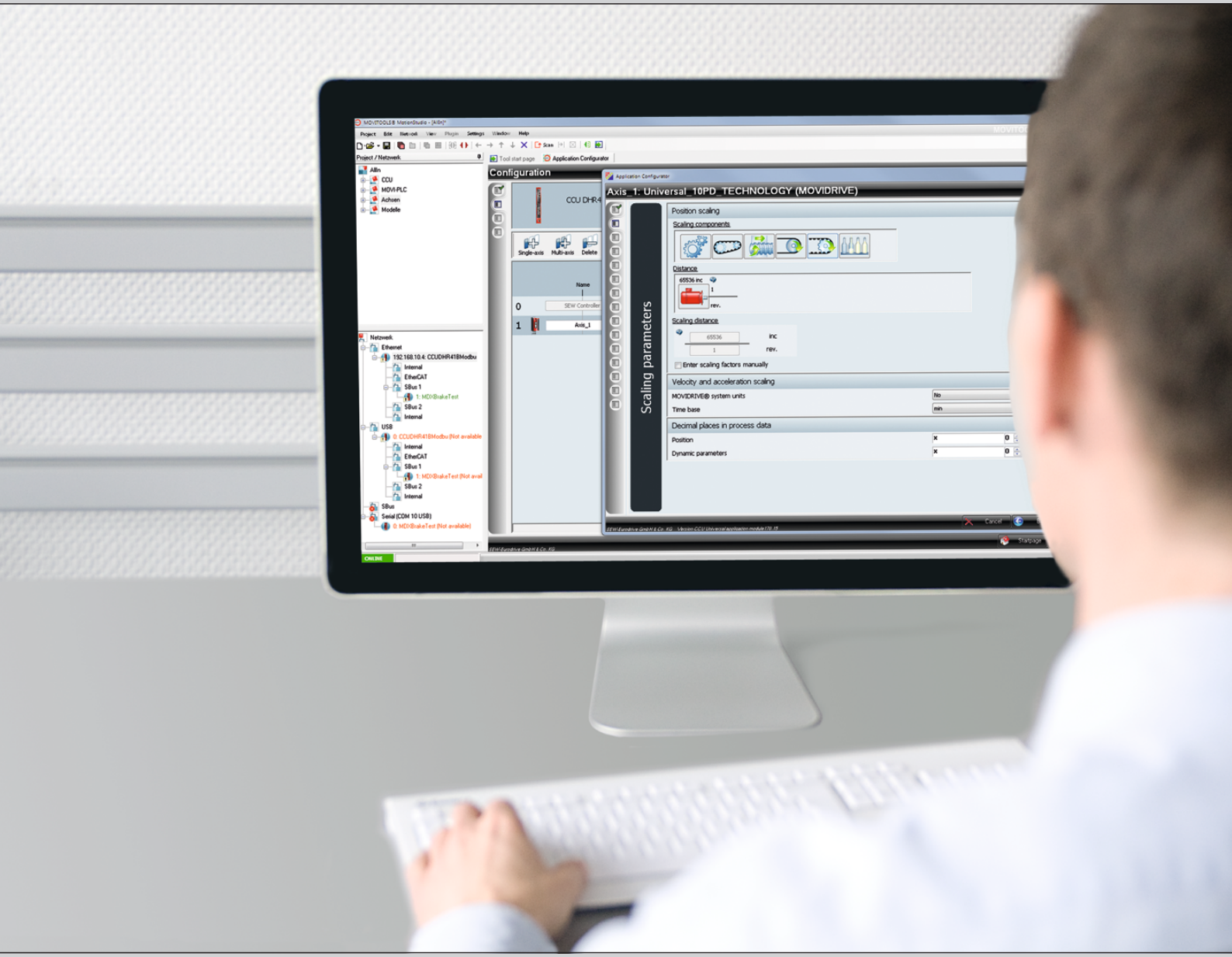
SEW EURODRIVE

Manual



Universal Module Technology Application Module

Edition 12/2016

23030526/EN

Table of contents

23030526/EN – 12/2016

23030526/EN – 12/2016

1 General information

1.1 About this documentation

The documentation is part of the product and contains important information. The documentation is for everyone who works with this product.

The documentation must be accessible and legible. Make sure that persons responsible for the system and its operation as well as persons who work independently with the software and the connected units of SEW-EURODRIVE have read through the manual carefully and understood it. If you are unclear about any of the information in this documentation or if you require further information, please contact SEW-EURODRIVE.

1.2 Structure of the warning notes

1.2.1 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 drive system or its environment.
INFORMATION	Useful information or tip: Simplifies handling of the drive system.	

1.2.2 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.

Meaning of the hazard symbols

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

Hazard symbol	Meaning
	General hazard

23030526/EN – 12/2016

Hazard symbol	Meaning
	Warning of dangerous electrical voltage
	Warning of hot surfaces
	Warning of risk of crushing
	Warning of suspended load
	Warning of automatic restart

1.2.3 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.

1.3 Right to claim under warranty

A requirement of fault-free operation and fulfillment of any rights to claim under limited warranty is that you adhere to the information in the documentation at hand. Therefore, read the documentation before you start working with the software and the connected devices from SEW-EURODRIVE.

Make sure that the documentation is available to persons responsible for the machinery and its operation as well as to persons who work independently on the devices. You must also ensure that the documentation is legible.

1.4 Exclusion of liability

Please observe this documentation as well as the documentation for the software used and the SEW-EURODRIVE devices connected. This documentation must be observed to ensure that the devices operate safely and that the specified product properties and performance characteristics are achieved.

SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of the documentation. In such cases, SEW-EURODRIVE assumes no liability for defects.

23030526/EN – 12/2016

1.5 Other applicable documentation

This document supplements the "Universal Module Application Module" manual. Use this document only together with the "Universal Module Application Module" manual.

"Other applicable documentation" is listed in the documentation for the configuration software "Application Configurator for CCU" and in the "Universal Module Application Module" manual.

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

23030526/EN – 12/2016

2 Safety notes

2.1 Use

Make sure that the basic safety notes are read and observed. Make sure that persons responsible for the machinery and its operation as well as persons who work on the device 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.

The following safety notes refer to the use of the software.

This document does not replace the detailed documentation for the connected devices. This documentation assumes that the user has access to and is familiar with the documentation for all connected products.

Do not perform installation or startup if the product is damaged.

Removing required covers without authorization, improper use or incorrect installation and operation may result in severe injury to persons, or damage to machinery.

All work in the areas of transportation, storage, operation and waste disposal must be carried out by persons who are trained appropriately.

2.2 Target group

Software specialist

Any work with the software may only be performed by adequately qualified personnel. Qualified personnel in this context are persons who have the following qualifications:

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

The above mentioned persons must have the authorization expressly issued by the company to operate, program, configure, label and ground devices, systems and circuits in accordance with the standards of safety technology.

2.3 Designated use

The *universal module Technology 10 PD* is a single-axis module for speed-controlled, positioning, and synchronized applications.

Use the device-independent "Application Configurator" configuration software to start up and configure the axes for the application module and to download the configuration to the controller.

2.4 Bus systems

A bus system makes it possible to adapt electronic drive 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.

23030526/EN – 12/2016

Especially in Ethernet-based networked systems and with engineering interfaces, make sure that unauthorized access is prevented.

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

2.5 Short designation

The following short designations are used in this documentation.

Type designation	Short designation
Universal module Technology 10 PD application module	Application module
Universal module application module	Universal module Standard

23030526/EN – 12/2016

3 Project planning information

3.1 Requirements

Correct configuration and proper installation of the units are required for successfully starting up and operating the application modules with the Application Configurator.

You find detailed configuration information in the documentation of the respective units (see chapter "Other applicable documentation").

3.2 PC and software

The application module is part of the configuration software "Application Configurator". For the applicable system requirements, refer to the documentation of the configuration software "Application Configurator for CCU".

You need the MOVITOOLS® MotionStudio engineering software for startup. The scope of delivery includes the technology editor "Drive Startup for MOVI-PLC®" and the latest version of the configuration software "Application Configurator".

3.3 Controller

You need one of the following controllers with technology level T2 or higher to use the application module.

CCU	Firmware version	Technology level
DHF41B	1115 or higher	T2 or higher
DHR41B		

For further information for technology activation, refer to the "Controller DHE21B / DHF21B / DHR21B (standard), DHE41B / DHF41B / DHR41B (advanced)" manual.

3.4 Inverter

To use the application module, you need one of the following inverters.

Inverter	Firmware version
CMP ELVCD	3.4 280.1.37 or higher
MOVIDRIVE® B	xxx.16 or higher
MOVIAXIS®	xxx.29 or higher

3.5 Compatibility

The *Universal module Technology* application module is backward compatible with the *Universal module Standard* application module.

23030526/EN – 12/2016

INFORMATION

Except for the "Speed synchronism" operating mode, the *Universal module Technology* application module offers all operating modes and functions available with *Universal module Standard*.

3.6 Control mode

Synchronous operation of the slave axis is based on the setpoints of the master axis. This way, the slave axis does not follow each minimal control task of the master axis und thus travels very smoothly. Therefore, the maximum lag distance between master axis and slave axis is the mean value of both lag error windows. For detailed information, refer to the manual for the used inverter.

23030526/EN – 12/2016

4 System description

4.1 Area of application

The *Universal module Technology* application module expands the scope of functions of the *Universal module Standard* (see "Universal module application module" manual) by additional applications with synchronous angles in operating mode 8 "Gearing".

4.2 Features

The application module has the following characteristics:

- Synchronous motion of up to 8 drives at a baud rate of 1 MBaud can be realized in a master-slave group.
- You can start and end synchronous operation in various submodes with different configurations under the following conditions:
  - In idle state
  - Time based
  - Master based depending on the master axis
- The application module has different initiators for synchronization and desynchronization of the axes, such as the start signal or the master position.
- You can adapt the application module perfectly to your process using the following functions:
  - Position to the absolute master position
  - Offset during synchronous operation

4.3 Scope of functions of the process data profiles

The *Universal module Technology* supports linear axes and modulo axes and has the following profile.

Profile	Scope of functions
10 PD	Operating modes: • Speed mode • Jog mode • Referencing mode • Positioning mode • Synchronous angle mode (operating mode 8 "Gearing") Functions: • Touchprobe • Adjustment (operating mode 8 "Gearing") • Offset (operating mode 8 "Gearing")

23030526/EN – 12/2016

5 Operating modes and functions

This document describes only operating mode 8 "Gearing". For details on the other operating modes, refer to the "CCU – Universal Module Application Module" manual.

5.1 Overview

The following table shows the relation between the operating modes and the submodes.

Operating mode	Submode[1)]
1: Velocity control	-
2: Jog mode	-
3: Referencing mode	30: Static reference offset 31: Variable reference offset
4: Positioning mode	40: Absolute positioning 41: Relative position control CW rotation 42: Relative position control CCW rotation
5: Positioning mode – Touchprobe	50: Absolute position control with remaining distance processing 51: Endless movement positive with remaining distance processing 52: Endless movement negative with remaining distance processing
6: Reserved	Reserved
7: Emergency mode	70: Emergency mode without external encoder
8: Gearing	80: Gearing Direct – synchronizing and desynchronizing in idle state 81: Gearing Expert – Configurable transition[2)]

1) Submode selection via the sub control word PE7.

2) Transition = Transition function of the slave axis from desynchronized to synchronized state and vice versa.

INFORMATION

Compared to the *universal module Standard*, **operating mode 6 "Speed synchronism"** is **not available** in *universal module Technology 10 PD* (see operating mode "6: Reserved").

23030526/EN – 12/2016

5.2 Operating mode 8: Gearing

5.2.1 Application

In operating mode 8 "Gearing", the axes travel at a synchronous angle based on a defined synchronization process until synchronous operation is canceled by a defined desynchronization process.

A configurable gear ratio between master and slave axis can compensate different gear ratios of the drive or the application.

5.2.2 Sub modes and functions

In operating mode 8 "Gearing", the following submodes are available:

- **80: Gearing Direct** – synchronizing and desynchronizing in idle state
- **81: Gearing Expert** – Configurable transition[1)]

The following table gives an overview of the various functions of the submodes.

Functions	Submodes	
	80: Gearing Direct	**81: Gearing Expert**
Start events	Rising edge of the start signal	• Rising edge of the start signal • Master cycle • Master position
Transition[1)] (Transition function)	Direct for master axis in idle state	• Direct for master axis in idle state • Master based • Time based
Stop events	Falling edge of the start signal	• Falling edge of the start signal • Master cycle • Master position
Aligning	Yes	Yes (only recommended for direct transition)
Offset	Yes	Yes
Stop of the master axis in case of a slave error	Yes	Yes

NOTICE

No switching of the operating mode on-the-fly.

Switching operating mode 8 "Gearing" to another operating mode on-the-fly is not possible. Operating modes can only be switched if the slave axis is in idle state with "Status gearing" = "0" (inactive) and with "Start" = "0", see chapter "Process data" (→ 🗎 46).

1) Transition = Transition function of the slave axis from desynchronized to synchronized state and vice versa.

23030526/EN – 12/2016

5.3 Sub mode 80: Gearing Direct – Synchronizing and desynchronizing at standstill

Submode 80 "Gearing Direct" realizes synchronization of the slave axis with the master axis in idle state.

5.3.1 Requirements

The synchronization process with the master axis specified in the configuration starts under the following conditions:

- **Master** and **slave axis** are **in idle state**.
- Before the slave axis is started, the master axis must be enabled. This is detected by the signals O1:4 *Brake released* = 1 and O1:8 – 15 *Code for status/warning/ error of the VFD* = 10.
- Operating mode 8 "Gearing" is selected.
- Submode 80 "Gearing Direct" is selected.

5.3.2 Start event

The synchronization process starts with rising edge of the start signal. Depending on the configuration, the slave axis stays in the current position at the start signal or it adjusts to the absolute master position.

5.3.3 Transition (synchronize)

Process data word O4 "Status gearing" signals the synchronization status of the slave axis "**Active**" (Status gearing = 4) as soon as the slave axis is in position, see chapter "State machine: Status gearing" (→ 🗎 26). Master axis can be started. The slave axis follows the master axis with synchronous angle and the configured gear ratio.

5.3.4 Stop event

The slave axis is desynchronized at standstill with the falling edge of the start signal.

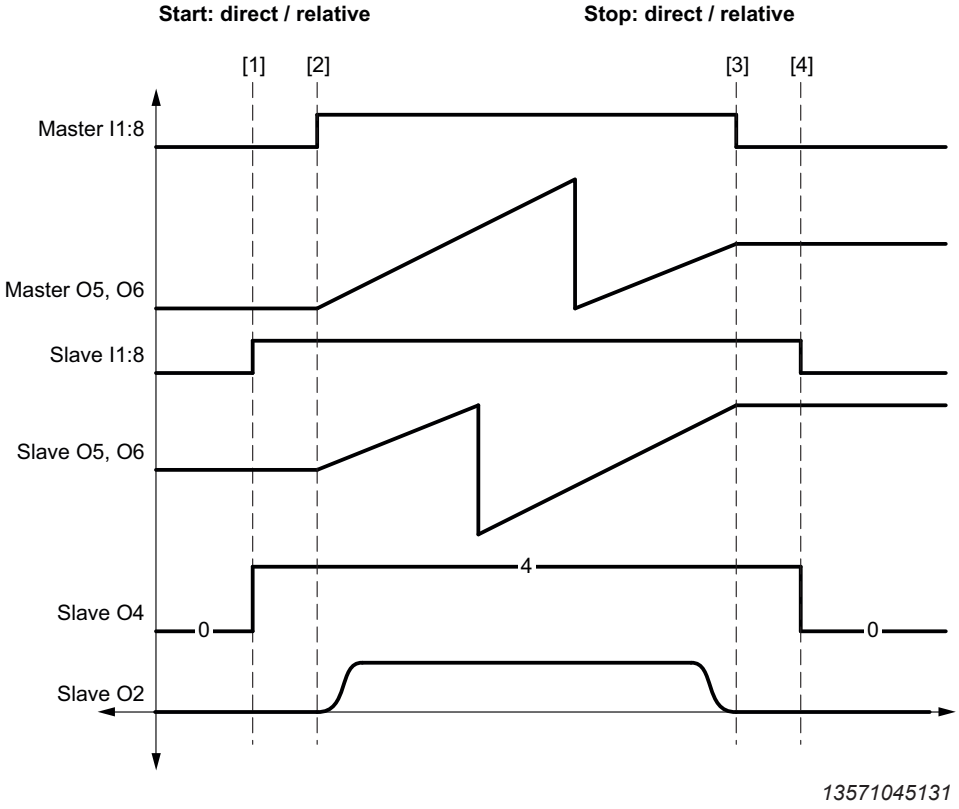
5.3.5 Transition (desynchronize)

Once desynchronization is completed, the slave axis is in synchronization status "**Inactive**" (Status gearing = 0).

23030526/EN – 12/2016

5.3.6 Example of a sequence

Cycle diagram



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I1:8	Start
O5, O6	Actual position
O4	Synchronization status: Status gearing (0 = Inactive / 4 = Active)
O2	Actual velocity
[1] – [4]	Changing process data/signal states (see following sequence)

Sequence

No.	Sequence	Process data/signal states	
	Initial status: Master axis is in idle state and enabled. Operating mode of the slave axis is selected.	Slave: Slave:	I1:11 – 14 Operating mode 8: Gearing I7:8 – 15 Submode 80: Gearing Direct
		Slave:	O4 Status gearing = 0
[1]	Slave axis is synchronized due to the set start signal.	Slave: Slave: Slave:	I1:8 Start = 1 O1:3 Setpoint reached= 1 O4 Status gearing = 4
[2]	Master axis starts. Synchronized axis movement starts.	Master:	I1:8 Start = 1
[3]	Master axis stops.	Master:	I1:8 Start = 0

23030526/EN – 12/2016

No.	Sequence	Process data/signal states
[4]	Slave axis is desynchronized due to reset of the start signal.	Slave: I1:8 Start = 0 Slave: O1:3 Setpoint reached= 0 Slave: O4 Status gearing = 0

For detailed information on process data assignment, refer to chapter "Process data" (→ 🗎 46).

5.4 Sub mode 81: Gearing Expert – Configurable transition

Submode 81 "Gearing Expert" allows for synchronization/desynchronization of the synchronous operation with configurable transitions after aconfigurable start/stop event. For exact synchronization, the master axis must be enabled before the slave axis is started.

5.4.1 Start and stop events

Synchronization/desynchronization of the master axis starts with a start/stop event. The following table shows which start/stop events can be set in the configuration.

Start/ stop event	Description	
Increasing/ Falling edge of the start signal	Synchronizing:	With rising edge of the start signal, the axis directly starts with a time or master based synchronization process to the master signal.
	Desynchronizing:	With falling edge of the start signal, the axis directly starts with a time or master based desynchronization process.
Master cycle	Synchronizing:	With rising edge of the start signal, the slave axis waits for the start of the master cycle. The subsequent synchronization process can be performed time or master based.
	Desynchronizing:	With falling edge of the start signal, the slave axis waits for the start of the new master cycle. The desynchronization process can be performed time or master based. You can set the desynchronization position in the configuration.
Master position	Synchronizing:	With rising edge of the start signal, the slave axis waits until the set master value of the master drive is reached. The subsequent synchronization process can be performed time or master based. **INFORMATION:** This function is mostly used for modulo applications.
	Desynchronizing:	With falling edge of the start signal, the slave axis waits until the set master value of the master drive is reached. The desynchronization process can be performed time or master based. You can set the desynchronization position in the configuration.

23030526/EN – 12/2016

5.4.2 Transitions for synchronization/desynchronization

For the *universal module Technology 10 PD*, transition is a transition function of the slave axis from desynchronized to synchronized state or vice versa.

Once synchronization is completed, the slave axis is in synchronization status "Active" (Status gearing = 4). After desynchronization – in synchronization status "inactive" (Status gearing = 0).

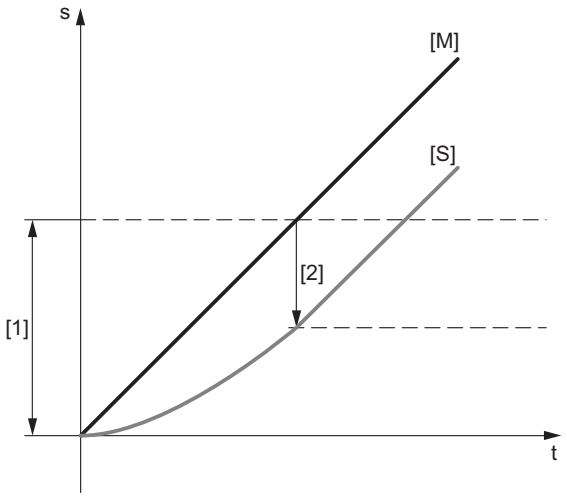
Transition types

Synchronization and desynchronization can be configured in 3 different ways.

Transition type	Description
Direct	The slave axis is synchronized or desynchronized in idle state.
Time based	The slave axis synchronizes to the master axis within a time frame (CamInTime). **INFORMATION:** The setting applies only for submode 81 "Gearing Expert".
Master based	The slave axis synchronizes to the master axis within a synchronization distance (transition distance) of the master axis. **INFORMATION:** The setting applies only for submode 81 "Gearing Expert".

The position of the slave axis in relation to the master axis after synchronization or desynchronization procedure is defined by the "Offset" (see "Synchronize" illustration) or the position of the slave axis after desynchronization "CamOutPosition" (see "Desynchronization" illustration), depending on the transition mode (see section "Transition modes").

Synchronize

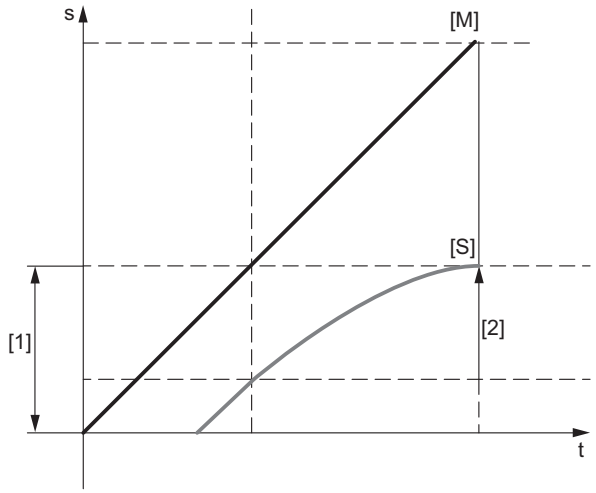


13571056395

[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance)
[2] Offset

23030526/EN – 12/2016

Desynchronizing



13571053963

[M] Master axis
[S] Slave axis
[1] Desynchronization distance of the master axis (transition distance)
[2] Position of the slave axis after desynchronization (CamOut-Position)

Transition modes

The transition mode defines in which relation the slave axis is synchronized.

The specifications for offset and the position of the slave axis after desynchronization are interpreted differently depending on the set transition mode.

Transition mode	Description
Relative	In **relative** transition mode, the offset between master and slave axis (osas = offset slave at start) at the start event is saved. Transition is executed based on the offset regarding the master axis.
Absolute	In **absolute** transition mode, the target position of the slave axis after the transition in relation to the absolute master axis position is determined. **INFORMATION:** This function is mostly used for modulo applications.

23030526/EN – 12/2016

5.4.3 Examples of "relative" and "absolute" transition modes

To following table shows the relation between transition mode and offset based on the following 4 cases.

Case	Transition mode	Offset
1	Absolute	0
2	Relative	0
3	Absolute	–Synchronization distance / 2 (–transition distance/ 2)
4	Relative	–Synchronization distance / 2 (–transition distance/ 2)

Settings for the example configurations

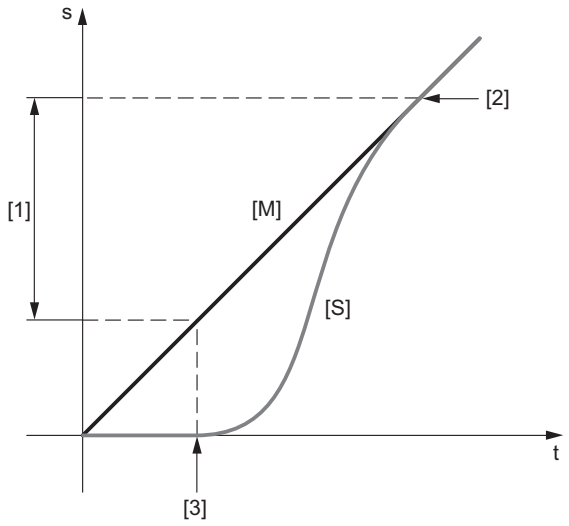
- Start event: Rising edge of the start signal
- Transition mode: master-based
- Axis type: linear, see chapter "Basic settings" (→ 🖹 36)

Distance (s) over time (t) is shown in the following graphs. Synchronization starts with the start event und ends if the position of the slave axis is reached after the synchronization process (CamInPosition). The distance covered by the master axis during synchronization is the synchronization distance (transition distance). Depending on the transition type and the offset, the slave axis is guided relatively or absolutely by this synchronization distance.

Case 1

Transition mode = Absolut

Offset = 0



13731104395

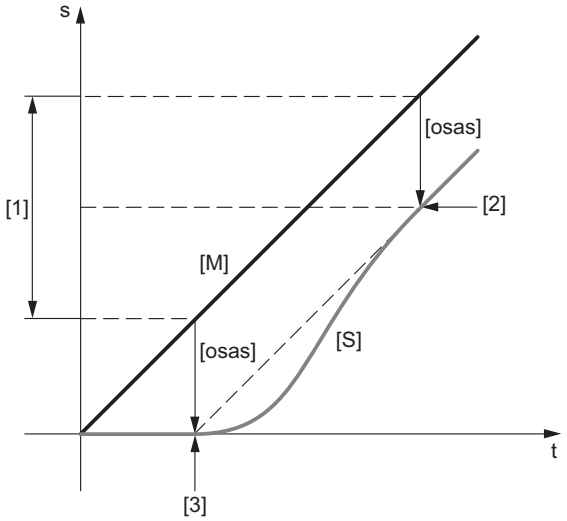
[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance)
[2] Position of the slave axis after synchronization (CamInPosition)
[3] Start event

23030526/EN – 12/2016

Case 2

Transition mode = Relative

Offset = 0



13731109259

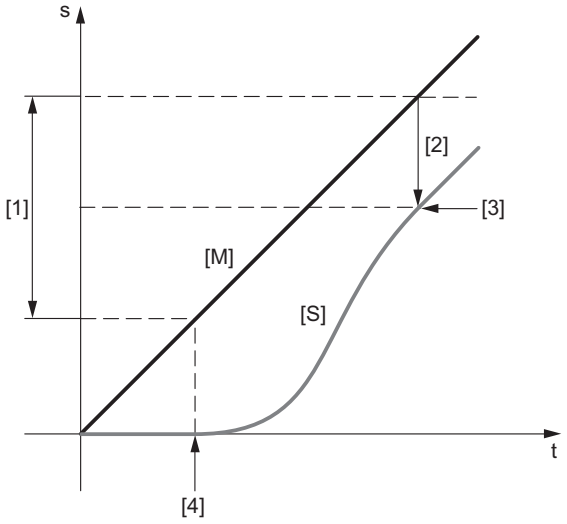
[M] Master axis
[S] Slave axis
[osas] Offset at the time of the start event (offset slave at start)
[1] Synchronization distance of the master axis (transition distance)
[2] Position of the slave axis after synchronization (CamInPosition) = Position of master axis + offset at the time of the start event (osas)
[3] Start event

23030526/EN – 12/2016

Case 3

Transition mode = Absolut

Offset = −Synchronization distance / 2



13731106827

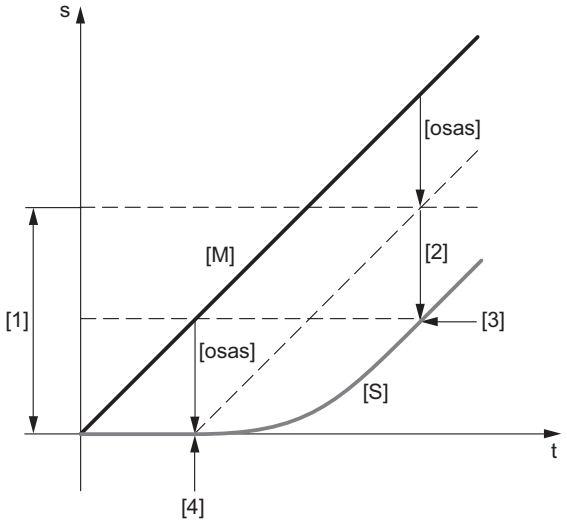
[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance)
[2] Offset
[3] Position of the slave axis after synchronization (CamInPosition) = Position of master axis + offset. **INFORMATION:** Offset is negative.
[4] Start event

23030526/EN – 12/2016

Case 4

Transition mode = Relative

Offset = −Synchronization distance / 2



13731111691

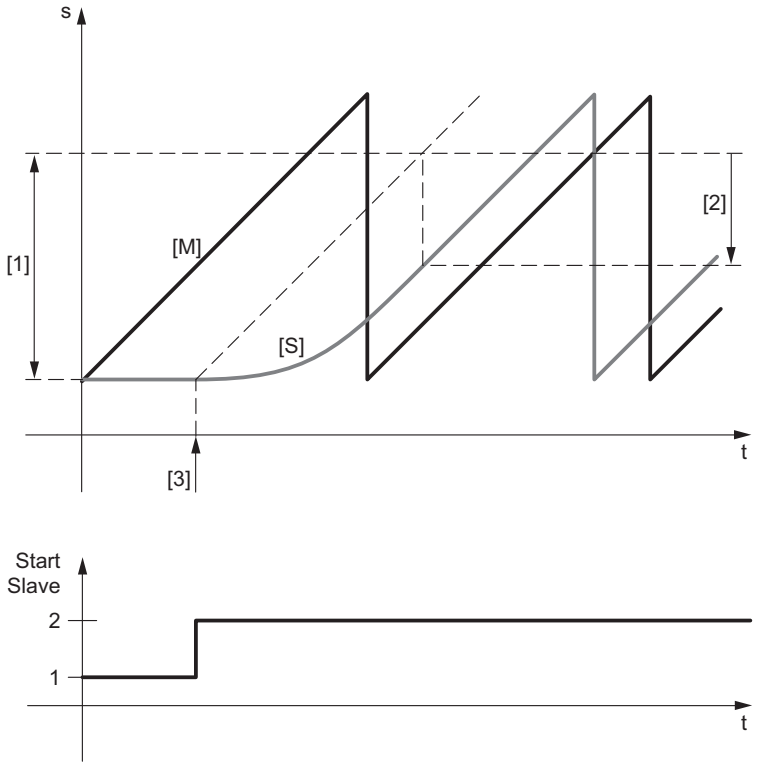
[M] Master axis
[S] Slave axis
[osas] Offset at the time of the start event (offset slave at start)
[1] Synchronization distance of the master axis (transition distance)
[2] Offset
[3] Position of the slave axis after synchronization (CamInPosition) = Position of master axis + offset at the time of the start event (osas) + offset. **INFORMATION:** Offset is negative.
[4] Start event

23030526/EN – 12/2016

5.4.4 Synchronization examples

The following diagrams show synchronization of the slave axis based on the following 3 start events.

Rising edge of the start signal

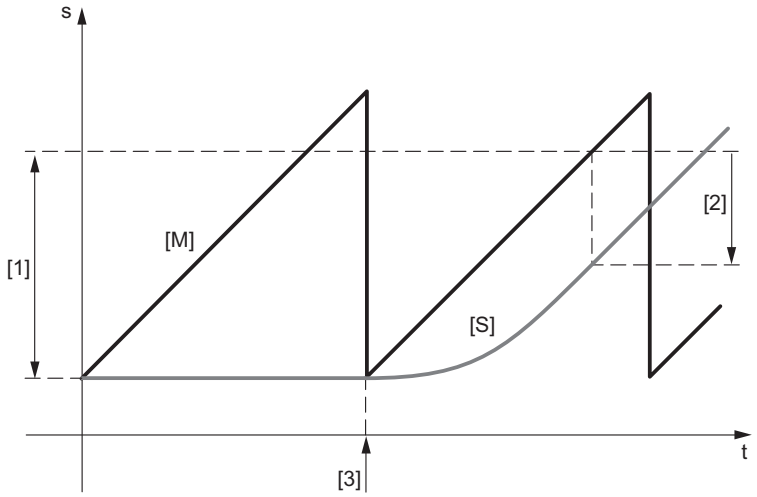


13744691211

[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance)
[2] Offset
[3] Start event: Rising edge of the start signal

23030526/EN – 12/2016

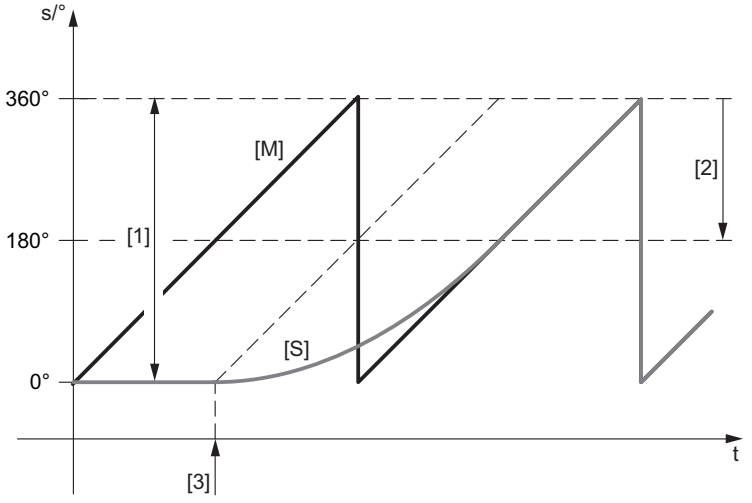
Master cycle



13744693643

[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance)
[2] Offset
[3] Start event: Master cycle

Master position



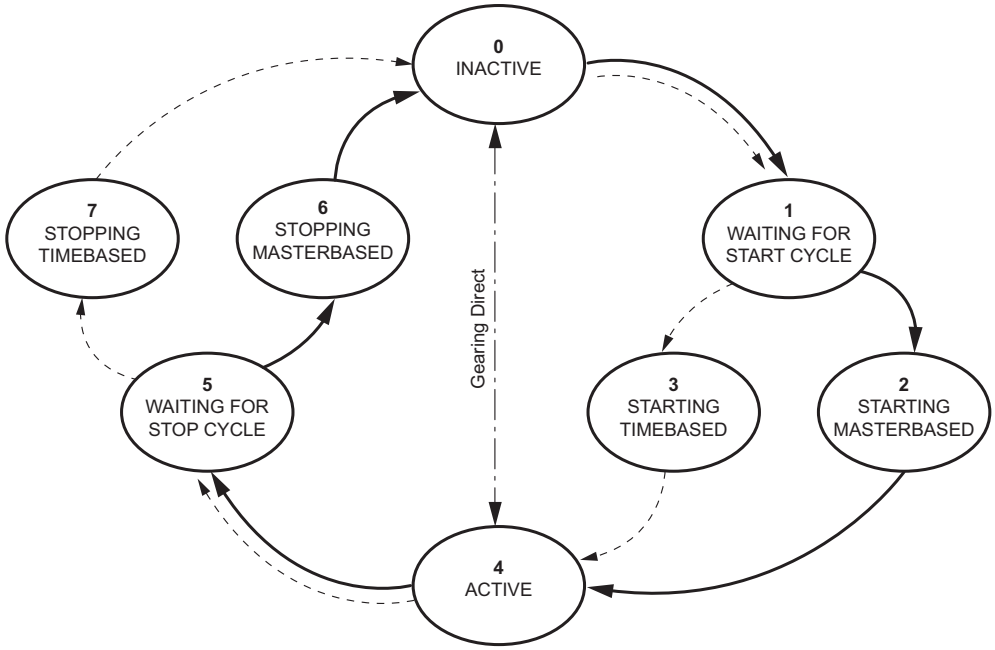
13744798475

[M] Master axis
[S] Slave axis
[1] Synchronization distance of the master axis (transition distance) = 35536 inc. (= 360° if gear ratio i = 1)
[2] Offset = −32768 inc. (= 180°; if gear ratio i = 1)
[3] Start event: Master position = 32768 inc.

5.4.5 State machine: Gearing status

The synchronization states of the state machine are run through based on the configured transition types – direct, time-based or master-based.

The following synchronization states can be accepted during the transition from synchronization status "inactive" (status gearing = 0) to the synchronization status "active" (status gearing = 4) or from "active" to "inactive" (status gearing O4 see chapter "Process output data" (→ 🗎 49)).



State machine "Status gearing" *13681385355*

_·—·_ Synchronization states in direct transition mode

- - - - - - Synchronization states in time-based transition mode

——— Synchronization states in master-based transition mode

5.4.6 Example of the state machine

Settings

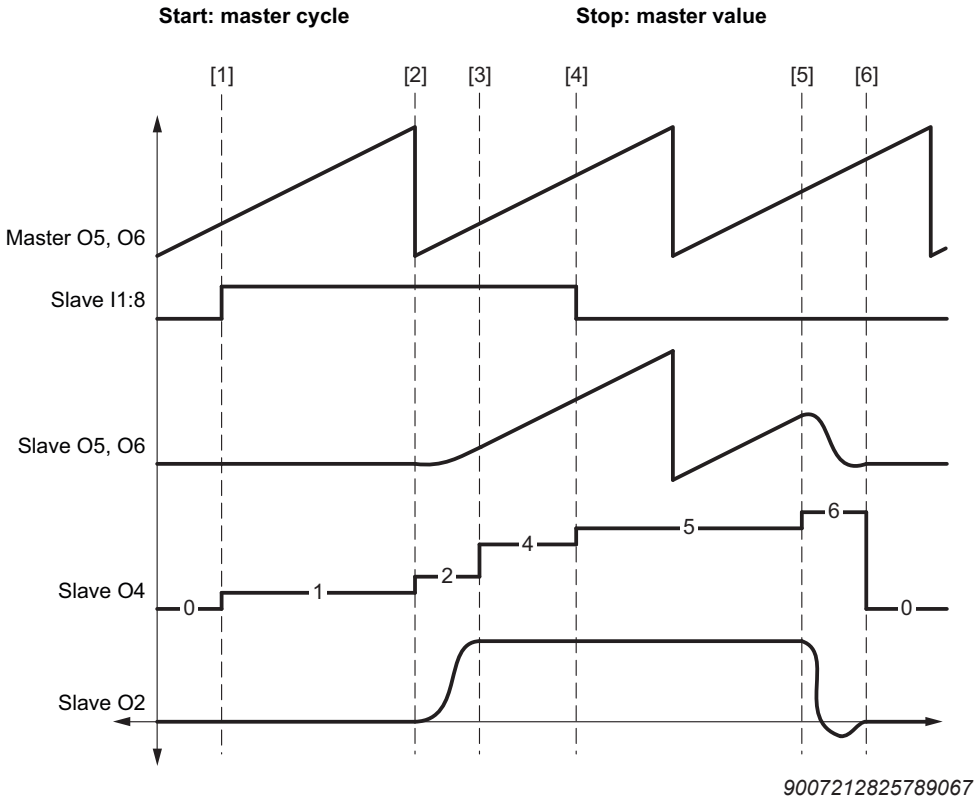
The following settings are the basis for the cycle diagram and the process description.

Selected setting: Synchronize	Setpoint
Start event	Master cycle
Transition mode	Absolute
Transition type	Master based
Master position	-
Synchronization distance (transition distance)	16384 inc. (90°)
Synchronization time (CamInTime)	-
Offset	0

23030526/EN – 12/2016

Selected setting: Desynchronizing	Setpoint
Stop event	Master position
Transition mode	Absolute
Transition type	Master based
Master position	32768 inc. (180°)
Desynchronization distance (transition distance)	16384 inc. (90°)
Desynchronization time (CamInTime)	-
Offset	8192 inc. (45°)

Cycle diagram



O5, O6	Actual position
I1:8	Start
O4	Synchronization status: Status gearing, see chapter "Process output data" (→ 🗎 49)
O2	Actual velocity
[1] – [6]	Changing process data/signal states (see following sequence)

Sequence

No.	Sequence	Process data/signal states	
	Initial status: Master axis travels. Slave axis is in idle state.	Slave: Slave: Slave:	I1:11 – 14 Operating mode 8: Gearing I7:8 – 15 Submode 81: Gearing Expert O4 Status gearing = 0
[1]	Start signal of the slave axis is set. Waiting for the start of the synchronization process.	Slave: Slave:	I1:8 Start = 1 O4 Status gearing = 1
[2]	Synchronization process starts with master position = "0°".	Slave:	O4 Status gearing = 2
[3]	Synchronization is completed if the defined synchronization distance is reached. Slave axis travels synchronously with the master axis.	Slave:	O4 Status gearing = 4
[4]	Start signal of the slave axis is reset. Waiting for the beginning of the desynchronization event once the master position is reached.	Slave: Slave:	I1:8 Start = 0 O4 Status gearing = 5
[5]	Desynchronization starts at the current position of the master axis (master position).	Master: Slave:	O5, O6 actual position = 32768 inc. (converted in user units) O4 Status gearing = 6
[6]	Desynchronization is completed if the defined desynchronization distance is reached. Slave axis travels independent of with the master axis.	Slave: Slave:	O4 Status gearing = 0 O5, O6 actual position = "Absolute desynchronization position"

For detailed information on process data assignment, refer to chapter "Process data" (→ 🗎 46).

23030526/EN – 12/2016

6 Additional functions

During operating mode 8 "Gearing", the following functions and the functions of the *universal module Standard* can be used.

Exception: Torque limiting cannot be used in operating mode 8 "Gearing", see "Universal Module Application Module" manual.

You cannot activate several functions at the same time but only sequentially at one drive.

6.1 Adjustment

The master position is read and saved with the rising edge of the start signal. With set start signal in operating mode 8 "Gearing" and submode 80 "Gearing direct", positioning on the saved master position is realized with dynamic setpoints via bus.

You can select the modulo travel strategy in control word I1 via bit 9 "positive" and bit 10 "negative" according to the following table.

I1:9 "positive"	I1:10 "negative"	Modulo travel strategy
0	0	Short distance
0	1	Negative
1	0	Positive
1	1	Short distance

In the process output data, the active adjustment process is shown in bit O7:5.

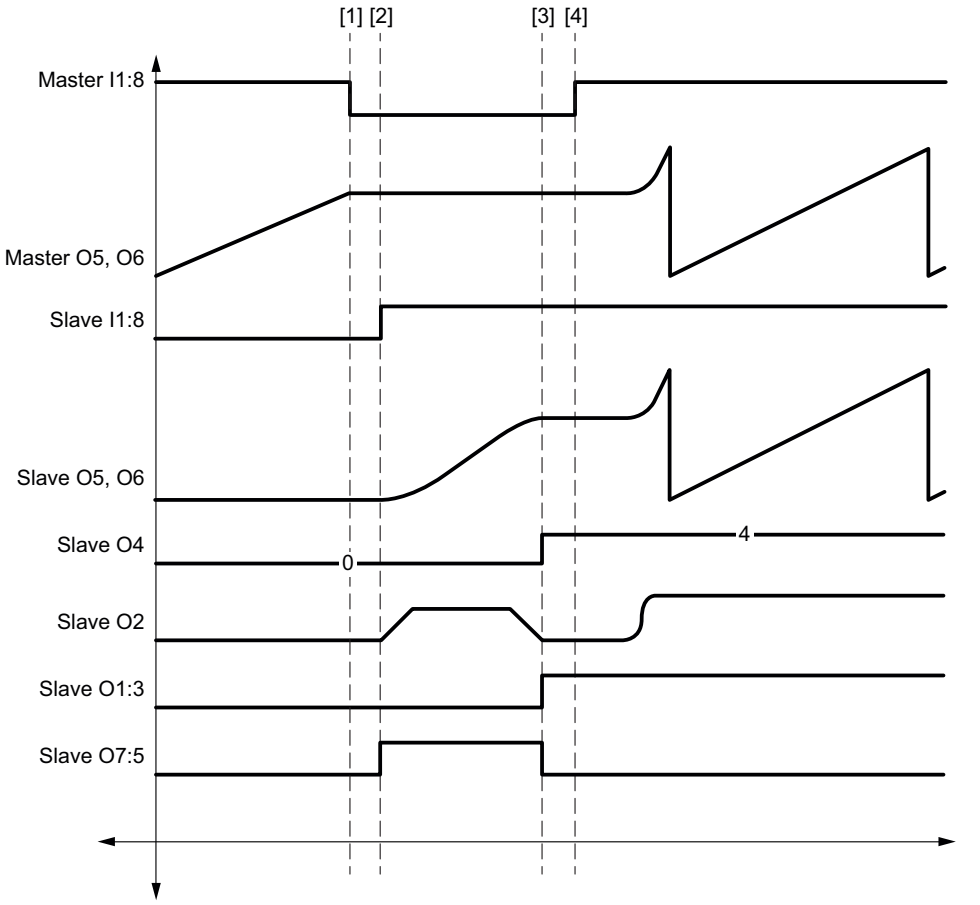
6.1.1 Requirements

- The **master axis** is in **idle state** and **enabled** during the adjustment process.
- The adjustment function is configured, see chapter "Relative movement master – slave" (→ 🗎 40).
- The slave axis is referenced.
- The configured axis types of master and slave axis are identical.
- The user units of master and slave axis are identical.

23030526/EN – 12/2016

6.1.2 Example

Cycle diagram



I1:8	Start
O5, O6	Actual position
O4	Synchronization status: Status gearing (0 = Inactive / 4 = Active)
O2	Actual velocity
O1:3	Setpoint reached
O7:5	Adjustment active
[1] – [4]	Changing process data/signal states (see following sequence)

Sequence

No.	Sequence	Process data/signal states
[1]	Master axis is in idle state. Operating mode of the slave axis is selected.	Master: I1:11 – 14 Operating mode 8: Gearing Master: I7:8 – 15 Submode 81: Gearing Expert Slave: O4 Status gearing = 0
[2]	The speed and the ramps are specified via the process input data. Start signal of the slave axis is set. Adjustment starts.	Master: I1:8 Start = 1 Slave: O4 Status gearing = 1 Slave: O7:5 Adjustment active = 1

23030526/EN – 12/2016

No.	Sequence	Process data/signal states
[3]	Adjustment completed.	Slave: O4 Status gearing = 4
[4]	Master axis starts. Slave axis travels synchronously with the master axis.	Slave: O4 Status gearing = 4

For detailed information on process data assignment, refer to chapter "Process data" (→ 🗎 46).

6.2 Offset

In synchronous operation, you can position the slave axis in a superimposed time-based way relatively to the master axis via offset processing.

The setpoint offset is defined via process input data I5 and I6. The offset between master and slave axis remains after offset execution. The offset can be undone by an inverse offset. The offset function can be executed as often as required.

You can configure the dynamic parameters (speed, acceleration, braking deceleration, jerk) or specify them dynamically via the process input data I2 – I4, see chapter "Process input data" (→ 🗎 47).

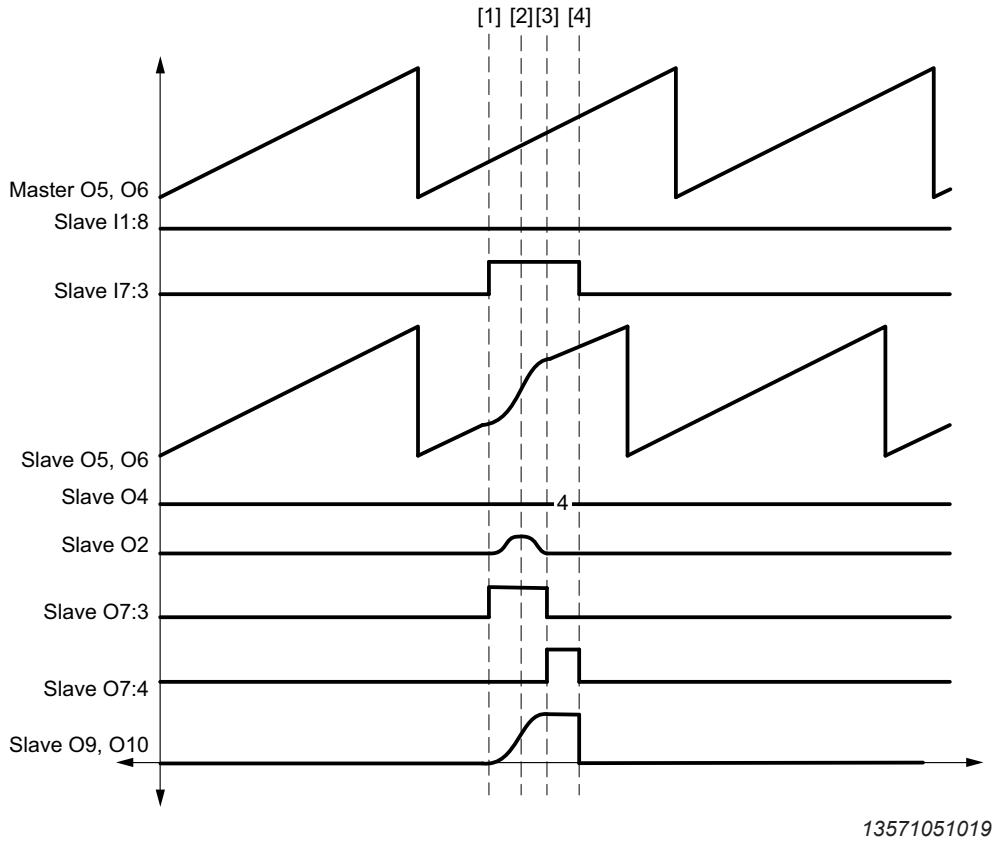
6.2.1 Requirements

- The gearing offset mode is configured, see chapter "Relative movement master – slave" (→ 🗎 40).
- Synchronization status is active (status gearing = 4).

23030526/EN – 12/2016

6.2.2 Example

Cycle diagram



O5, O6	Actual position
I1:8	Start
I7:3	Activate gearing offset
O4	Synchronization status: Status gearing (4 = Active)
O2	Actual velocity
O7:3	Gearing offset active
O7:4	Gearing offset completed
O9, O10	ActualValue2
[1] – [4]	Changing process data/signal states (see following sequence)

Sequence

No.	Sequence	Process data/signal states
[1]	The transferred offset is taken over with rising edge of the "Activate gearing offset" signal.	Slave: I7:3 Activate gearing offset = 1 Slave: **I5, I6 Setpoint2 = Offset**
[2]	Offset processing is active. Offset is processed according to the specified dynamics. The already traveled offset is shown.	Slave: O7:3 Gearing offset active = 1 Slave: O7:4 Gearing offset completed = 0 Slave: **O9, O10 ActualValue2 shows the already traveled offset distance.**

23030526/EN – 12/2016

No.	Sequence	Process data/signal states
[3]	Offset processing is completed.	Slave: O7:3 Gearing offset active = 0 Slave: O7:4 Gearing offset completed = 1 Slave: O9, O10 actual value = Offset
[4]	By resetting the "Activate gearing offset" signal, the offset machine is reset. Each activated offset processing is canceled.	Slave: I7:3 Activate gearing offset = 0 Slave: O7:4 Gearing offset completed = 0 Slave: O9, O10 ActualValue2 = 0

For detailed information on process data assignment, refer to chapter "Process data" (→ 🗎 46).

6.3 Stop of the master axis in case of a slave error

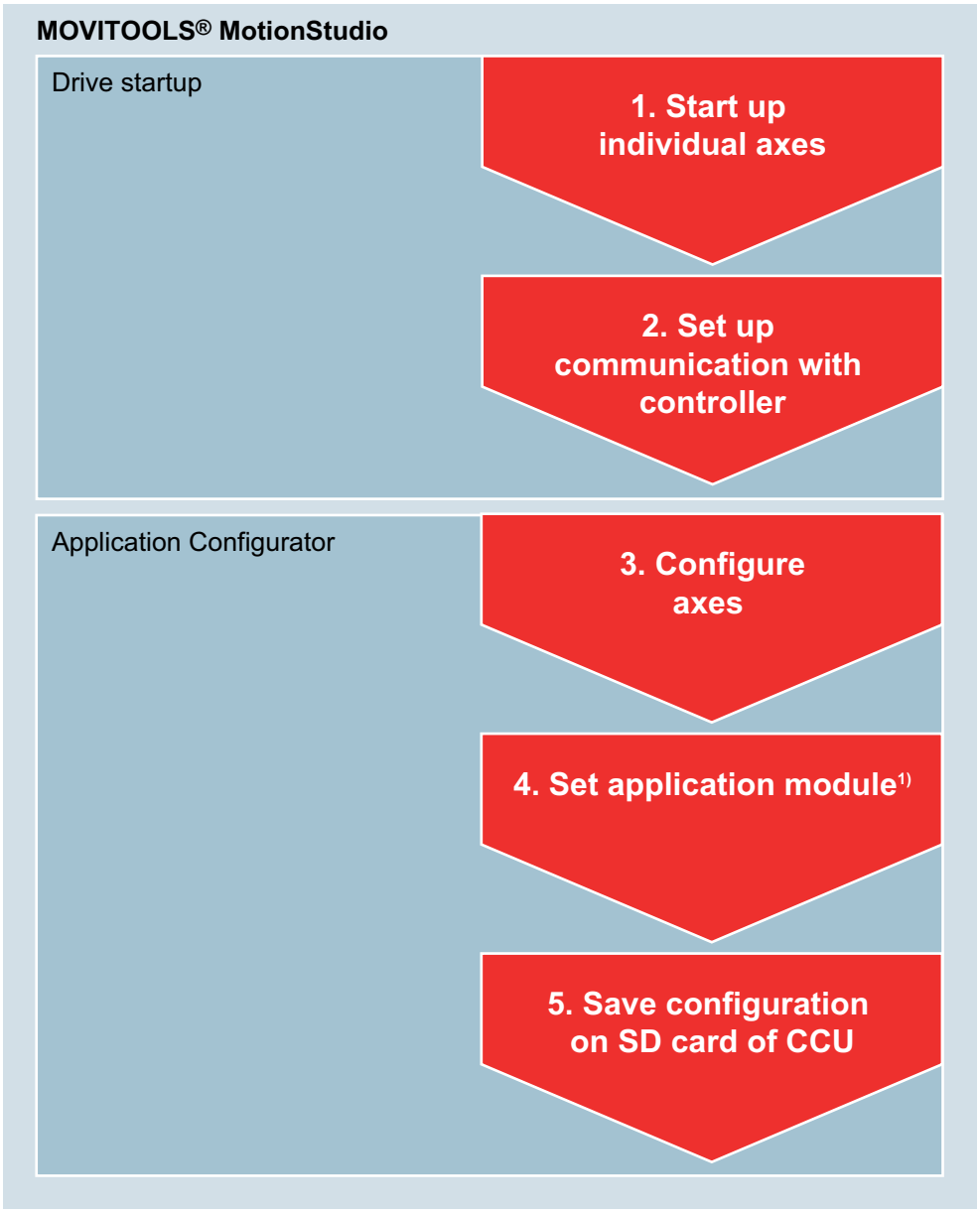
Especially for rigidly mechanically coupled applications, it is necessary that all drives stop immediately in case of an error. If this function is activated in the configuration, the master axis is stopped with an emergency stop ramp in case of a slave axis error, see chapter "Master axis configuration" (→ 🗎 37).

Synchronized slave axes without error follow the master axis according to the master-slave gear ratio.

23030526/EN – 12/2016

7 Startup

7.1 Startup procedure



13576286475

1) *Universal module Technology 10 PD* application module

INFORMATION

Before performing steps 3 – 5 in the *Application Configurator*, perform single-axis startup for each axis of the corresponding controller using "Drive Startup for MOVI-PLC®" (steps 1 to 2).

"Drive Startup for MOVI-PLC®" resets the device to its factory settings and writes the frequency inverter parameters required to control the drive properly.

23030526/EN – 12/2016

In steps 1 – 2:

- In the network view of "MOVITOOLS® MotionStudio", select the **drive** you want to take into operation.
- Perform "Drive Startup for MOVI-PLC®".
- Perform the startup steps.

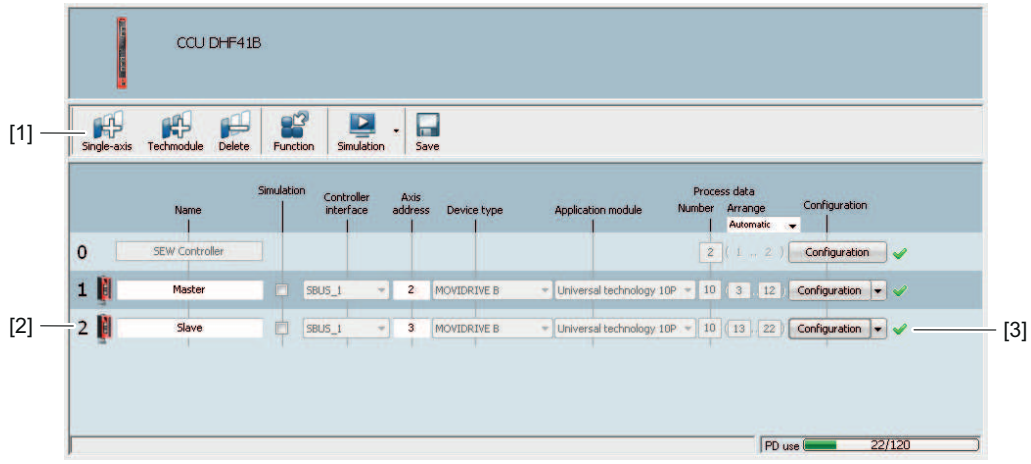
7.2 Adding individual axes to the configuration

Observe the following notes on axes configuration:

- Up to 8 axes can be operated with a controller in the *Universal module Technology*.
- The slave axis and the master axis require the same application module. This means that no master axis from the *Universal module Standard* can be combined with a slave axis of the *Universal module Technology* or vice versa.
- The master axis must always be configured prior to the corresponding slave axis. However, one configuration can contain several master-slave combinations.
- With master-slave combinations of modulo axes, observe that ModuloMax[1)] of the slave axis ≥ ModuloMax[1)] of the master axis.

Proceed as follows:

1. Start the "MOVITOOLS® MotionStudio" engineering software.
2. Select the **controller** in the network view of MOVITOOLS® MotionStudio.
3. Start the "Application Configurator" configuration software.
4. Click the button [1] in the configuration interface of the Application Configurator.



13664717195

⇨ A new line appears in the axis section [2].

5. Configure the axis according to your requirements:
   ⇨ Name of the axis
   ⇨ Simulation mode
   ⇨ Controller interface
   ⇨ Axis address
   ⇨ Device type
6. Select the *universal module Technology* application module with a suitable profile.

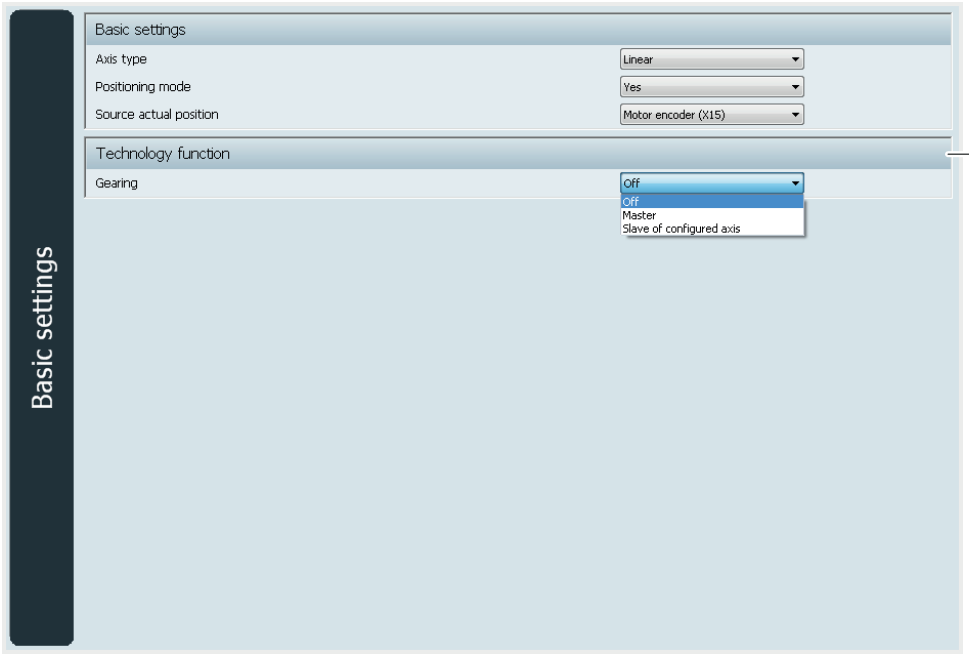
7. Click the button [3].
   ⇨ A software wizard for setting the application module appears.
8. Follow the instructions of the wizard as described in the following chapter "Setting the application module".
   ⇨ Once you have completed the instructions of the software wizard, the yellow warning symbol turns into a green check [3].
9. Click [Next].
   ⇨ The "Download" window is displayed (see "Application Configurator for CCU" manual).

1) Maximum value for modulo travel strategy

7.3 Setting the application module

7.3.1 Basic settings

"Basic settings" offer the following functions:



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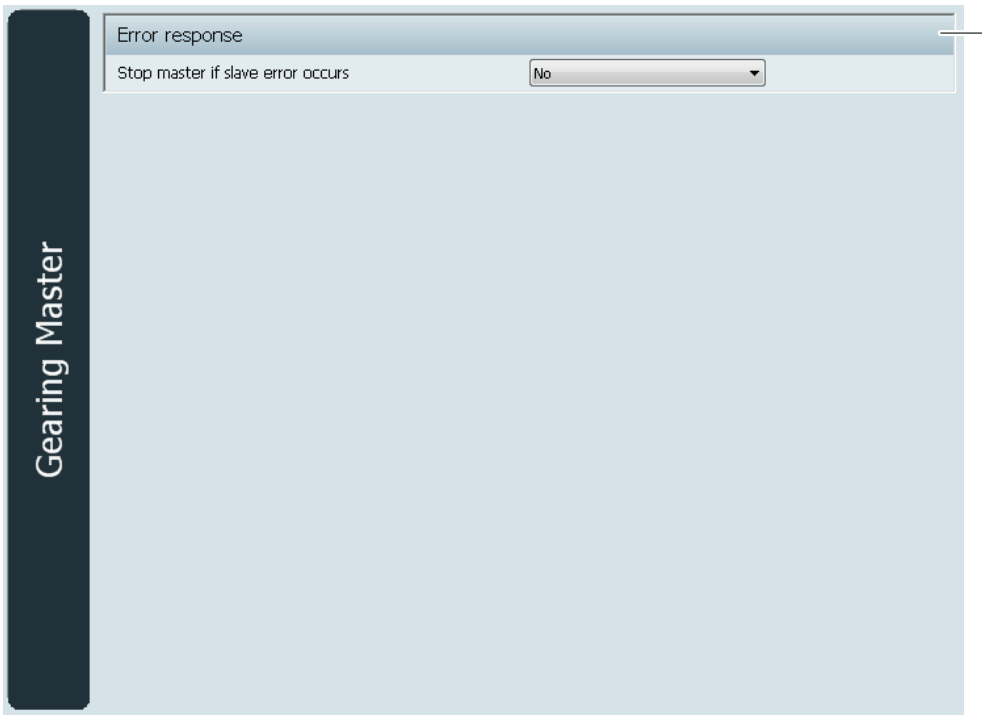
No.	Description
[1]	In this group you choose whether the axis is the master or a slave. You have the following options: • **Off**: The gearing function is disabled. • **Master**: The axis is activated as the master for the gearing function. • **Slave of configured axis**: The axis is activated as the slave for the gearing function.

7.3.2 Master axis configuration

"Gearing master" provides the following function.

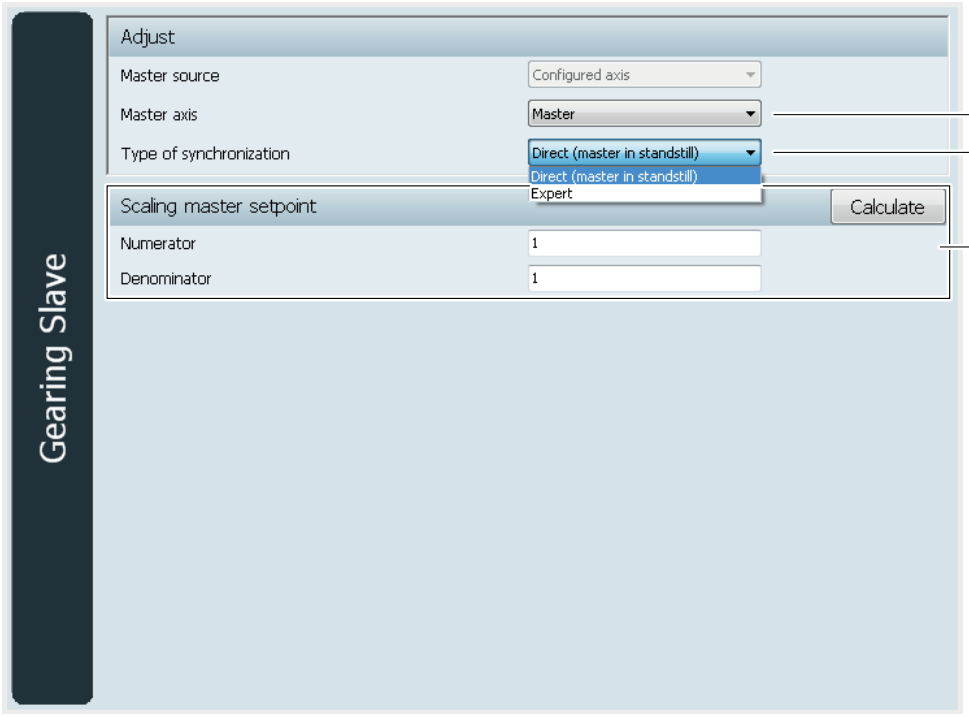


13665827339

No.	Description
[1]	In this group, you can activate the stopping of the master axis in the event of a slave axis error.

7.3.3 Slave axis configuration Gearing slave

"Gearing slave" provides the following functions.



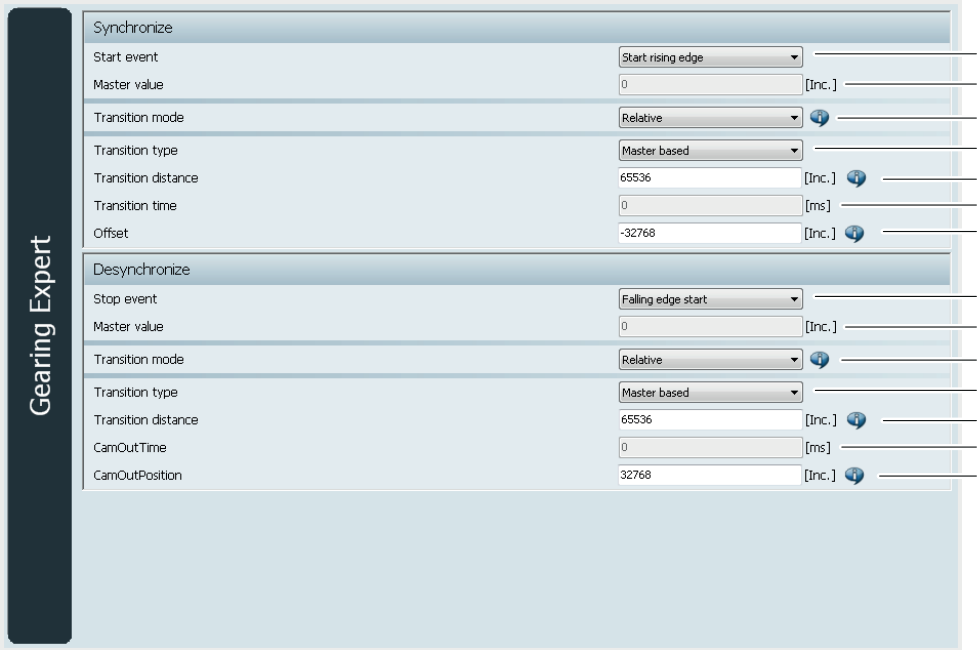
13666142219

No.	Description
[1]	Select the master axis in this drop-down list.
[2]	Select the synchronous operation type in this drop-down list. You have the following options: • **Direct**: Use this setting to skip the following page "Gearing expert" and go directly to the configuration page "Relative movement master – slave" (→ 🗎 40). • **Expert**: Use this setting to get to the next configuration page "Gearing expert" using the [Next] button, see the following chapter.
[3]	In this group, use the [Calculate] button to automatically calculate the scaling of the master setpoint in case of identical user units. Further, you can enter the values for numerator and denominator of your required scaling: $\frac{\text{Slave increments}}{\text{Master increments}} = \frac{\text{Numerator}}{\text{Denominator}}$

23030526/EN – 12/2016

7.3.4 Slave axis configuration Gearing Expert

"Gearing expert" provides the following functions.



9007212922490635

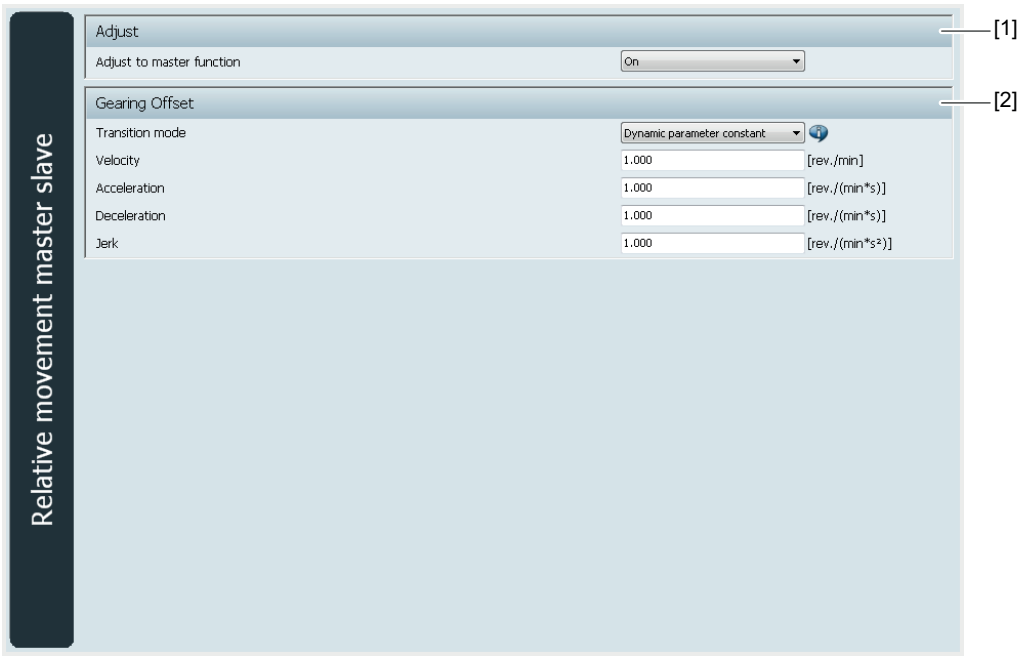
No.	Description
[1]	Select the start event for synchronization from this drop-down list, see chapter "Submodes and functions" (→ 🗎 14).
[2]	In this edit box, enter the position of the master axis at the time when synchronization starts.
[3]	Select the transition mode for synchronization as reference for the position of the slave axis after synchronization in this drop-down list, see chapter "Transitions for synchronization/desynchronization" (→ 🗎 18).
[4]	Select the transition type for synchronization from the drop-down list, see chapter "Transitions for synchronization/desynchronization" (→ 🗎 18).
[5]	In this edit box, enter the synchronization distance of the master-based transition.
[6]	In this edit box, enter the time for time-based transition.
[7]	In this edit box, enter the offset of the transition.
[8]	Select the stop event for desynchronization from this drop-down list, see chapter "Submodes and functions" (→ 🗎 14).
[9]	In this edit box, enter the position of the master axis at the time when desynchronization starts.
[10]	Select the transition mode for desynchronization as reference for the position of the slave axis after desynchronization in this drop-down list, see chapter "Transitions for synchronization/desynchronization" (→ 🗎 18).
[11]	Select the transition type for desynchronization from the drop-down list, see chapter "Transitions for synchronization/desynchronization" (→ 🗎 18).
[12]	In this edit box, enter the desynchronization distance of the master-based transition.

No.	Description
[13]	In this edit box, enter the time for time-based transition.
[14]	In this edit box, enter the position of the slave axis after desynchronization.

For detailed information on the functions, refer to the chapter "Operating modes and functions" (→ 🗎 14).

7.3.5 Relative movement of master – slave

"Relative movement master – slave" provides the following functions.



9007212932008843

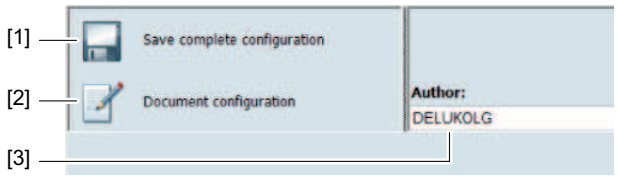
No.	Description
[1]	Activate the adjustment function in this group.
[2]	Activate offset processing in this group. Select here whether the dynamics parameters (speed, acceleration, braking deceleration, jerk) for offset movement will be configured or specify via the process data interface variably.

23030526/EN – 12/2016

7.4 Saving the configuration on the SD card of the controller

7.4.1 Completing the axis configuration

After successful axis configuration, the following functions are available in the displayed window.



14794534795

No.	Description
[1]	Use this button to save frequently used configurations in a configuration file (*.XML). This way, you do not have to enter the values again for future startups with the same configuration.
[2]	Use this button to create a PDF file with a configuration report.
[3]	If you enter a name in this input field, it will be listed in the report.

Saving the configuration to a configuration file (*.xml)

Proceed as follows:

1. Click button [1].
   ⇨ A window opens with the directory structure of your computer.
2. Search the desired storage location in the directory structure.
3. Enter a random name for the configuration.
4. To close the dialog, click [Save].

⇨ You have now saved the configuration.

Finishing the configuration

Proceed as follows:

1. To exit the wizard, click [Finish].

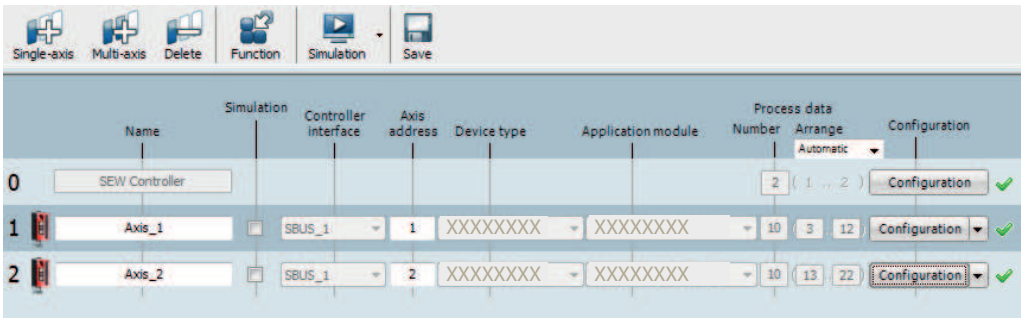
⇨ You have now completed the configuration.

⇨ The screen of the Application Configurator is displayed again.

23030526/EN – 12/2016

7.4.2 Finishing the configuration

The following window shows the complete configuration.



9007214493540747

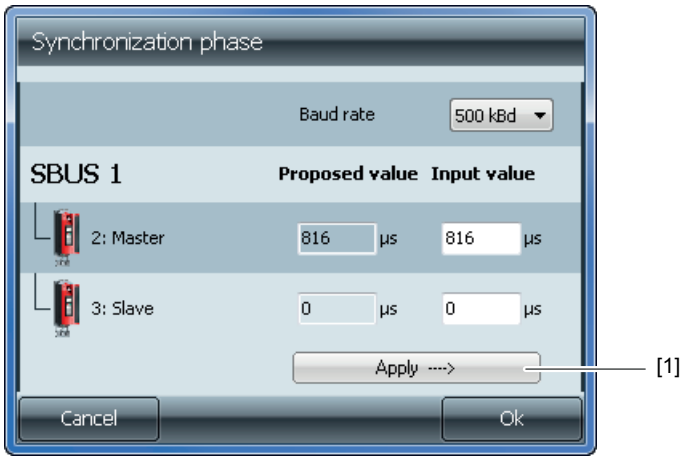
To finish the complete configuration, click [Next].

If you **use MOVIDRIVE® B**, the window for setting the synchronization phase opens depending on the configuration, see the next chapter.

If you **DO NOT use MOVIDRIVE® B**, skip the next chapter and go directly to chapter "Downloading the configuration".

7.4.3 Setting the synchronization phase of MOVIDRIVE® B

Once the configuration is completed, the following window opens, depending on the configuration.



13678964491

INFORMATION

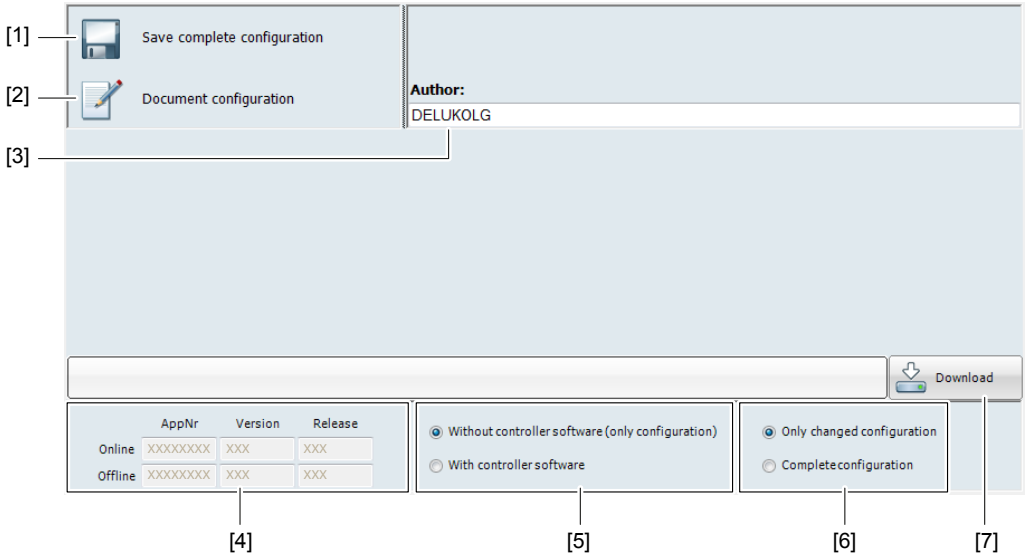
SEW-EURODRIVE recommends to set a baud rate of 1 MBaud at the devices and in the software interface.

1. Click the button [1] to confirm the suggested values.
   ⇨ The values are adopted.
2. Click [OK] to complete the configuration.
   ⇨ Configuration is completed.

23030526/EN – 12/2016

7.4.4 Downloading the configuration

If you configured the application module, the following data is available under "Download".



9007212935349131

No.	Description
[1]	Use this button to save the configurations in a file of the format *.AppConfig.ZIP. This way, the values can be reused for future startups.
[2]	Use this button to create a PDF file with a configuration report.
[3]	If you enter a name in this input field, it will be listed in the report.
[4]	In this group, information on the online and offline installed boot project is displayed: • Part number of the application module • Currently installed and downloaded version • Currently installed and downloaded release
[5]	Use the radio buttons to choose if you want to download the configuration with or without controller software.
[6]	Use the radio buttons to choose if you want to download the changed or the entire configuration.
[7]	Use this button to download the configuration.

1. Make the required settings.
2. Click the button [7] to download.

⇨ The configuration is downloaded.

⇨ The controller is ready for operation.

⇨ Use the [Next] button to get back to the configuration interface of the Application Configurator.

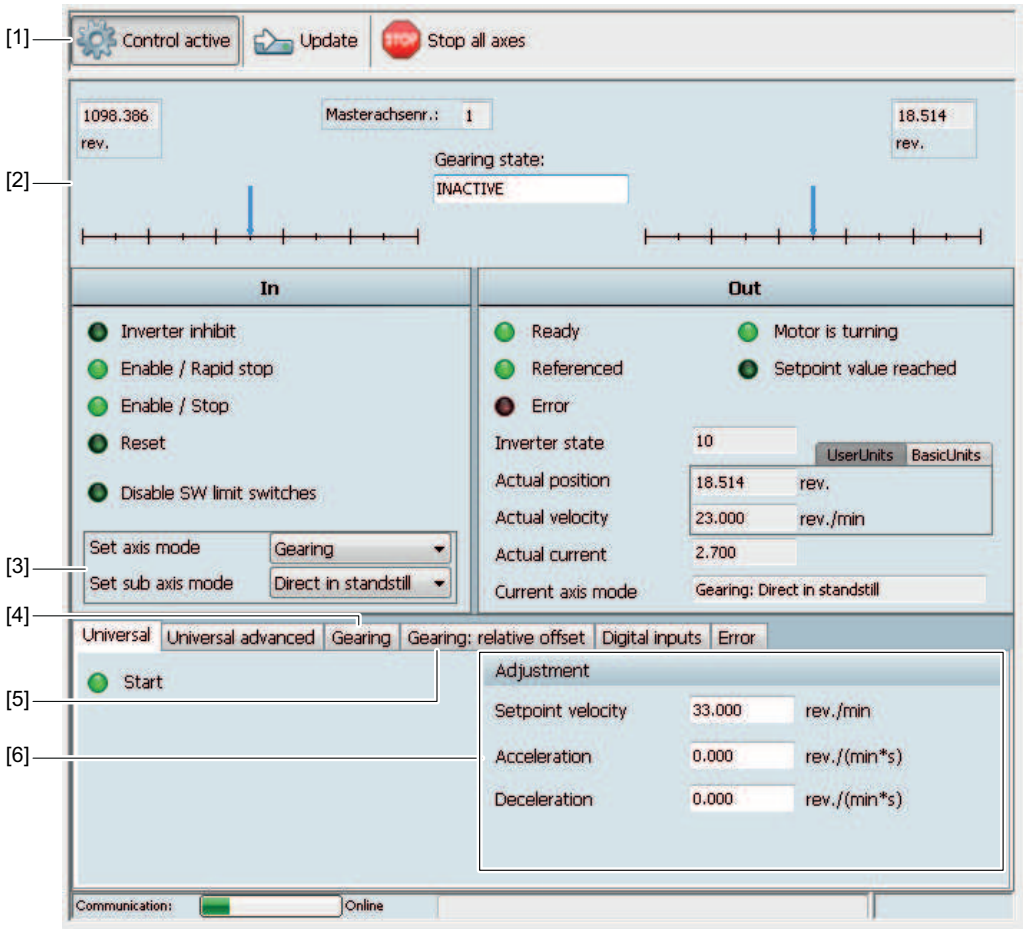
⇨ You can start operation or the test run in diagnostics, see following chapter.

8 Operation and diagnostics

The functions for operation and diagnostics of the application module are integrated in the Application Configurator, from where they are called. For detailed information, refer to the documentation of the "Application Configurator for CCU" configuration software.

8.1 Module diagnostics

Module diagnostics provides the following functions.



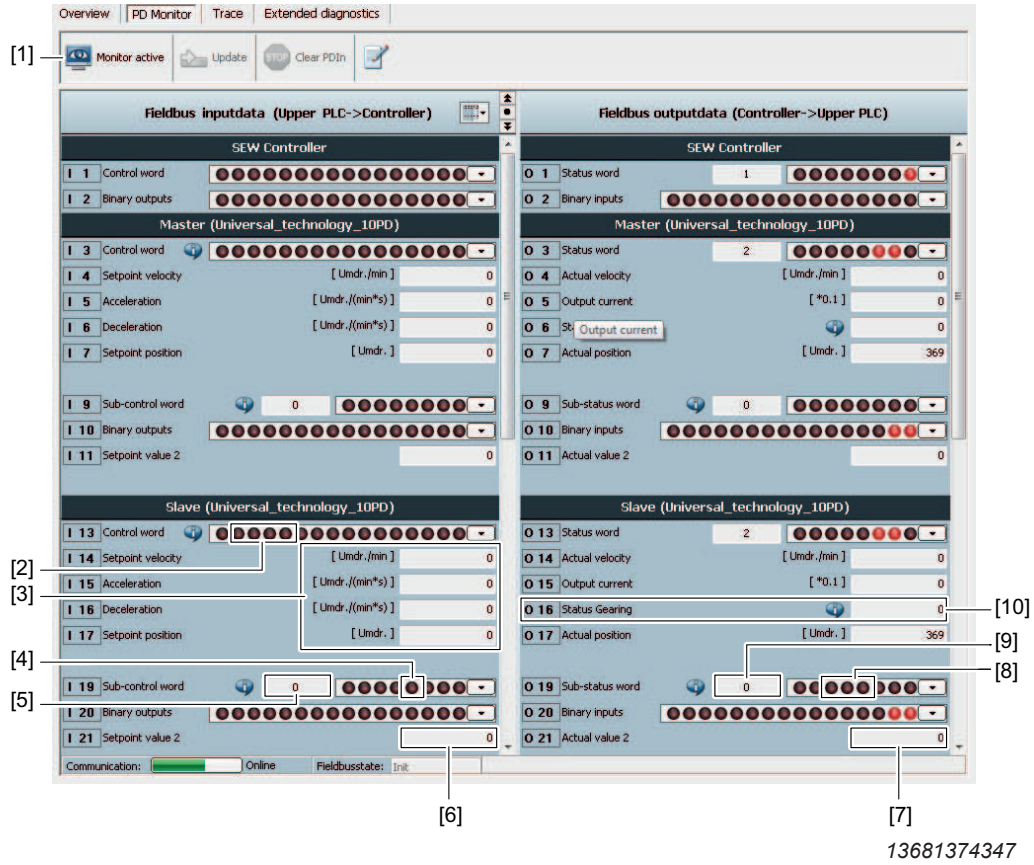
13680615691

No.	Description
[1]	Use this button to switch to monitor mode or control mode. • In **monitor mode**, you can monitor the functions of the application module. • In **control mode**, you can control the functions of the application module.
[2]	In this section, you can monitor the operation of the selected operating mode.
[3]	In this section, you choose the operating mode and submode.
[4]	In this tab, you monitor the synchronization status of the master and slave axis.
[5]	In this tab, you control the offset.
[6]	In this section, enter the dynamics parameters for the adjustment function.

23030526/EN – 12/2016

8.2 Process data monitor

The process data monitor provides the following functions.



13681374347

No.	Description
[1]	Use this button to switch to monitor mode or control mode: • In **monitor mode**, you can monitor the functions of the application module. • In **control mode**, you can control the functions of the application module.
[2]	Use these bits to activate operating mode 8 "Gearing".
[3]	In this section, enter the required dynamics parameters for adjustment and offset.
[4]	Use this bit to activate the offset.
[5]	In this edit box, enter the required submode: • **80**: Gearing Direct • **81**: Gearing Expert
[6]	In this edit box, enter the required offset.
[7]	In this display field, the current offset is displayed.
[8]	These bits show the current status of offset and adjustment function.
[9]	In this display field, the current submode is displayed.
[10]	In this display field, the current synchronization status is displayed, see chapter "State machine: Status gearing" (→ 🗎 26).

9 Process data

9.1 Overview

The process data interface is defined for 10 process data words and is backward compatible to the *universal module Standard*. The following table shows the process data of the "10 PD" profile.

Profile	Process data	
	Process input data	Process output data
10 PD	I1 = Control word	O1 = Status word
	I2 = Setpoint speed	O2 = Actual speed
	I3 = Acceleration	O3 = Output current
	I4 = Deceleration	O4 = Status gearing
	I5 = Setpoint position (high word)	O5 = Actual position (high word)
	I6 = Setpoint position (low word)	O6 = Actual position (low word)
	I7 = Sub control word	O7 = Sub status word
	I8 = Digital outputs	O8 = Digital inputs
	I9 = Setpoint 2 (high word)	O9 = Actual value 2 (high word)
	I10 = Setpoint 2 (low word)	O10 = Actual value 2 (low word)

For process data assignment of the profile, refer to the following chapters.

23030526/EN – 12/2016

9.2 Process input data

The following table shows the process input data assignment from the PLC to the controller for fieldbus control with 10 process data words.

Word	Bit	Function	
I1	0	/Controller inhibit	
	1	Enable/Rapid stop	
	2	Enable/stop	
	3	Reserved	
	4	Reserved	
	5	Release brake with inhibited output stage (MG/DRC/ELVCD)	
	6	Reset fault	
	7	Reserved	
	8	Start	
	9	Jog positive (CW rotation)	
	10	Jog negative (CCW rotation)	
	11	Mode 2^0	0000 = Operating mode 0: Reserved
	12	Mode 2^1	0001 = Operating mode 1: Velocity control
	13	Mode 2^2	0010 = Operating mode 2: Jog mode
	14	Mode 2^3	0011 = Operating mode 3: Referencing mode 0100 = Operating mode 4: Positioning mode 0101 = Operating mode 5: Positioning mode – Touch-probe 0110 = Operating mode 6: Reserved 0111 = Operating mode 7: Emergency mode 1000 = Operating mode 8: Gearing
	15	/SWLS (deactivate software limit switch)	
I2	0 – 15	Setpoint speed [user unit]	
I3	0 – 15	Acceleration [user unit]	
I4	0 – 15	Braking deceleration [user unit]	
I5	0 – 15	Setpoint position/gearing offset (high word) [user unit]	
I6	0 – 15	Setpoint position/gearing offset (low word) [user unit]	

23030526/EN – 12/2016

Word	Bit	Function	
I7	0	Touchprobe enabled	
	1	Reserved	
	2	Activate torque limiting (not available in operating mode "Gearing")	
	3	Gearing offset activated	
	4 – 7	Reserved	
	8 – 15	Submodes	
		Operating mode 1: Velocity control	No submode implemented
		Operating mode 2: Jog mode	No submode implemented
		Operating mode 3: Referencing mode	30: Static reference offset 31: Variable reference offset (taken from I5/I6 "setpoint position")
		Operating mode 4: Positioning mode	40: Absolute positioning 41: Relative position control CW rotation 42: Relative position control CCW rotation
		Operating mode 5: Positioning mode – Touchprobe	0: Absolute positioning (default) 50: Absolute positioning 51: Relative position control positive 52: Relative position control negative
		Reserved	Reserved
		Operating mode 7: Emergency mode	70: Emergency mode without external encoder 71: In preparation (emergency mode with switching to parameter set 2)
		Operating mode 8: Gearing	80: Gearing Direct 81: Gearing Expert
I8	0 – 15	Digital outputs [user unit]	
I9	0 – 15	Setpoint 2 (high word) [user unit]	
I10	0 – 15	Setpoint 2 (low word) [user unit]	

23030526/EN – 12/2016

9.3 Process output data

The following table shows the process output data assignment from the controller to the PLC for fieldbus control with 10 process data words.

Word	Bit	Function
O1	0	Motor is running
	1	Inverter ready
	2	Drive referenced
	3	Target position / speed reached / drive synchronous
	4	Brake released
	5	Inverter error
	6	Warning inverter
	7	Fault code application
	8 – 15	Code for status / warning / error of the frequency inverter
O2	0 – 15	Actual velocity [user unit]
O3	0 – 15	Output current [user unit]
O4	0 – 15	Status gearing[1)]
		0: MC_CAM_MANAGER_INACTIVE
		1: MC_CAM_MANAGER_WAITING_FOR_START_CYCLE
		2: MC_CAM_MANAGER_STARTING_MASTERBASED
		3: MC_CAM_MANAGER_STARTING_TIMEBASED
		4: MC_CAM_MANAGER_ACTIVE
		5: MC_CAM_MANAGER_WAITING_FOR_STOP_CYCLE
		6: MC_CAM_MANAGER_STOPPING_MASTERBASED
		7: MC_CAM_MANAGER_STOPPING_TIMEBASED
		8: MC_CAM_MANAGER_MASTERBASED_TRANSITION
		9: MC_CAM_MANAGER_TIMEBASED_TRANSITION
		99: MC_CAM_MANAGER_ERROR_STATE
O5	0 – 15	Actual position (high word) [user unit]
O6	0 – 15	Actual position (low word) [user unit]
O7	0	Touchprobe enabled
	1	Touchprobe detected
	2	Reserved
	3	Gearing offset active
	4	Gearing offset completed
	5	Adjustment active
	6	Hardware limit switch positive
	7	Negative software limit switch
	8 – 15	Submode (see I7)

Word	Bit	Function
O8	0 – 15	Digital inputs [user unit]
O9	0 – 15	Actual – gearing offset (high word) [user unit]
O10	0 – 15	Actual – gearing offset (low word) [user unit]

1) For detailed information, refer to chapter "State machine: Status gearing".

23030526/EN – 12/2016

Index

23030526/EN – 12/16

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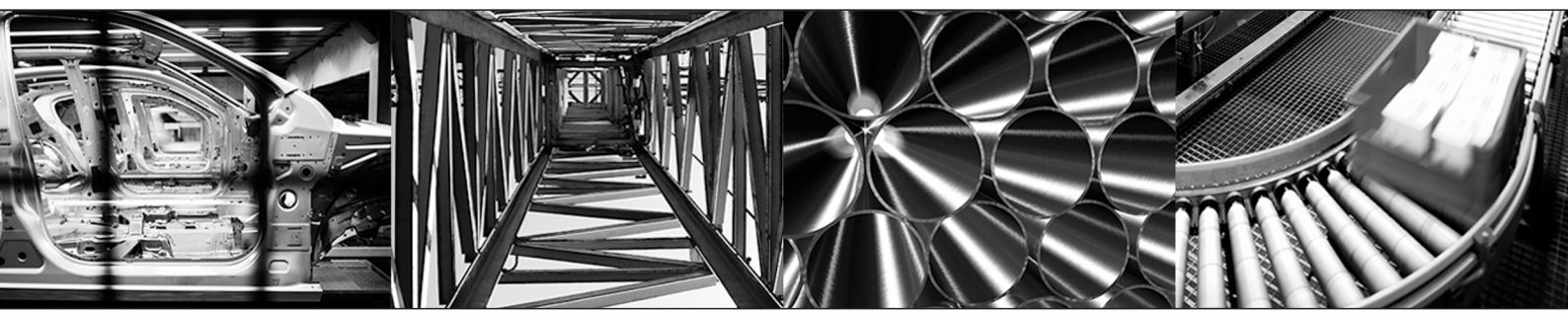
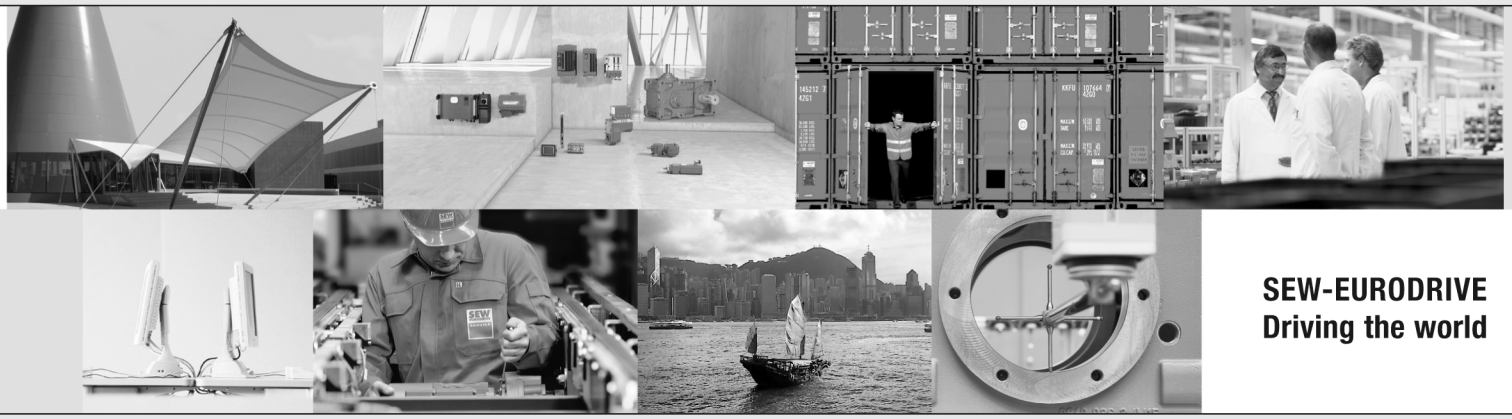
23030526/EN – 12/16





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