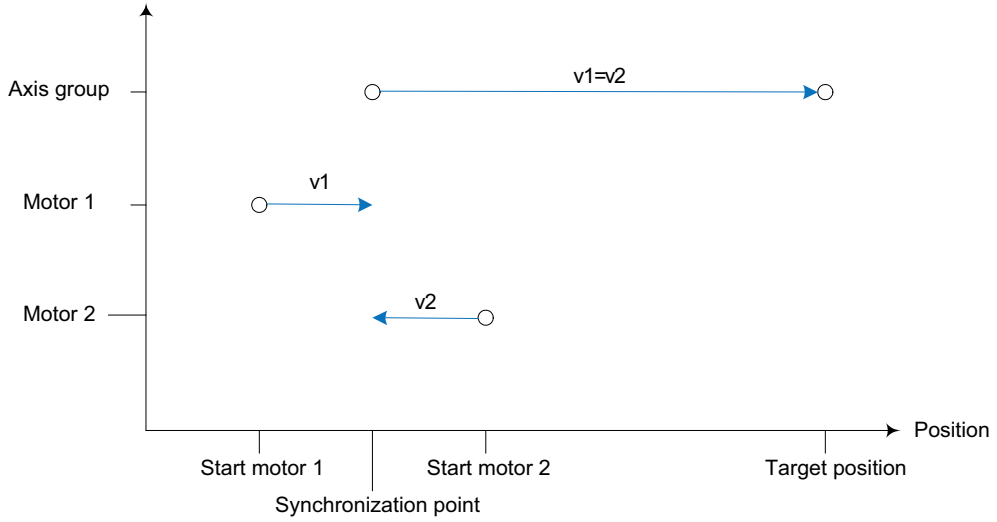
10.3 Indoor crane (skew priority)

The following application example for the software module illustrates the use of "Skew priority" operating mode.

10.3.1 Types of synchronization

If the group members are not in the same position when the software module starts balance control, make sure to first synchronize the system. For example, an offset may occur when a group member was moved separately beforehand. There are two different synchronization options:

- The two group members move toward each other until they meet in the middle. Then, the two group members move as a group to the specified target position.



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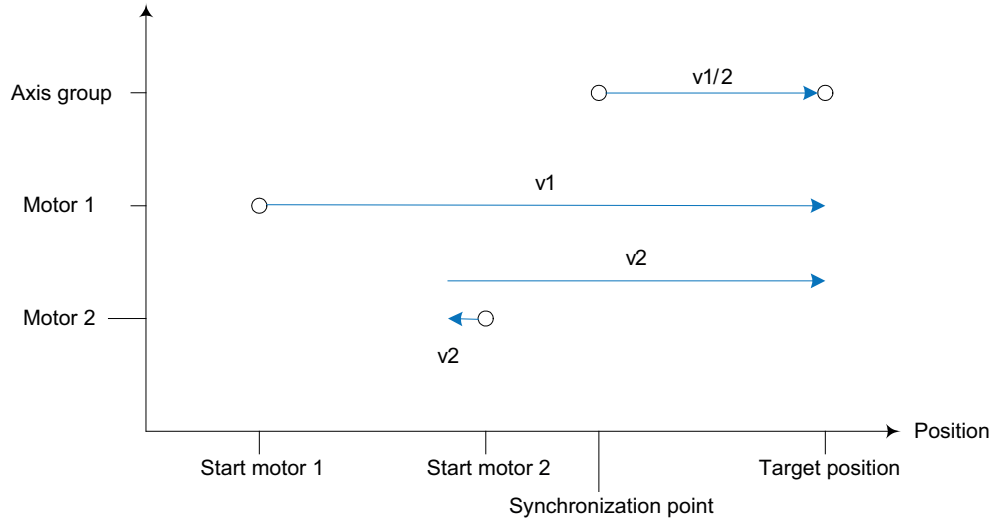
- Group member 2 briefly travels toward group member 1, then changes direction and synchronizes its movement to the movement of group member 1. Depending on the parameterization of the controllers, it is also possible that group member 2 remains in its position until group member 1 has reached the same position.



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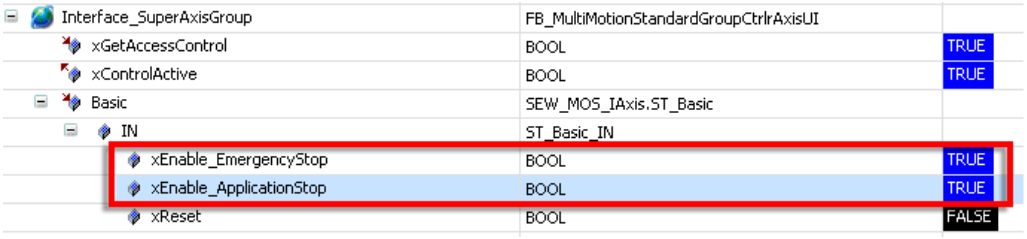
Synchronizing group members first

1. Set the *MAC.Config.ePriority* variable of the *SuperAxisGroup* to the value "SkewLevelingWithoutOverloadGuard" to activate the operating mode "Skew priority – without overload protection", and reference all group members.
2. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE".



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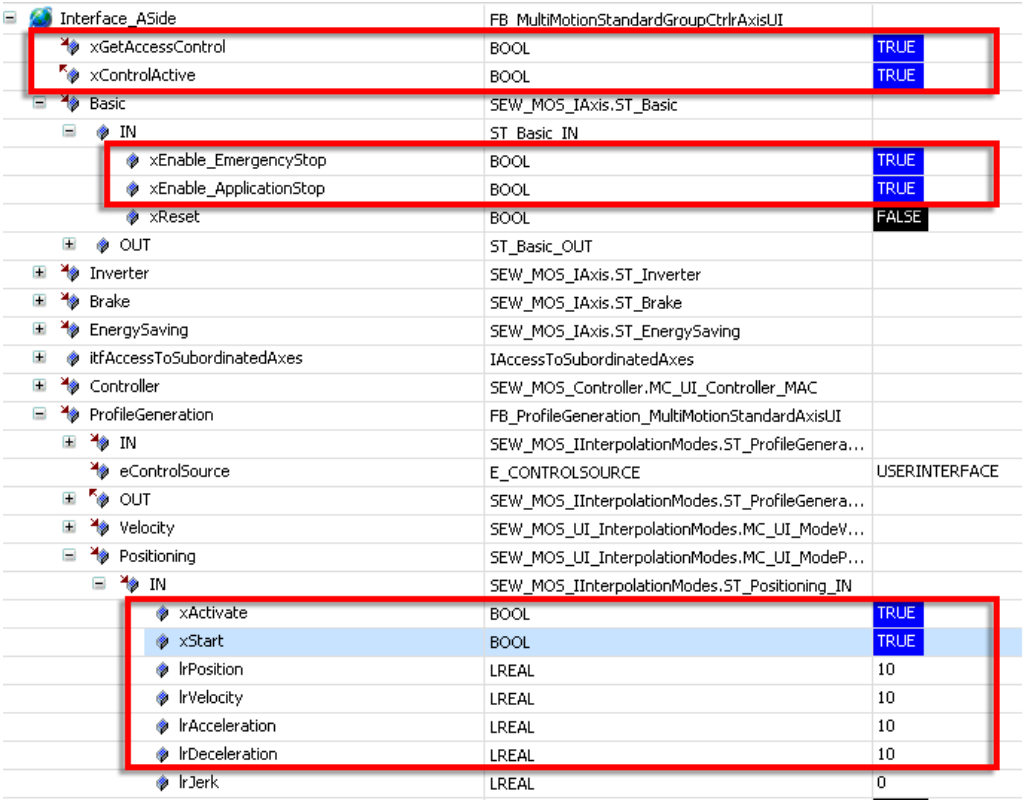
3. Set the *xGetAccessControl* variable of the *ASide* to "TRUE" to request access to the user interface of the axis group member.

   ⇨ If the request was successful, the *xControlActive* variable provides the value "TRUE.

4. In the *Basic.IN* structure of the *ASide*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE" to enable the axis group member.
5. In the *ProfileGeneration.Positioning.IN* structure of the *ASide*, enter 10 as the *lrPosition* target position.
6. In the *ProfileGeneration.Positioning.IN* structure of the *ASide*, enter 10 for *lrVelocity*, *lrAcceleration*, and *lrDeceleration* for the movement of the axis group member.
7. Set the *xActivate* and *xStart* variables to "TRUE" to carry out a movement.



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8. Set the *xGetAccessControl* variable of the *ASide* to "FALSE" to terminate access to the axis group.
9. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE" to enable the axis group.

GVL_User_MAC.Interface_ASide.Basic.OUT.lrActualPosition	PLC.Application	LREAL	0.06836
GVL_User_MAC.Interface_BSide.Basic.OUT.lrActualPosition	PLC.Application	LREAL	-0.0441600
GVL_User_MAC.Interface_ASide.Controller.OUT.PositionControllerState.lrPosLagDistance	PLC.Application	LREAL	-0.06836
GVL_System_MAC.SuperAxisGroup.Controller.CONFIG.stConfigMAC.lrMACPriority_Torque_	PLC.Application	LREAL	2
GVL_User_MAC.Interface_ASide.xGetAccessControl	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_ASide.Basic.IN.xEnable_EmergencyStop	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_ASide.Basic.IN.xEnable_ApplicationStop	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.xActivate	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.xStart	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.lrPosition	PLC.Application	LREAL	10
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.lrVelocity	PLC.Application	LREAL	10
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.lrAcceleration	PLC.Application	LREAL	10
GVL_User_MAC.Interface_ASide.ProfileGeneration.Positioning.IN.lrDeceleration	PLC.Application	LREAL	10
GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_ApplicationStop	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_EmergencyStop	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.xActivate	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.xStart	PLC.Application	BOOL	FALSE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrPosition	PLC.Application	LREAL	300
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrVelocity	PLC.Application	LREAL	10
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrAcceleration	PLC.Application	LREAL	10
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrDeceleration	PLC.Application	LREAL	10

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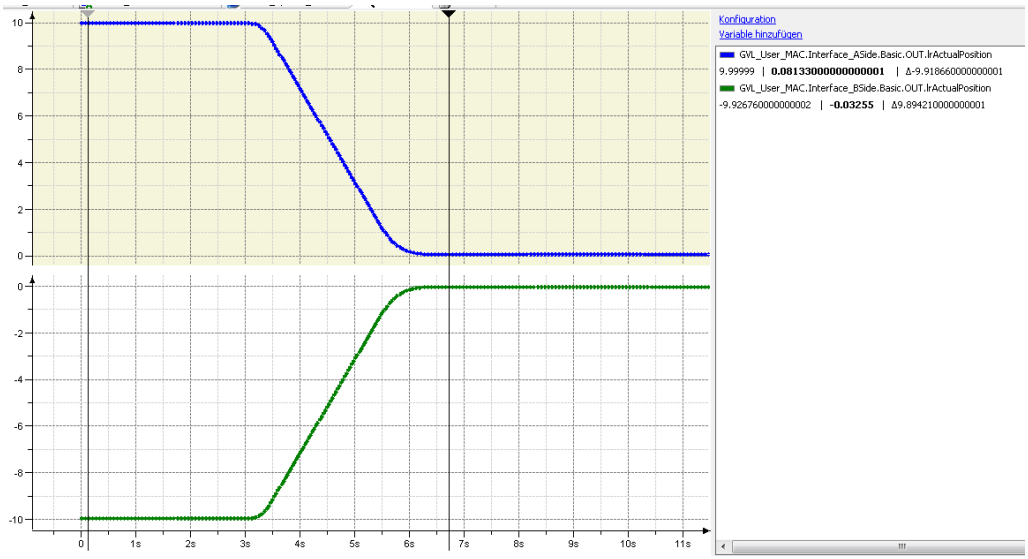
⇨ The two group members move in opposite directions until both have reached a position of "0".

⇨ The two group members move as a group to the specified target position.



Trace recording of the synchronization

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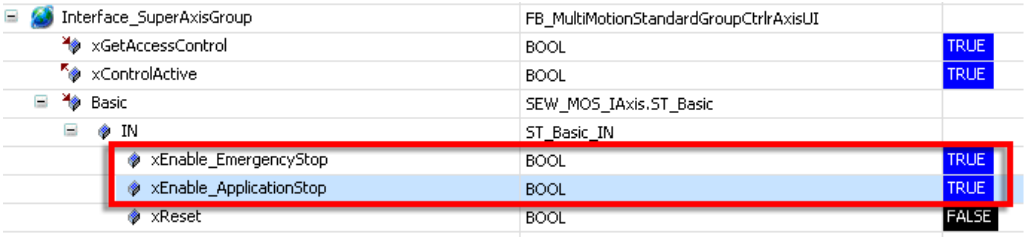
Group members synchronize while moving

1. Set the *lrMACPriority_Torque_Skew* variable of the *SuperAxisGroup* to the value "2" to activate the operating mode "Skew priority – without overload protection", and reference all group members.
2. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE".



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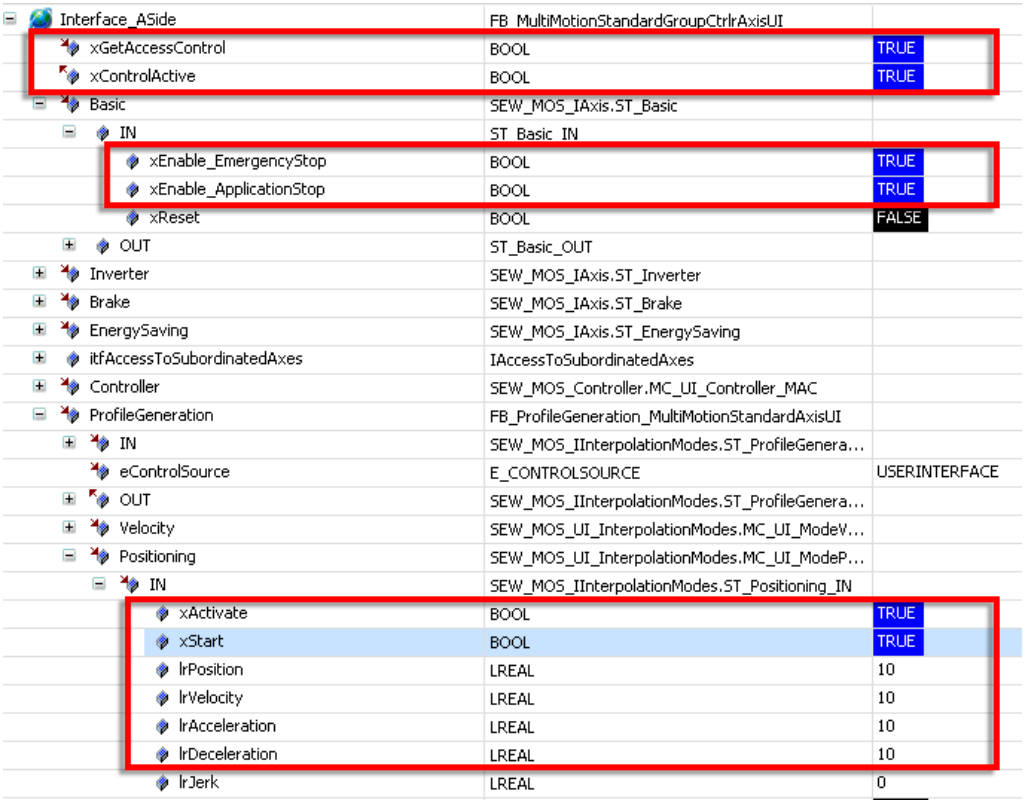
3. Set the *xGetAccessControl* variable of the *ASide* to "TRUE" to request access to the user interface of the axis group.

   ⇨ If the request was successful, the *xControlActive* variable provides the value "TRUE.

4. In the *Basic.IN* structure of the *ASide*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE" to enable the axis group.
5. In the *ProfileGeneration.Positioning.IN* structure of the *ASide*, enter 10 as the *lrPosition* target position.



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6. Set the *xGetAccessControl* variable of the *ASide* to "FALSE" to terminate access to the axis group.
7. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE" to enable the axis group.

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8. At the same time, set the following signals in the "Positioning" structure.
9. In the *ProfileGeneration.Positioning.IN* structure of the *SuperAxisGroup*, enter the value "100" as the *lrPosition* target position.
10. In the *ProfileGeneration.Positioning.IN* structure of the *SuperAxisGroup*, enter the value "10" for *lrVelocity*, *lrAcceleration*, and *lrDeceleration* for the movement of the axis group.
11. In the *ProfileGeneration.Positioning.IN* structure of the *SuperAxisGroup*, set the *xActivate* and *xStart* variables to "TRUE" to carry out a movement.

GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_ApplicationStop	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_EmergencyStop	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.xActivate	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.xStart	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrPosition	PLC.Application	LREAL	100
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrVelocity	PLC.Application	LREAL	10
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrAcceleration	PLC.Application	LREAL	10
GVL_User_MAC.Interface_SuperAxisGroup.ProfileGeneration.Positioning.IN.lrDeceleration	PLC.Application	LREAL	10

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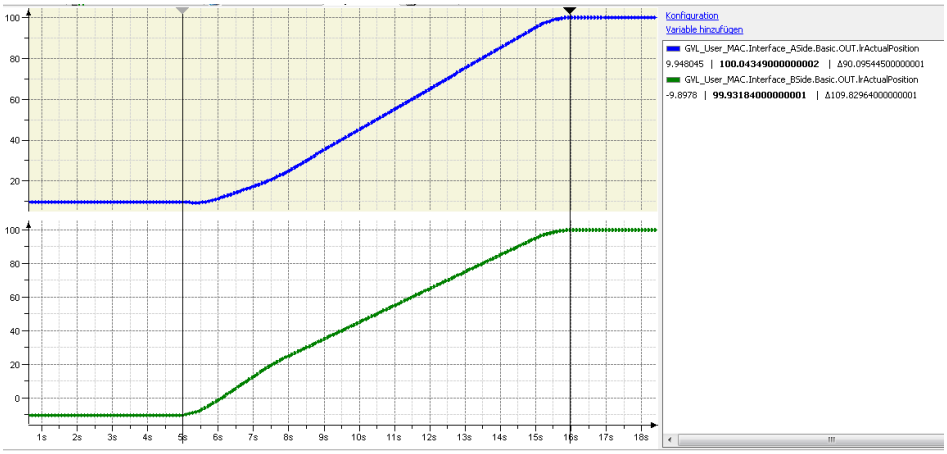
⇨ By simultaneously setting the enable signals and the values in the *ProfileGeneration.Positioning.IN* structure, both axis groups move in the direction of the target position.



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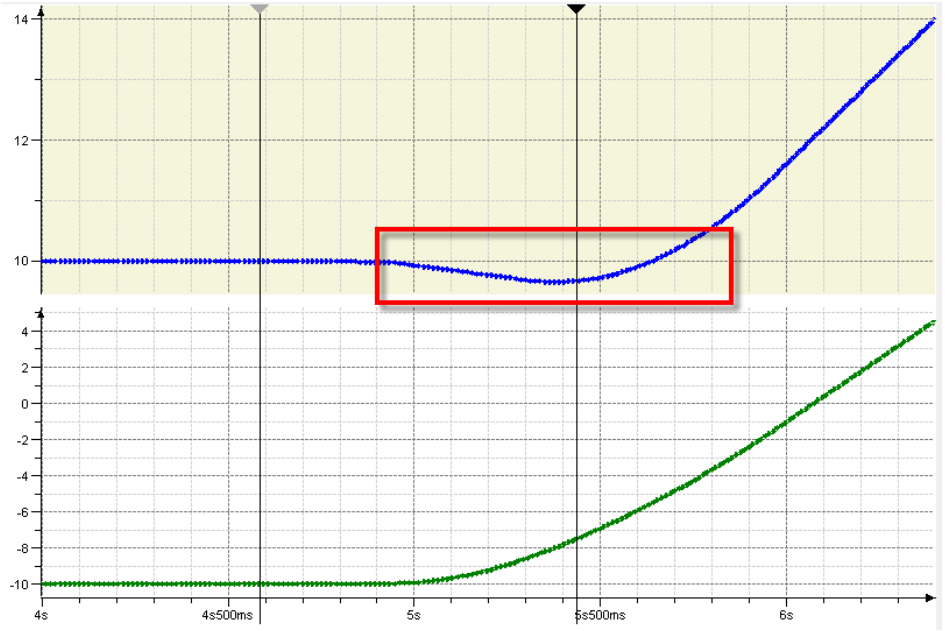
⇨ A closer look reveals that the *ASide* initially moves briefly in the direction of the *BSide* and only then in the direction of the target position. This corresponds to the behavior described for synchronization type "Group members synchronize while moving".



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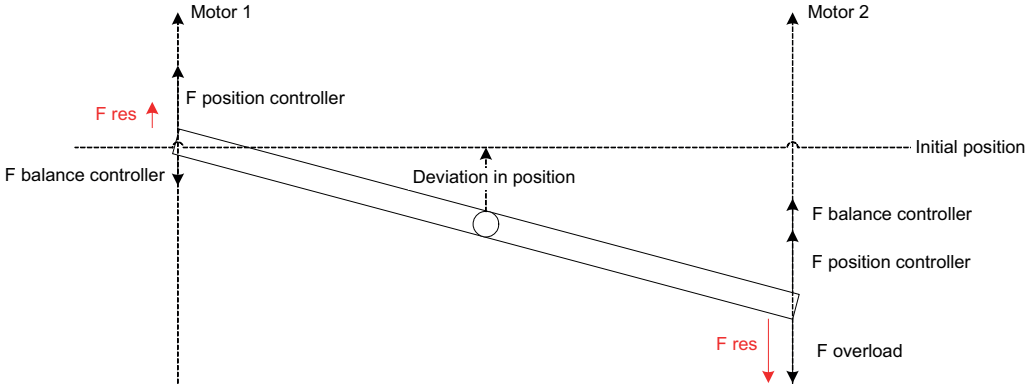
10.3.2 Overload protection

The following application example for the software module illustrates the "Overload protection" function integrated into "Skew priority" operating mode. The example below uses a hoist to show how the group members behave when a drive is overloaded.

- Without overload protection

  When a drive on a hoist is overloaded, the affected side begins to lower, resulting in a deviation in position within the axis group. The position controller then tries to compensate for this deviation in position by specifying a correcting value for the axis group, which applies to both drives. The balance controller recognizes that the drives are in a different position to each other and tries to compensate for this. The correcting value of the balance controller thus counteracts the correcting value of the position controller for drive 1. Depending on the configuration of the individual controllers, this may worsen the tilt or misalignment of the hoist. For drive 2, the balance controller and the position controller both act in the same direction. However, since drive 2 has reached its torque limit, it can no longer generate the required torque.



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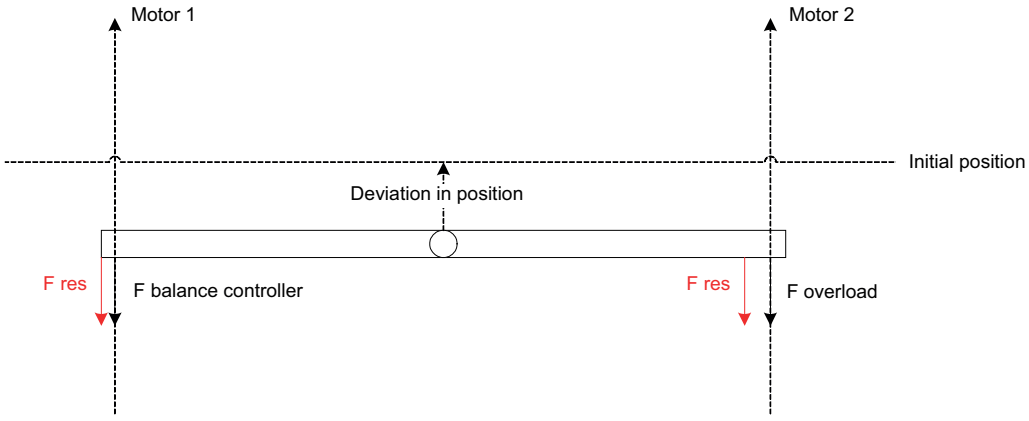
- With overload protection

  The software module detects that group member 2 has reached its maximum torque, and, therefore, eliminates the correcting value specified by the position controller. Drive 1 then continues to react to the misalignment of the application and moves downwards synchronously with drive 2.



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Example

1. Adjust the following values in the *SuperAxisGroup* structure:

GVL_System_MAC.SuperAxisGroup.Controller.CONFIG.stConfigMAC.lrVelSkewMaxMin	PLC.Application	LREAL	23
GVL_System_MAC.SuperAxisGroup.Controller.CONFIG.stConfigMAC.lrAccDecSkewMaxMin	PLC.Application	LREAL	100

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2. Set the *rMACPriority_Torque_Skew* variable of the *SuperAxisGroup* to the value "2" to activate the operating mode "Skew priority – without overload protection".

GVL_System_MAC.SuperAxisGroup.Controller.CONFIG.stConfigMAC.lrMACPriority_Torque_Skew	PLC.Application	LREAL	2

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3. In the *Basic.IN* structure of the *SuperAxisGroup*, set the *xEnable_EmergencyStop* and *xEnable_ApplicationStop* variables to "TRUE".

GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_ApplicationStop	PLC.Application	BOOL	TRUE
GVL_User_MAC.Interface_SuperAxisGroup.Basic.IN.xEnable_EmergencyStop	PLC.Application	BOOL	TRUE

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   ⇨ All axis group members of the *SuperAxisGroup* are enabled.

4. Simultaneously turn the two motors of the *ASide* by hand, making sure they go beyond their nominal torque.

   ⇨ The *BSide* moves along in the opposite direction. This corresponds to a behavior **without overload protection**.

5. Set the *lrMACPriority_Torque_Skew* variable to 1.

6. Simultaneously turn the two motors of the *ASide* by hand, making sure they go beyond their nominal torque.

   ⇨ The *BSide* moves along in the same direction. This corresponds to a behavior **with overload protection**.

⇨ Overload protection serves the purpose of preventing major damage to the system, and allows for the hoist to be lowered in a controlled manner until the brake engages.

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10.4 Starting up a dual-column hoist with external encoder in combined operation

1. Measuring the load moment of inertia: There are two ways depending on the application:
   - ⇨ If a motor alone can move the application in no-load condition, then the load cycling mode of the inverter can be used. In this case the second inverter is switched to controller inhibit and the brake is released. Finally, the measured value of the load moment of inertia is divided by two and entered in both inverters.
   - ⇨ If one motor alone is not sufficient to move the application in no-load condition, then encoder evaluation in the MultiAxisController must be set to "Motor encoder" and load cycling must be performed using the IEC Editor or the monitor. For example in jog mode with direction of rotation reversal. The measured value for load moment of inertia of one inverter can then be transferred to the other inverter.
2. Adjusting stiffness and clearance of the inverter: This can be done as usual and both parameters can be increased until the oscillation on the torque/current stops or decreases slightly. In this case, the encoder evaluation of the MultiAxisController is also set to "Motor encoder".
3. Configuring the MultiAxisController: Encoder evaluation can now be set to "Motor encoder and external encoder". Next, the dead time of the encoder in use must be set in the encoder evaluation. For example to 2 ms for an AMS304i of Leuze. For the dead time of the installed encoder, inquire SEW-EURODRIVE or the manufacturer. The hoist must now be moved using the IEC Editor or the monitor, and the gain value of the position controller of the MultiAxisController must be decreased until no or a sufficiently small oscillation can be detected on the torque/current.

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10.5 Anti-sway control

The following application example illustrates how to use the add-on "Anti-sway control" (→ 🗎 14) (MOVIKIT® Motion add-on AntiSway). You activate the add-on in the configuration menu "Basic settings" of the software module in the "Functions used" section. When the add-on is activated, the corresponding configuration menus are displayed in MOVISUITE® and the corresponding structures are created when generating an IEC project.

10.5.1 Defining the application type

1. In the configuration of the software module, open the "Anti-sway control" (→ 🗎 46) configuration menu.
2. Select the required "Application type" from the "Anti-sway control" section.
   ⇨ The setting fields for configuring the selected application type are displayed.
3. Specify a "Conversion factor for user units in meters". This step is necessary because the function works in physical units. If you have already selected meters as the user unit, you can deactivate conversion by setting the value "0".

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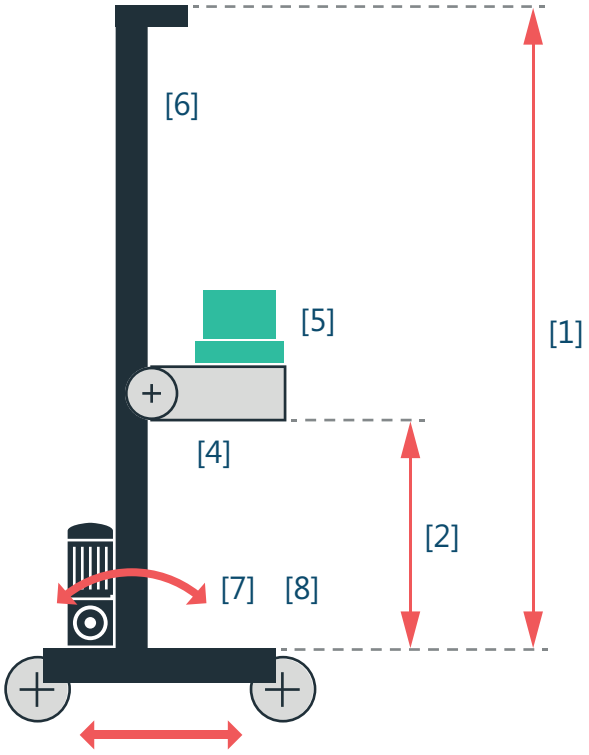
10.5.2 Configuring the application type

TowerSway

Configure your application in the "Anti-sway control" configuration menu by entering values for the parameters shown in the following diagram. For more information on the parameters, refer to the chapters "Anti-sway control" (→ 🗎 46) and "IEC programming" (→ 🗎 72).



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No.	Field in the configuration menu	IEC name
[1]	Height of the tower	IrHeightTower
[2]	Distance between lifting and traveling trolley	IrDistanceHoistToCar
[4]	Mass of the trolley	IrMassHoist
[5]	Mass of the payload	IrMassPayload
[6]	Mass of the tower	IrMassTower
[7]	Spring stiffness between tower and trolley **Information:** To determine this parameter, refer to chapter "Determining stiffness" (→ 🗎 114).	IrSpringTowerToCar
[8]	Degree of damping between tower and trolley **Information:** To determine this parameter, refer to chapter "Determining stiffness" (→ 🗎 114).	IrDampTowerToCar

Determining stiffness

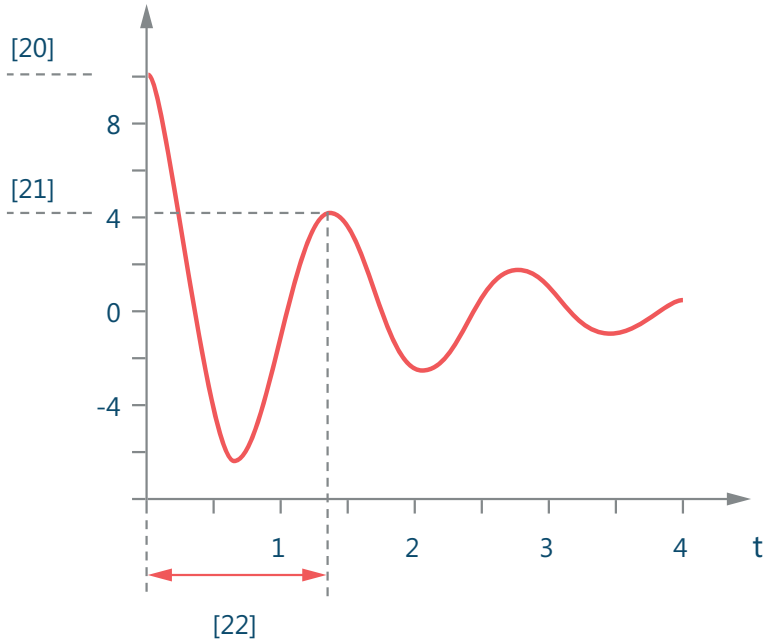
INFORMATION

The calculations in the configuration menu "Support for parameter determination" (→ 🖹 48) are based, among others, on the values entered in the "Anti-sway control" (→ 🖹 46) configuration menu.

The configuration of some application types includes the definition of the parameter "Spring stiffness between tower and trolley". If an application type is used that does not require this parameter, you can skip this step.

If you do not know these values, they can be determined from the signal waveform of the oscillating system by entering certain measured values in the configuration menu "Support for parameter determination" (→ 🖹 48).

1. Record the amplitudes of the oscillating system e.g. by means of a video recording at the point of greatest oscillation. If there is enough torque back to the motor from the oscillating mass, a scope recording of the torque can also be used.



No.	Field in the configuration menu
[20]	Oscillation amplitude (1st peak)
[21]	Oscillation amplitude (2nd peak)
[22]	Oscillation period (time between 1st and 2nd oscillation amplitude)

2. Enter the determined measured values (see diagram) into the corresponding setting fields in the configuration menu "Support for parameter determination".
   ⇨ The values "Damping ratio between tower and trolley" and "Spring stiffness between tower and trolley" are calculated and used directly for anti-sway control.

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⇨ The natural frequency, resonance frequency and "Deflection at lifting height" are determined for plausibility checks against reality and design calculations.

3. Carry out a plausibility check of the calculated values together with the data provider.

10.5.3 Transferring the configuration

Use automatic code generation to generate an IEC project and load the project and the modified configuration to the MOVI-C® CONTROLLER. See chapter "Generating an IEC project" (→ 🗎 51).

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10.5.4 Controlling/monitoring a function

The setting fields in the configuration menus in MOVISUITE® or variables in the IEC project explained in the following chapters are available for controlling, adapting and monitoring anti-sway control.

TowerSway

- Activate/deactivate the function via "Selection of setpoint correction" (IEC: *eSelector*)

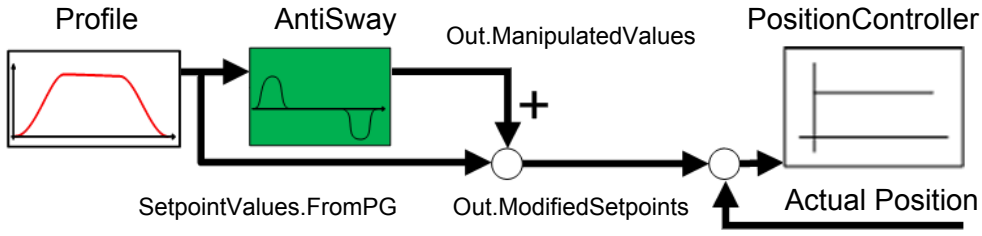
  Activate or deactivate the function during runtime at standstill.
- Adjust the lifting height via "Distance between lifting and traveling trolley" (IEC: *lrDistanceHoistToCar*)

  If the lifting axis has a considerable influence on the oscillation behavior of the travel axis, it is recommended to specify the height of the lifting axis continuously. It is important that this happens cyclically in the *HighPrio* task. The following guide values can be assumed to have a considerable influence: "Mass of lifting trolley" (*lrMassHoist*) > ⅓ × "Mass of master" (*lrMassTower*) Variance *lrDistanceHoistToCar* > ¼ "Height of tower" (*lrHeightTower*)
- Adjust the payload via "Mass of payload" (IEC: *lrMassPayload*)

  If the payload has a considerable influence on the oscillation behavior, it is recommended to set the payload as a static value prior to each positioning process. The following guide values can be assumed to have a considerable influence: Variance *lrMassPayload* > ⅓ mass of lifting gear (*lrMassHoist*)
- Terminate travel order via IEC: *xBusy*

  To continue the control chain, *xBusy* must report "FALSE". *xBusy* takes into account all changes triggered by anti-sway control compared to the original travel profile.

The variables illustrated in the following diagram are particularly suitable for monitoring the function (e.g. using trace recording):



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11 Fault management

11.1 Fault codes

11.1.1 Controller

16#7801	Lag error outside the lag error window.	• Select a larger lag error window. • Adjust the P gain of the position controller. • Adjust zero backlash/stiffness. • Check the mass inertia of the load.
16#7803	Encoder position not valid. Check the external encoder.	• Check wiring. • Wrong bit selected in "Take account of external encoder". • In status word 2, bit 12 is not assigned the status "Encoder 2/encoder status/fault".
16#780A	Skew error outside the skew error window.	• Select a larger skew error window. • Adjust the P gain of the control function. • Check for correct setting of the encoder source for skew.
16#780B	"Encoder 2 referenced" must be selected for bit 13 in status word 1.	• Assign the value "Encoder 2 referenced" to bit 13 in status word 1.
16#780C	Wrong actual position source selected. The actual position source must be set to encoder 1 for inverter "XYZ".	• Select the motor encoder for position control in the drive train and deselect the external encoder in the XYZ inverter.
16#780D	External encoder activated on a double-axis. Associated group member: X	• For inverter X, deselect the corresponding bit for "Take account of external encoder".
16#780E	No external encoder considered.	• Select the bit "Take account of external encoder" for an inverter. • In the encoder evaluation, select an encoder type without external encoders. • Select an encoder source without external encoder in the control function for skewing or overload guard.
16#780F	Combined encoder evaluation was not activated.	• Activate combined encoder evaluation. • In encoder evaluation, select an encoder type that does not contain a combination of two different encoder types.

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16#7811	Too many axis group members were declared as belonging to the same group.	• Check that the number of associated axis group members corresponds to the number of connected members.
16#7813	Not enough external encoders were considered.	• Check that the number of external encoders taken into account corresponds to the number of associated axis group members. • Select an encoder source without external encoder in the control function for skewing or overload guard.
16#7882	Access request not successful. Deactivate access of the subordinate group member.	• Terminate access of the lower-level member (single axis/axis group) in the UserInterface or HMI.
16#7885	Readjustment can only be used for a reference travel type with limit switches.	• Deactivate readjustment. • Modify the reference travel type.
16#7886	Readjustment can only be used with 2 members.	• Deactivate readjustment.
16#788A	License missing for "MOVIKIT® MultiAxisController add-on Cascading". Please purchase the missing license or activate the add-on in MOVISUITE® under "Functions used".	• Activate the missing license in the License Manager. • In MOVISUITE®, select the function used on the basic settings page.
16#788B	License missing for "MOVIKIT® MultiAxisController add-on FourAxes". Please purchase the missing license or activate the add-on in MOVISUITE® under "Functions used".	• Activate the missing license in the License Manager. • In MOVISUITE®, select the function used on the basic settings page.
16#788C	License missing for the "TorqueSkewing" operating mode. Please purchase the missing license or activate it in MOVISUITE® under "Functions used".	• Activate the missing license in the License Manager. • In MOVISUITE®, select the function used on the basic settings page.
16#788D	Wrong operating mode selected in MOVISUITE® for the MultiAxisController. Check the operating mode and control functions set under "Functions used".	• In MOVISUITE®, check the function used on the basic settings page. • In MOVISUITE®, check the set priority type under control functions.
16#788E	Timeout in parameter channel in the step: "E_ParameterState"	• Check the external encoders taken into account to ensure that they match your wiring.
16#788F	All group members must be activated for referencing. Associated group member: X	• Activate member X for referencing as an associated member.

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16#7891	Limit switches swapped during referencing.	• Check the wiring of the hardware limit switches.
16#7892	Safety period for readjustment exceeded.	• Check the set safety time. • Check the function of the hardware limit switches. • Check the number of hardware limit switches taken into account.
16#7893	Safety distance for readjustment exceeded.	• Check the set safety distance. • Check the function of the hardware limit switches. • Check the number of hardware limit switches taken into account.
16#7894	Home position outside DINT value range.	• Check the value for the home position.
16#7A40	Positive limit switch of inverter configured.	• Deactivation of the software limit switch of inverter X.
16#7A41	Negative limit switch of inverter configured.	• Deactivation of the software limit switch of inverter X.
16#7A42	Positive limit switch hit.	• Check the function of the hardware limit switches. • Check the number of hardware limit switches taken into account. • Check the logical operation of the hardware limit switches.
16#7A43	Negative limit switch hit.	• Check the function of the hardware limit switches. • Check the number of hardware limit switches taken into account. • Check the logical operation of the hardware limit switches.
16#7A48	Limit switches swapped.	• Check the function of the hardware limit switches. • Check the wiring of the hardware limit switches.
16#7A49	Both limit switches actuated.	• Check the function of the hardware limit switches. • Check the wiring of the hardware limit switches. • Check the number of hardware limit switches taken into account.

11.1.2 ConfigDataHandling

16#6600	The configuration file with the specified name could not be found.

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16#6601	The configuration file with the specified name could not be opened.
16#6602	The configuration file could not be closed again. File access is not complete.
16#6603	The configuration data could not be read from the file.
16#6604	One or more configuration parameters could not be found.
16#6605	The configuration parameter has no data or data length is too large.

11.1.3 DeviceAdapter

Fault

16#6A00	Inverter fault: The fault number can be found in the "Inverter.Out" structure.

Warnings

16#195F0	One of the dynamic values transferred is too large (cannot be mapped using 16 bits).
16#195F1	One of the dynamic values transferred is too small (cannot be mapped using 16 bits).

11.1.4 ProfileGeneration

16#7600	The software limit switches (in PLC units) are outside the DINT range of numbers.
16#7601	The modulo limits (in PLC units) are outside the DINT range of numbers.
16#7602	The preset position (in PLC units) is outside the DINT range of numbers.
16#7603	The reference offset (in PLC units) is outside the DINT range of numbers.
16#7604	The reference offset is outside the modulo limits of a modulo axis.
16#7605	The homing target position (in PLC units) is outside the DINT range of numbers.
16#7606	The selected ModuloMode is not allowed for this axis type or is not supported by the offset profile.
16#7607	The activated offset profile requires a referenced axis.
16#7608	The target position (in PLC units) is outside the DINT range of numbers.

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16#7609	The travel distance (in PLC units) is outside the DINT range of numbers.
16#760A	The target position is outside the software limit switches.
16#760B	The position to be approached when the velocity profile stops (in PLC units) is outside the DINT range of numbers.
16#760C	The tracking master resolution is outside the permitted limits.
16#760D	The tracking master modulo limits (in PLC units) are outside the DINT range of numbers.
16#760E	The tracking slave modulo limits (in PLC units) are outside the DINT range of numbers.
16#760F	The tracking numerator or denominator is outside the permitted limits.
16#7610	The tracking master position is outside the permitted limits.
16#7611	The tracking master time base is outside the permitted limits.
16#7612	The tracking slave time base is outside the permitted limits.
16#7613	Positive software limit switch approached.
16#7614	Negative software limit switch approached.
16#7615	The deceleration is greater than the application limit.
16#7616	The acceleration is greater than the application limit.
16#7617	The speed (velocity) is greater than the positive application limit.
16#7618	The speed (velocity) is greater than the negative application limit.
16#7619	Missing interface connection
16#761A	System error during profile generation. For further information on enumeration, refer to the "SEW ProfGen JLimit Extern" library.
16#761B	Error importing configuration data
16#761C	Missing or invalid license

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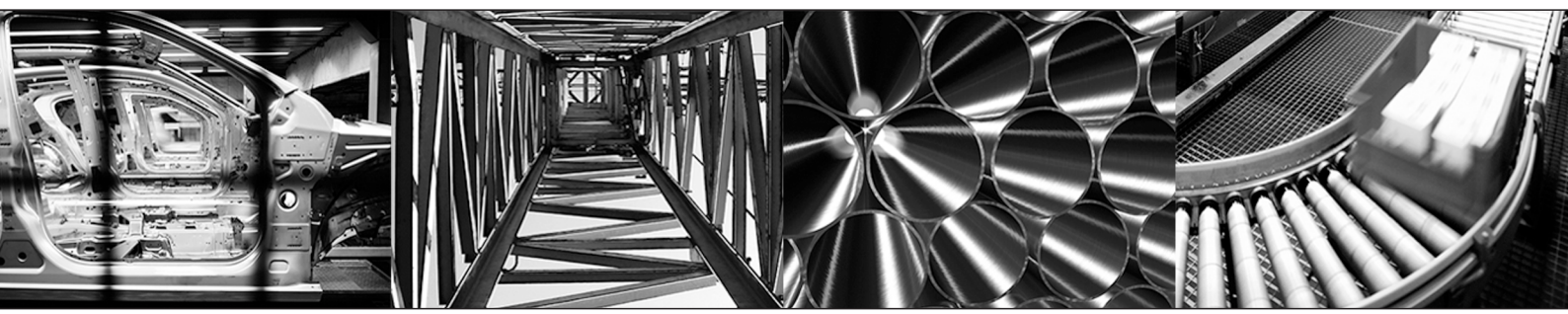

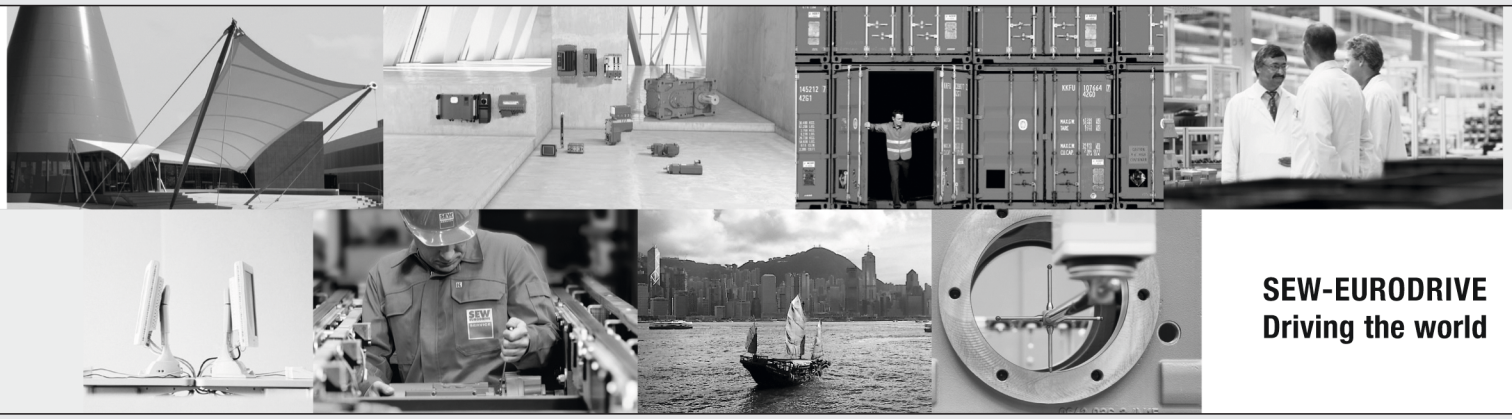

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