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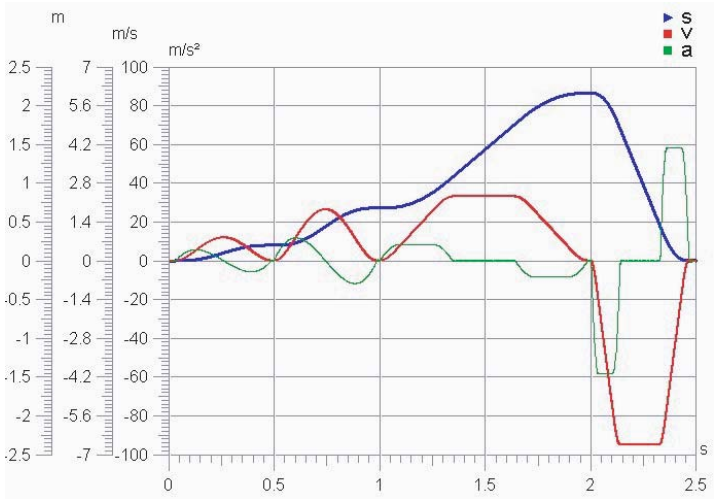
Telemecanique

by Berger Lahr

Technical Documentation



Cam profile operating mode for Twin Line units TLC6xx

CAM

Order no.: TLADOCCAM6E

Edition: V1.02, 08.2004

a company of Schneider Electric

Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

For more information see the chapter on safety.

Not all product types are available in all countries. Please see the current catalogue for the availability of products.

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All information refers to specifications and not to assured properties.

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Writing conventions and symbols

Work steps

If work steps must be carried out in sequence, they are shown as follows:

■ Special prerequisites for the following work steps

▶ Step 1

◁ Important response to this work step

▶ Step 2

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists

Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
  - Subpoint to 2
  - Subpoint to 2
- Point 3

Making work easier

Information on making work easier can be found at this symbol:

This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.

Parameters

Parameters are shown as follows:

`Group.Name Index:Subindex`

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1 Introduction

The type and structure of this operating manual is designed for the trained user.

The operating manual describes the user operating mode "cam profile operating mode“, referred to below as the "CAM operating mode". This operating mode has been integrated into the TLC6xx controller, and is part of the Twin Line operating system.

Knowledge of the function and use of the following is assumed:

- TLC63x and the previous operating modes
- TLC61x and the previous operating modes
- TLCT, the commissioning software and its functions
- CoDeSys, the IEC program development environment
- Fieldbus

This operating manual is designed as a supplement to the following documents:

- Twin Line Controller TLC61x / TLC63x
- TLCT commissioning software
- CoDeSys
- Fieldbus
  - CAN
  - DeviceNet
  - Interbus-S
  - Profibus-DP
  - RS485

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1.1 General overview

The operating mode 'cam' serves the same function as the mechanical cam profile in generating derived movements (referred to hereafter as slave movements) that have a non-linear movement relationship to the originating movement (referred to hereafter as master movement).

In addition, two mechanical cam signals can be electronically reproduced.

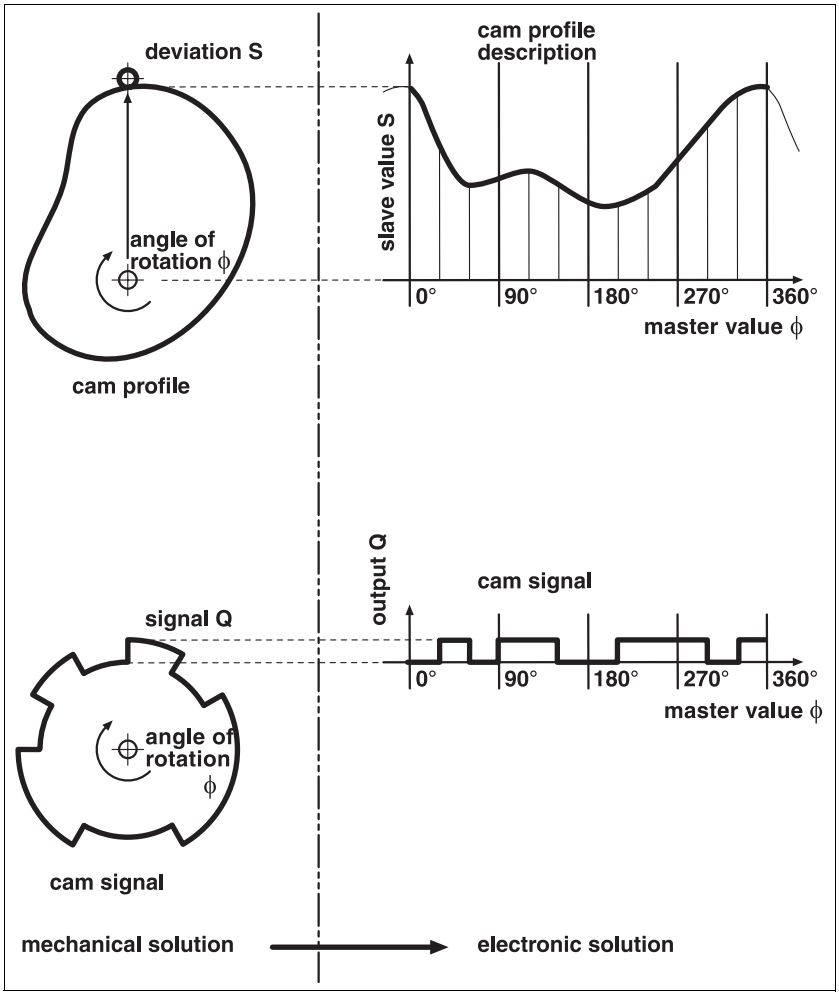

Figure 1.1 Converting mechanical to electronic cam profile

Master movement Position preset by an incremental encoder at module slot M1 or by a virtual master (manual/profile)

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Slave movement Derived movement that is generated by the implemented cam.

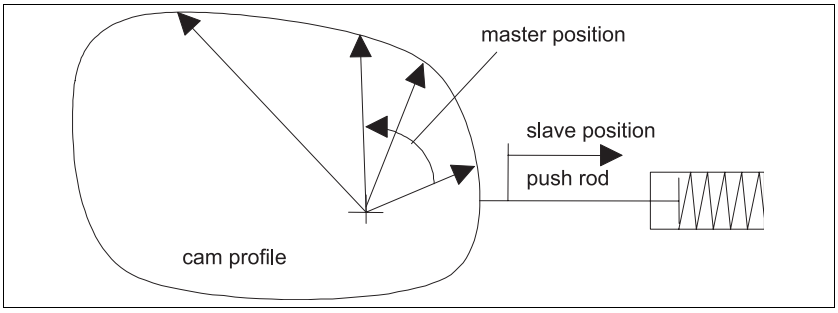

Figure 1.2 Schematic view of a mechanical cam profile movement

The rotating cam profile generates a slave movement with a closed curve profile at the pushrod.

The non-linear movement of the cam profile can be shown as a position reference from master to slave position in the form of a table or a graph as follows:

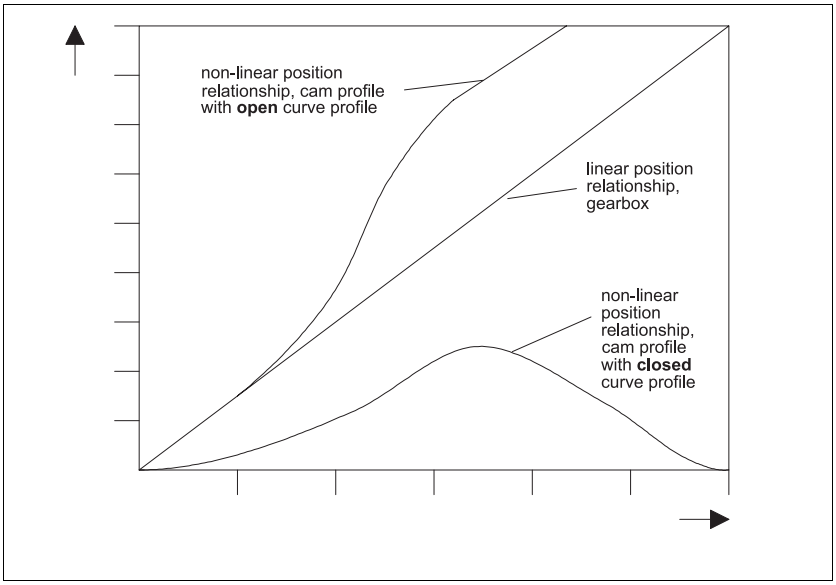

Figure 1.3 Position relationship of a cam profile and a gearbox

1.2 Electronic cam profile ('cam')

The electronic cam profile (cam) replaces a mechanical cam profile, and enables the TLC6xx controller, which is controlled by a master position, to execute the follow movement (slave movement). The relationship between master and slave position is described by a mapping table.

The cam can be controlled by the TLCT commissioning software, various fieldbuses and with a CoDeSys application. The cam profile description file can be created on a PC with a cam profile editor (cam editor). This program calculates an optimum movement path from the specified interpolation points or profiling segments.

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An ASCII file can be created from the calculated movement path. It shows the path in the form of equidistant interpolation points (master values at the same distance apart). This file also contains additional curve-specific information. The cam profile description file can then be transferred to the controller via TLCT.

The cam profile description can also be calculated with CAD systems, spreadsheet programs or mathematical programs and a description file corresponding to the defined file format can be created.

In addition to transferring the cam profile description to the controller, the TLCT can also be used to set parameters, for commissioning, observation and recording values.

The access over the various fieldbuses or a CoDeSys application is similar to the operation of the already available operating modes.

Curve number Every curve in the cam profile description is identified by a unique curve number in the header. The curves that are to be used in the cam profiling are selected with these numbers.

1.2.1 Principle of operating procedure

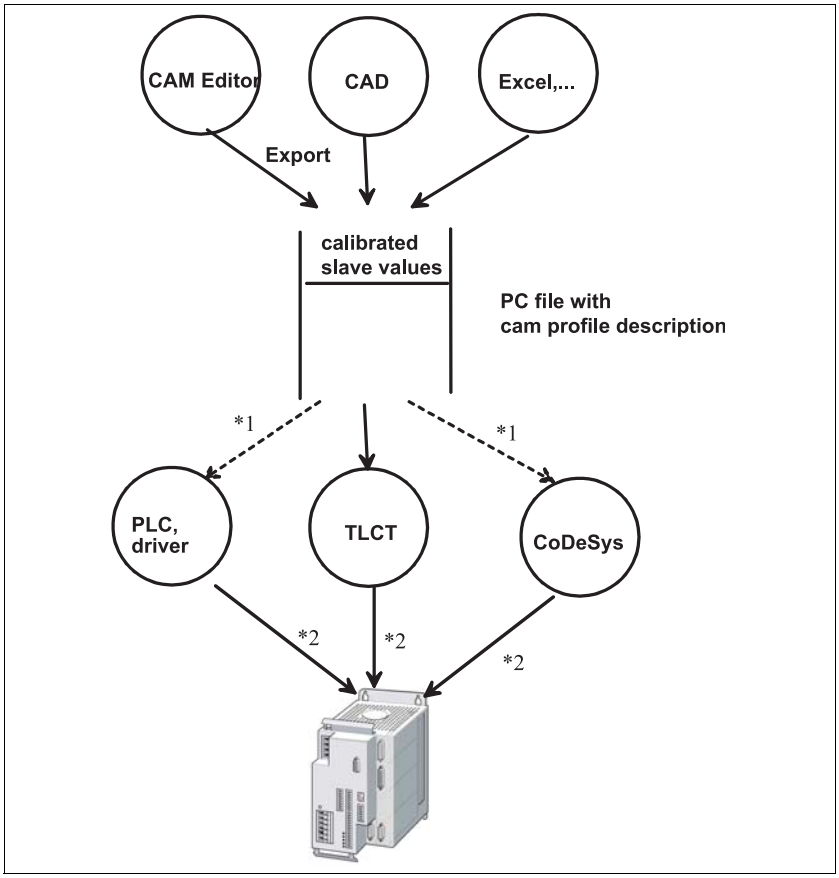

Figure 1.4 Principle of operating procedure

- Access depends on the type of master controller (not yet available via CoDeSys.)
- Diagram of the available actions depending on the access channel

Action	TLCT	CoDeSys	Field bus
Download cam profile description file	x		
Setting parameters for cam profiling	x	x	x
Activating cam profiling	x	x	x
Status monitoring and observation of profiling values	x	x	x
Recording and visualising	x		

Table 1.5 Actions that can be initiated over the various access channels

1.3 Software version

The following software packages are available in connection with the CAM operating mode.

1.3.1 Cam editor

The cam editor is used to create the curve shapes as motion profiles by using the laws of motion for cam mechanisms (VDI 2143). The optimised curve shapes can be exported for the TLC controller as cam profile description files.

1.3.2 TLCT commissioning software

The TLCT commissioning software is available for downloading the cam profile description file and also for setting parameters, commissioning, observation and recording of values.

1.3.3 CoDeSys programming software incl. library

Programming tool for developing and testing user programs with the IEC 61131-3 programming language

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2 Safety

Only the changes relevant to using cam are described here. For a detailed description of the required safety measures see the safety instruction in the TLC61x or TLC63x device manual.

Because of the complex setup and the potential problems that can result from unexpected positioning motions, speeds and accelerations caused by incorrect curve inputs or controller parameter settings, attendance at a training course is strongly recommended.

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

2.2 Intended use

The operating mode 'cam' supplies an electronic cam profile and is used to generate a motor movement electronically in the same way as a mechanical cam profile.

Two mechanical cam signals can be electronically reproduced simultaneously.

Before initial use the Twin Line units must be correctly installed and the functioning of the units must have been tested in an initial commissioning test.

2.3 Hazard categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions affixed to the product that warn of possible hazards and help to operate the product safely.

Depending on the seriousness of the hazard, the messages are divided into three hazard categories.

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⚠ DANGER!

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.

⚠ WARNING!

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION!

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

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2.4 General safety instructions

⚠ WARNING!

Danger of injury and damage to system components by loss of control!

- The system manufacturer must consider the possible errors that could occur with the signals and in particular the critical functions to ensure a safe status during and after errors. Critical functions include emergency stop and limiting end positions. Refer to NEMA ICS1.1 Safety Guidelines for the Application, Installation and Maintenance of Solid State Control and NEMA ICS7.1 Safety Standards for construction and Guide for Selection, Installation and Operation of Adjustable – Speed Drive Systems for further information
- Consideration of possible errors must include unexpected delay and failure of signals or functions
- Separate redundant controller paths must be provided for critical functions.

Failure to follow these instructions can result in death or serious injury.

⚠ WARNING!

Unexpected responses may cause injury and damage to the system.

The behaviour of the drive system is governed by numerous saved data. Unsuitable data may cause unexpected motions or responses to signals.

- Do not operate a unit with unknown data.
- Check the saved data.
- When commissioning carefully run tests for all operating states and fault cases.
- Check the functions after replacing a unit and also after changes to the saved data.
- Start the system only if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death or serious injury.

⚠ DANGER!

Danger of injury by complex system!

When starting field bus operation the attached controllers are generally out of view of the operator and cannot be directly monitored.

- Start the system only if there are no persons within the actuation zone of the moving system components and the system can be operated safely.

Failure to follow these instructions will result in death or serious injury.

3 Basics

3.1 Cam profile description

The actual cam profile description contains a defined number of standardised slave values. The associated standardised master values can be calculated from the max. master value transferred in the header and the number of table points. The number of tables to be transferred and the lengths of the individual tables are only limited by the available memory. See also chapter 6.1 „Processing cam profile description data“

The master values of the cam profile description are equidistant from one another. For example, they are generated from the non-equidistant master values of the cam profile description by the CAM editor.

Open and closed curve profiles can be processed. The transition to the subsequent cams (open and closed) is implemented independently by the CAM operating mode
See also chapter 3.5 „Closed and open curve profile“.

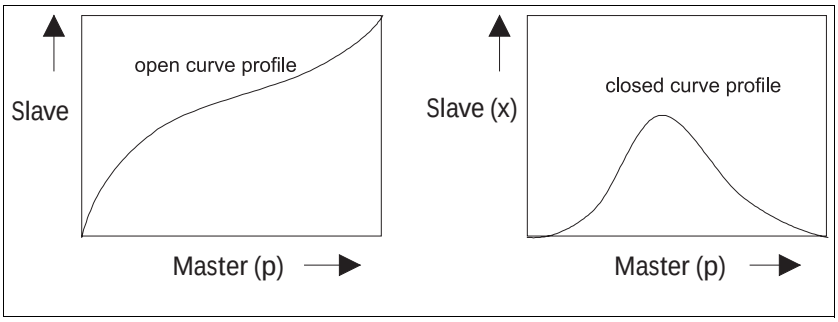

Figure 3.1 Open and closed curve profile

The movement laws and the resulting slave positions can be calculated with a CAM editor.

Additional cam profile descriptions can be loaded while the cam is being profiled.

All limits affecting speed, acceleration and jerk can be checked in the cam editor.

3.2 Description of cam parameters

Units of the master values [MasterUnits]

The master values can be given in physical units (e.g. degrees in range 0.. 360,000). These values must be converted into integer values in accordance with a defined number of decimal places (e.g. 0.. 360000 if three decimal places are specified). This format is the same as that used in the cam profile description file; the smallest unit corresponds to one MasterUnit.

Units of the slave values [SlaveUnits]

The slave values can be given in physical units (e.g. degrees in range 0.. 123,456). These values must be converted into integer values in accordance with a defined number of decimal places (e.g. 0.. 123456 if three decimal places are specified). This format is the same as that used in

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the cam profile description file; the smallest unit corresponds to one SlaveUnit.

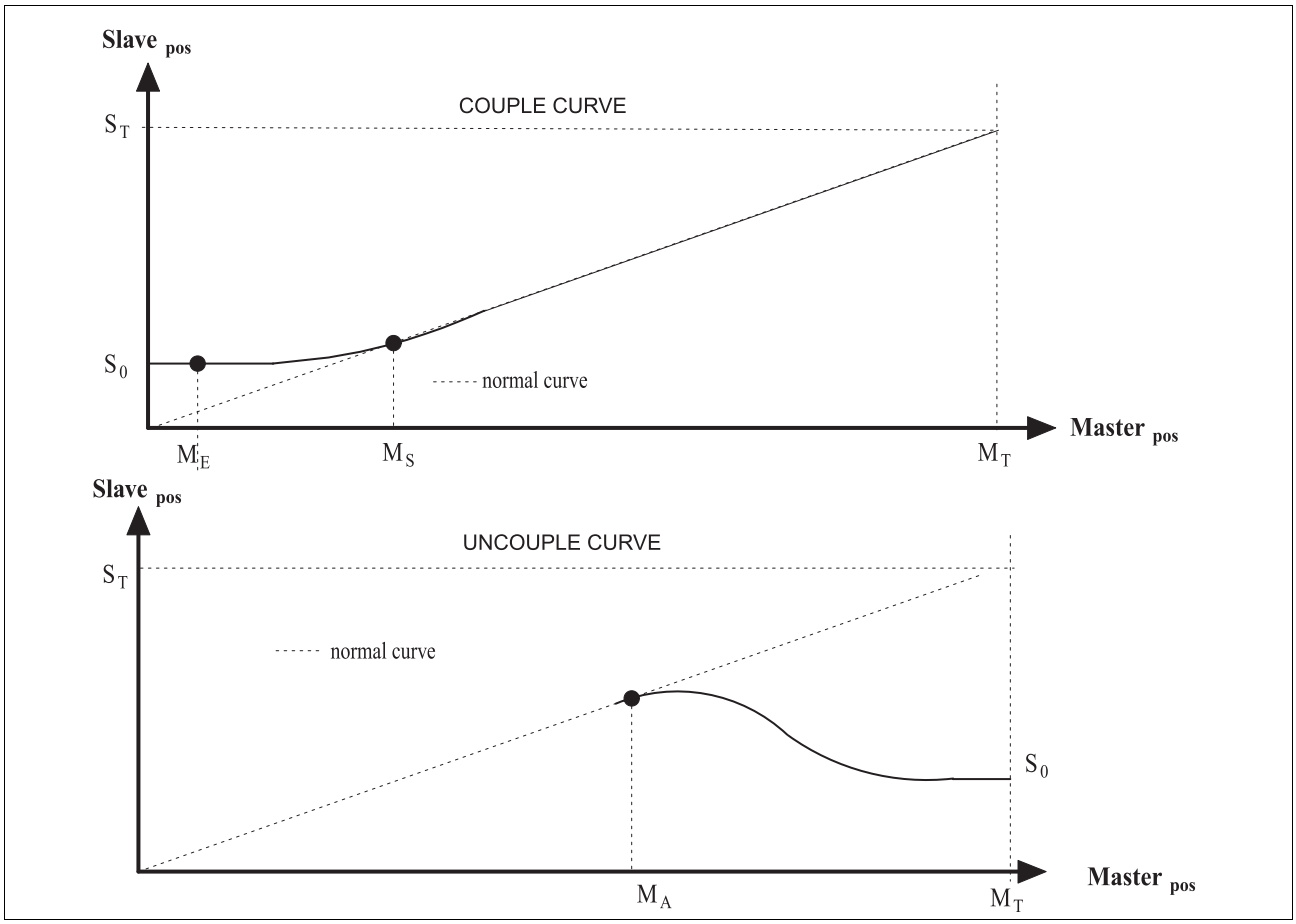

Figure 3.2 Description of the cam parameters using the example of an open curve profile

Uncouple position M_A Master position at which the uncouple process begins. This value is only meaningful in the uncouple curve.

Couple position M_E Master position at which the couple process begins. This value is only meaningful in the couple curve.

Synchronous position M_S Master position at which the couple process is ended, i.e. from this position the slave moves synchronously with the path of the normal curve. This value is only meaningful in the couple curve.

Master cycle length M_T The master cycle length corresponds to the maximum master position of the curve and thus to the master position of the last curve point. This length can be given in position units of the master. If the master position exceeds this point, the current curve is profiled again from the start.

Standstill position of slave S_0 Initial position of the slave at start of the couple process and end position on completion of the uncouple process.

Slave cycle length S_T The slave cycle length is the maximum slave position in the curve. This length can be given in position units of the slave.

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3.3 Evaluating the master and slave values

The curve data in user-specific values must be adapted to the conditions of the system or the drive by adaptation factors. The information is based on the maximum master or slave values and is referred to below as cycle length. It can be set with numerator and denominator value, allowing ratios that are not a whole number to be set.

Master increment

A change of the master position by the value 1 corresponds to one master increment.

Slave increment

A change of the slave position by the value 1 corresponds to one slave increment.

Evaluation of master values

When setting a command variable, e.g. with an incremental encoder, the value change of the encoder position that corresponds to a master cycle must be set.

Two parameters are used to specify what value change of the encoder position will correspond to one or more master cycles. A direction reversal of the command variable can also be set here.

Evaluation of slave values

The motor movement resulting from one processing of the position range of the slave cycle length must be set for the drive.

Two parameters specify what maximum value change of the slave position corresponds to one or more slave cycles.

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3.4 Couple curve - normal curve - uncouple curve

A separate curve must be defined for each of the phases: couple, normal mode and uncouple.

The maximum slave values of the couple and uncouple curve must not exceed the maximum slave value of the normal curve.

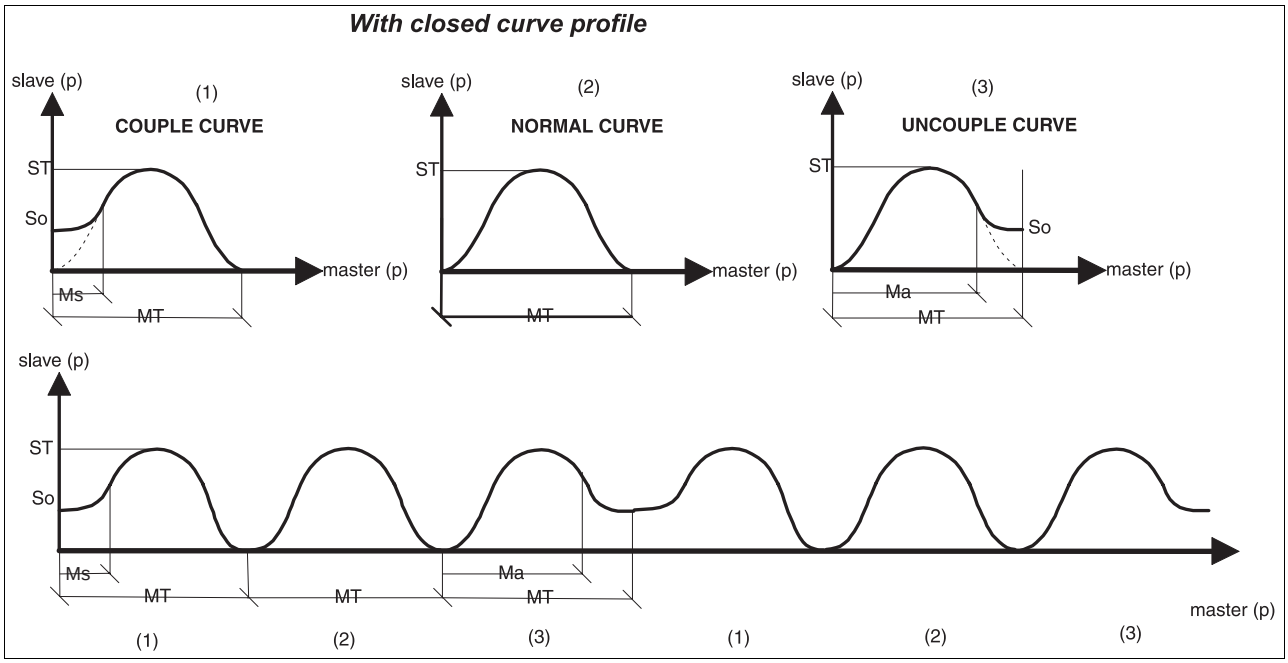

Figure 3.3 Curve types with a closed curve profile

Switching between the curve profiles depends on the settings of the couple position M_E, the synchronous position M_S and the uncouple position M_A with the couple request `CoupleReq`.

For some applications the couple and uncouple curve may not be required.

An overrun of the value range of command variable or slave position does not influence this process.

Couple process

The slave motor can be coupled corresponding to the saved curve into a running master movement. This process is necessary if the start position of the slave at the time of the master cycle is not equal to the slave position of the normal curve under this condition.

The couple process is started automatically by the cam as soon as the conditions for the couple process have been met (including master position is less than or equal to the couple position M_E) on triggering.

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Uncouple process

The slave motor can be uncoupled from a running master movement. This means that the slave motor starts its uncouple process corresponding to the curve position at a previously specified master position. This process is required if the end position of the slave at the maximum master position of the cam profile description is not equal to the slave position of the normal curve at this point.

The uncouple process is automatically started by the cam as soon as the condition for the uncouple process has been met (couple request disabled, normal curve profiling completed and uncouple curve present).

3.5 Closed and open curve profile

Closed curves

In a closed curve profile the start and end positions of the normal curve are identical.

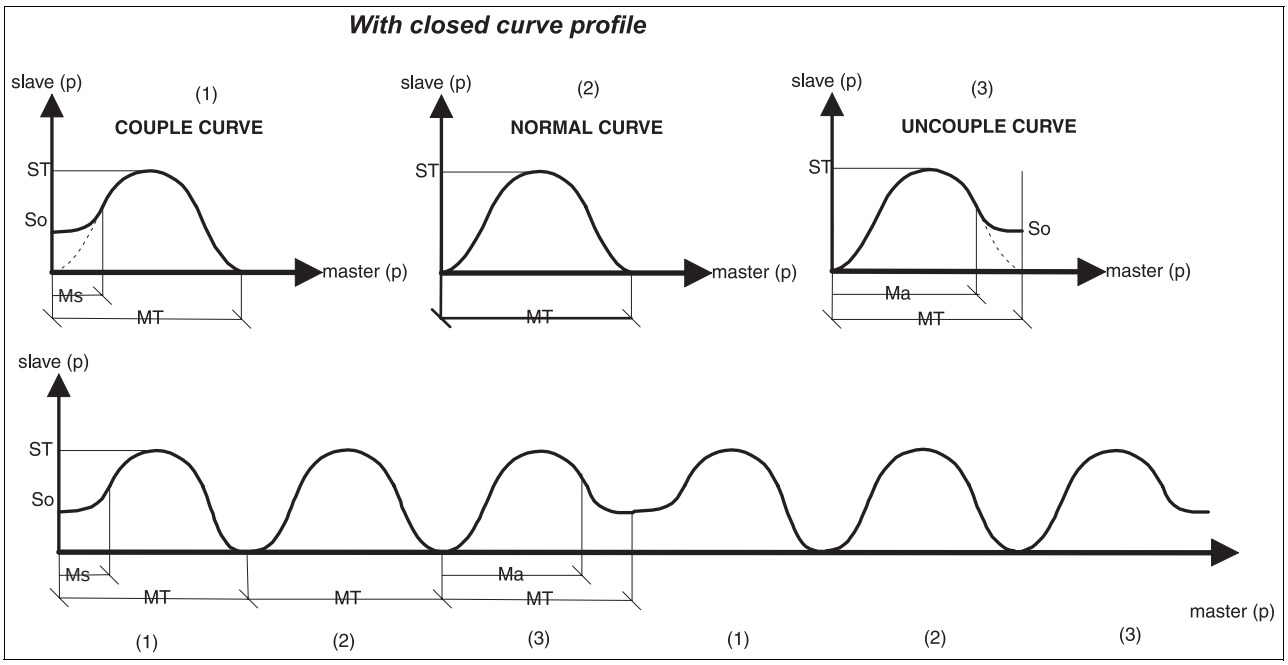

Figure 3.4 Process sequence with a closed curve profile

Open curves In an open curve profile the start and end positions of the normal curve are not identical. On transition to the follow curve the current slave position at the end of an open curve is placed at the first position of the follow curve.

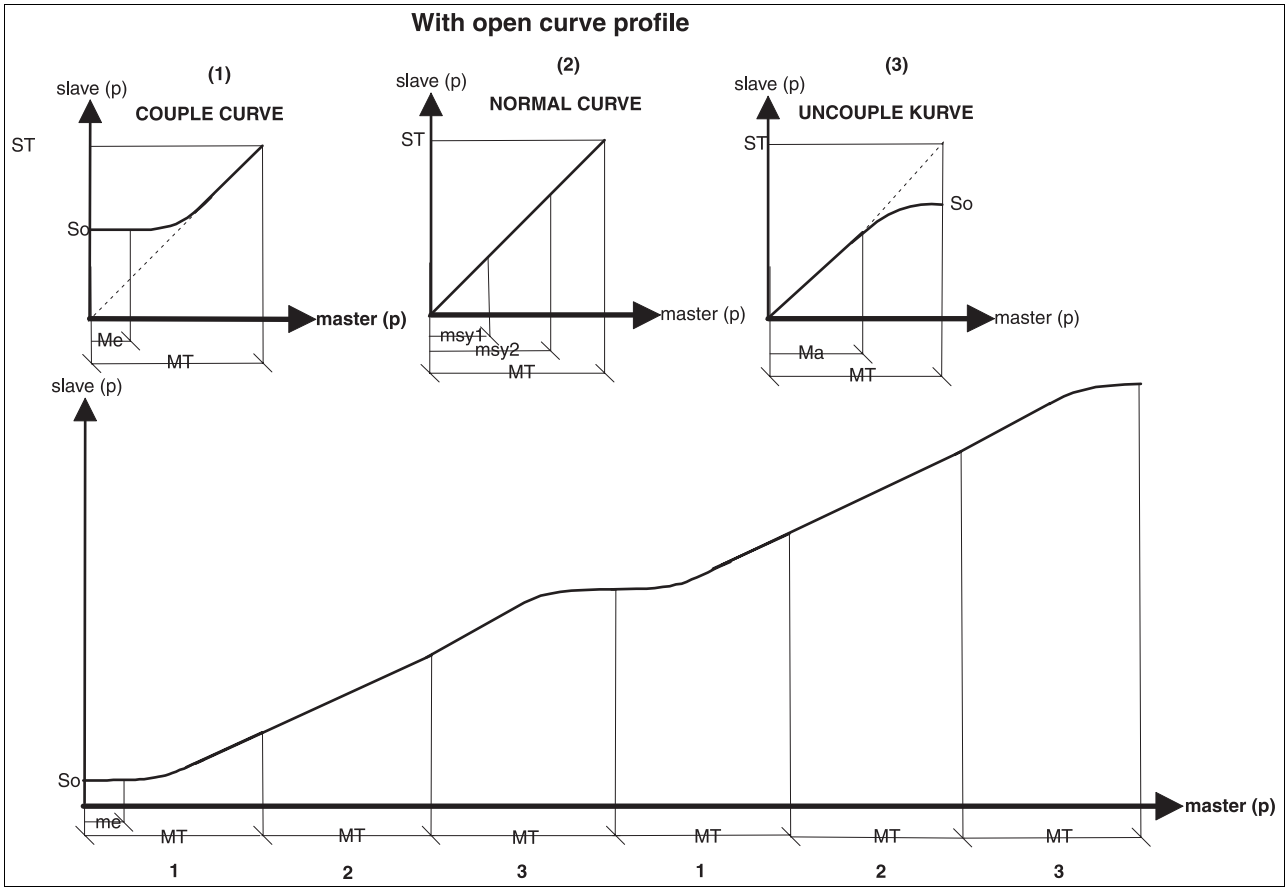

Figure 3.5 Profiling sequence with an open curve profile

3.6 The cam profile description file

The cam profile description file has two parts:

- Header
- Curve points

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You can describe one or more curves in the cam profile description file with the aid of the cam editor. The individual curves are attached in sequence to multiple curves in a cam profile description file (Figure 3.6).

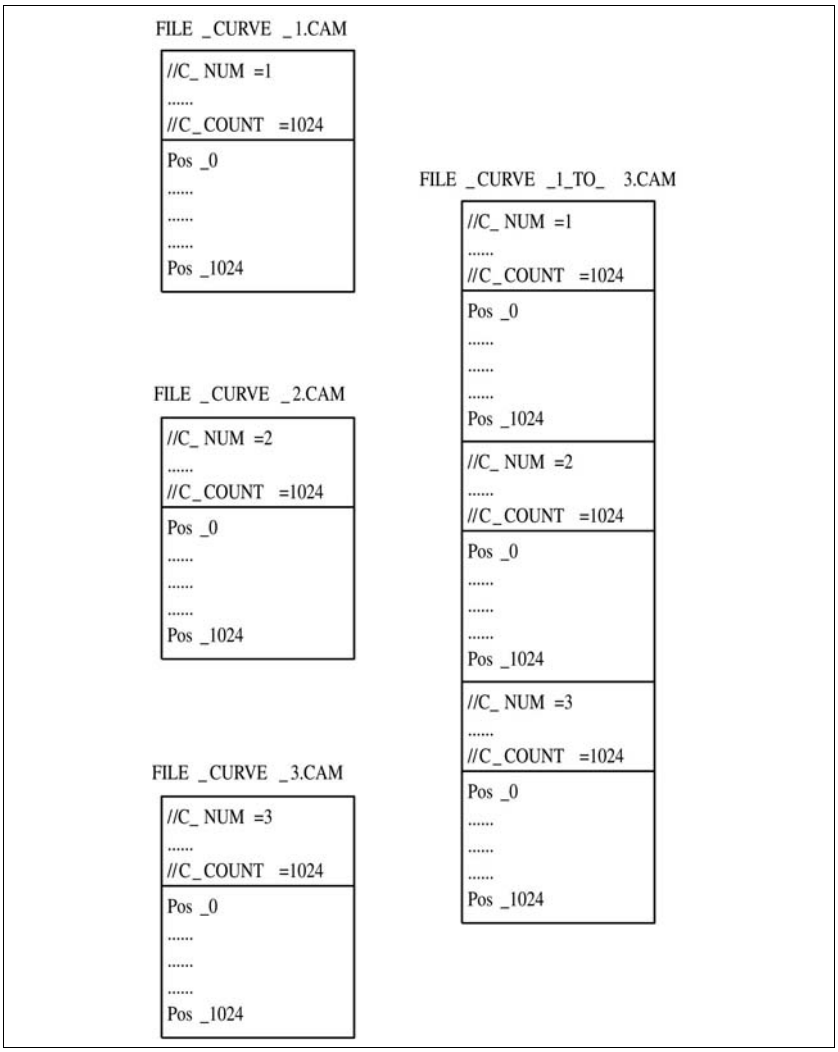

Figure 3.6 Diagram of cam profile description file with several individual curves

3.6.1 Header

A header is structured as follows:

```
//TOKEN=Value<CR>
```

Value	Contents
//:	Identifier that a header entry follows.
TOKEN:	unique identifier of the header entry
=	Assignment operator, separator between identifier and value
Value:	associated value
<CR>	Carriage Return
<LF>	Line Feed: also permitted as a following character

Table 3.7 Header entries

permitted token

Table 3.8 shows the meanings of the permitted header entries (tokens). There is an explanation of the abbreviations used at the bottom of the table.

Note the case of the "Token". Lower-case letters are not permitted and will generate an error message.

Token	Meaning/unit	Range/format	Comments	Type
C_COUNT	Number of equidistant curve intervals (number of interpolation points is greater by 1)	permitted values: 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192	Default: 1024	M
C_CYCLE_TIME	Minimum duration of the motion cycle in milliseconds	(e.g. 100,000000 ms)	Setting in CAM editor as cycle time in ms	M
C_DATE	Date curve created, e.g. 28.10.02	8 ASCII characters in the format DD.MM.YY. The first 8 characters are imported and the following are ignored. No format check		M
C_M_COUPLE_MA	Master value of uncouple position (Ma)	MasterUnits / INT32	Default: 0	O
C_M_COUPLE_ME	Master value of couple position (Me)	MasterUnits / INT32	Default: 0	O
C_M_COUPLE_MS	Master value of synchronous position (Ms)	MasterUnits / INT32	Default: 0	O
C_M_VAL_EXPO	Number of decimal places of master values taken into account, here factor is 10^x	UINT8	Master values are set off with this factor in the cam editor	M
C_M_VAL_MAX	Maximum master value in curve, corresponds to master value at last curve point	INT32	Calculates the last value from curve, then converts to master value decimal places with factor	M
C_NAME	unique name of cam profile description	16 ASCII characters. The first 16 characters are imported and the following are ignored.	Corresponds to entry in 'properties movement curve name:', adapt number of characters in input box	M
C_NUM	unique number of curves	1-99	When creating the first curve input "1" as start value, then the following curves always receive the next value in sequence.	M
C_S_VAL_EXPO	Number of decimal places of slave values taken into account, here factor is 10^x	UINT8	Slave values are set off with this factor in the cam editor	M
C_TIME	Time of curve generation, e.g. 10.11.12	8 ASCII characters in the format HH:MM:SS. The first 8 characters are imported and the following are ignored. No format check		M
C_VERSION	Version identifier of the cam profile description, e.g. 1.01, corresponds to postprocessor version	4 ASCII characters The first 4 characters are imported and the following are ignored.		M

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Token	Meaning/unit	Range/format	Comments	Type
COMMENT	Comment text		not saved in controller, e.g. corresponds to comment line in 'properties of movement curve’ dialogue	I
D_JRED	reduced total moment of inertia at the motor shaft		not saved in the controller	I
D_MCONST	constant harmonic torque on motor shaft		not saved in the controller	I
D_MEFFMAX	rated drive torque		not saved in the controller	I
D_MMAX	maximum permissible drive torque		not saved in the controller	I
D_NMAX	maximum permissible drive speed		not saved in the controller	I
P_NAME	Project name	16 ASCII characters. The first 16 characters are imported and the following are ignored.		O

Table 3.8 Header entries and their meaning

Explanation for Table 3.8 **Meaning of abbreviation in "Type" column**

Column	Abbreviation	Meaning
Type	I	Information - These settings are not used in the controller, but are to be understood as comments
	M	Mandatory - Settings must be made (e.g. unique curve number)
	O	Optional - Settings may be present (e.g. couple position)

Table 3.9 Explanations of available tokens in

3.6.2 Curve points

Entries without tokens are interpreted as slave values and processed in sequence. The interpretation starts after the number of interpolation points has been sent (token `C_COUNT`).

The number of slave values is greater than the number of equidistant intervals defined in C_COUNT by 1

Example of Principle

Extract from a curve with 1024 equidistant ranges.

```
//COUNT=1024<CR>
<POS_0>
...
<POS_1024>
```

Format of slave values

The slave values are given in SlaveUnits. The permissible range of values is between -2.147.483.648 and 2.147.483.647.

4 Installation

Only the changes relevant to using cam are described here. For a detailed description of the unit installation see chapter 'Installation' in the TLC61x or TLC63x device manual.

⚠ DANGER!

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors).
  - Measure voltage between DC+ and DC- and check for <48V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).
- Do not short-circuit DC bus or touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to grounding the drive system.
- Do not reach into the drive system (e.g. no pointed objects).

Failure to follow these instructions will result in death or serious injury.

4.1 24V signal interface

The table below shows the port assignment. Identical signals for all assignments are shown in the left column with an arrow =>.

Pin	Signal at IO_mode=0	Signal at IO_mode=1	active	Meaning	I/O
9	=>	Q_0	high	freely assignable output, in CAM operating mode as cam signal Q0	
10	=>	Q_1	high	freely assignable output, in CAM operating mode as cam signal Q1	

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Pin	Signal at IO_mode=0	Signal at IO_mode=1	active	Meaning	I/O
22	=>	CAPTURE1	high	fast input for exact capture of current position values In CAM operating mode: used as master cycle signal	
		I_5		Freely assignable input	
23	=>	CAPTURE2	high	fast input for exact capture of current position values In CAM operating mode: used as slave cycle signal	
		I_6		Freely assignable input	
24	ADR_64	ADR_64	high	Bit 6 for the network address, if Settings.IO_mode =0	
		COUPLE_REQ		In CAM operating mode: used as COUPLE signal	
		I_7		Freely assignable input	

Table 4.1 Port assignment

If the controller is turned on and the value "0" is set in `Settings.IO_mode`, the setting for ADR_64 of the field bus address is read at input I_7. After a successful start-up input I_7 can be used as a COUPLE signal. An external signal switchover is required for this case. For example, this can be implemented with a changeover contact using a relay. This can be done using the ACTIVE_CON output.

4.2 Configuration of the personal computer

The minimum hardware requirements for setup and operation are:

- IBM-compatible PC with Pentium II processor, 400 MHz.
- 128 MB RAM.
- 50 MB free space on the hard drive.
- CD-ROM drive
- A free serial port on the PC and an RS232 data cable for data exchange with the controller.

An operating system from Microsoft Windows 98 is required.

5 Commissioning

⚠ WARNING!

Unexpected responses may cause injury and damage to the system.

The behaviour of the drive system is governed by numerous saved data. Unsuitable data may cause unexpected motions or responses to signals.

- Do not operate a unit with unknown data.
- Check the saved data.
- When commissioning carefully run tests for all operating states and fault cases.
- Check the functions after replacing a unit and also after changes to the saved data.
- Start the system only if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death or serious injury.

Only the changes relevant to using cam are described here. For a detailed description of the commissioning see chapter 'Commissioning' in the TLC61x or TLC63x device manual.

5.1 Prerequisite

The prerequisite for commissioning is correct mechanical and electrical installation of the unit and completion of unit commissioning.

Set up the unit as detailed in the respective device manual. This prepares the unit for operation in the network.

5.2 Commissioning procedure

- Cam editor
  Creat a new cam design (movement plan)
  Generate a cam file with specific data format. This file will be stored in the specified project directory.
- TLCT:
  downloading generated cam profile description file:
  saving curves in non-volatile memory (flash)
- TLCT/CoDeSys/field bus: enabling power amplifier
- TLCT/CoDeSys/field bus: referencing slave (with referencing operating mode, if required)
- TLCT/CoDeSys/field bus: positioning slave at start position for cam profiling (e.g. with PTP operating mode, if required)

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- TLCT/CoDeSys/field bus: setting cam profiling parameters in Cam-Global (Index:52), CamCtrl1 (Index:53), CamCtrl2 (Index:54) and CamSigs (Index:55)
- TLCT/CoDeSys/field bus: activating used CamCtrl blocks

  Monitoring activation process

- TLCT/CoDeSys/field bus: starting operating mode 'cam'
- TLCT/CoDeSys/field bus: referencing cam profiling
- TLCT/CoDeSys/field bus/COUPLE input: Activate cam profiling with `CoupleReq`
- TLCT/CoDeSys/field bus: monitoring process status

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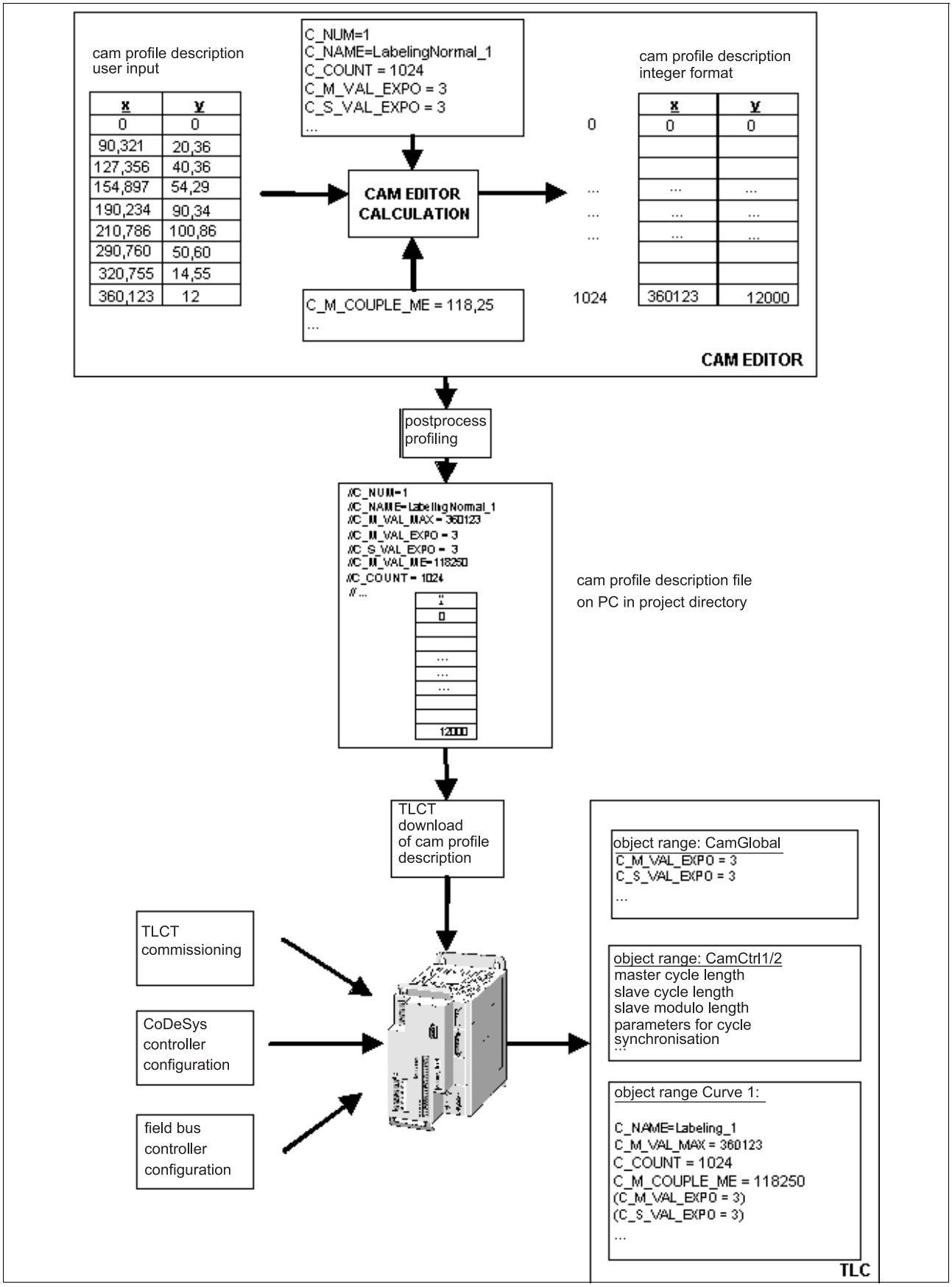

Figure 5.1 Principle unit control

5.3 Cam editor

The cam editor is used to create cam profiles as motion plans by using the laws of motion for cam mechanisms (VDI 2143). Curves created in the cam editor can be exported to cam profile description files using post-processing. The files can then be transferred to the TLC6xx controller via TLCT. See also chapter 7 „Examples“

Cam curves can for example be created with the CAM editor "Nolte Optimus Motus" or in Microsoft Excel with the "CamConverter & CamEditor CamToTlc.xls".

CAM editor "Nolte Optimus Motus"

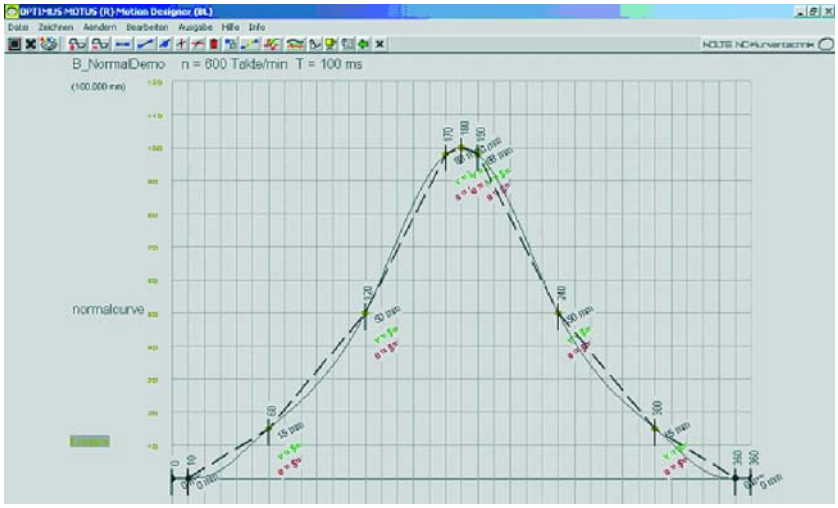

Figure 5.2 Cam editor - example of a created curve

The "Nolte Optimus Motus" CAM editor has been developed by Nolte NC-Kurventechnik GmbH and is available as an optional accessory with an interface for the Twin Line cam profile. For more information contact:

Nolte NC-Kurventechnik GmbH
Dipl.-Ing. Dipl.-Inform. Rainer Nolte
Hellingstraße 17
D-33609 Bielefeld

Telephone: +49 (0) 5 21 / 7 44 77
Fax: +49 (0) 5 21 / 75 08 80

E-mail: Nolte-NC-Kurventechnik@t-online.de
Homepage: http://www.nolte-nc-kurventechnik.de

CAM editor "CamToTlc.xls"

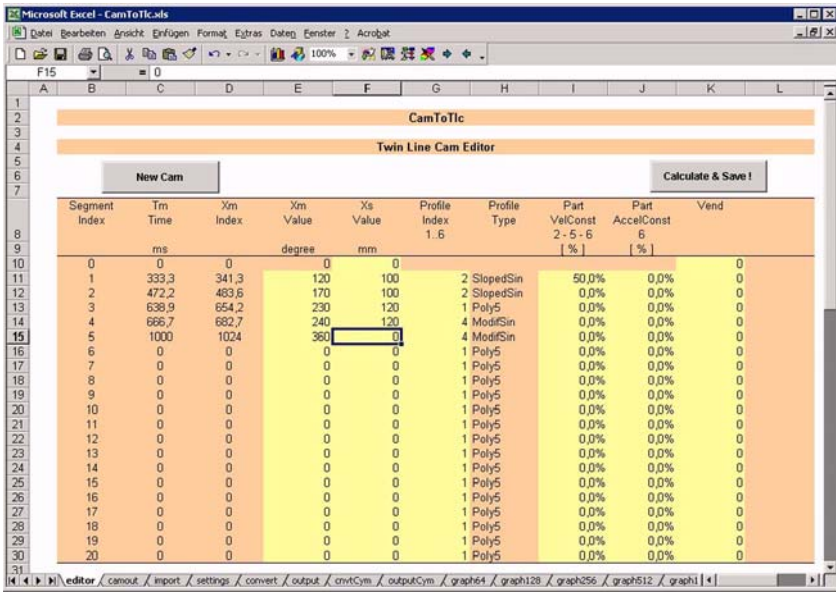

Figure 5.3 CamToTlc.xls - movement plan input

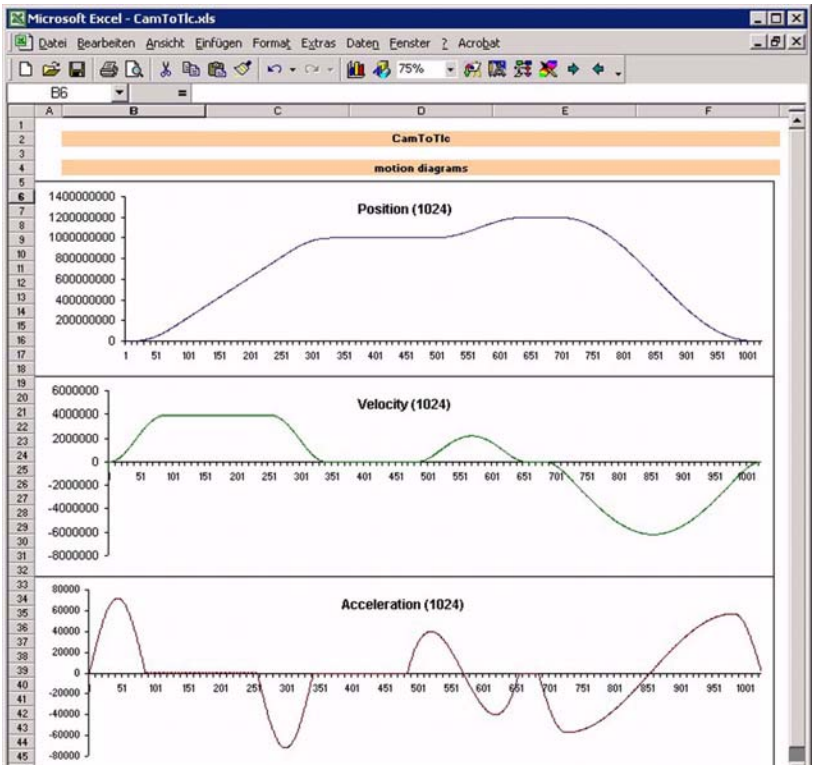

Figure 5.4 CamToTlc.xls - example of a created curve

The "CamToTlc.xls" CAM editor can be downloaded free of charge from the Internet: http://www.schneiderautomation.com

⇒Twin Line

⇒Technical Information

⇒Software

Conversion of master and slave values

The master and slave values input into the cam editor are converted into integer values. C_M_VAL_EXPO and C_S_VAL_EXPO are used to specify how many decimal places of the input value must be taken into account. The value range of the generated output values is limited to INT32. The cam profile description file generated with the postprocessor contains the standardised slave values and additional settings made in the cam editor.

For more information see page 6-2.

Project directory structure

The exported cam profile description files (*.cam) are saved in a user-definable project directory. The files can then be transferred from there to the controller via TLCT. It is recommended that the motion profile (i.e. *.bpl) created in the cam editor is saved in the same project directory.

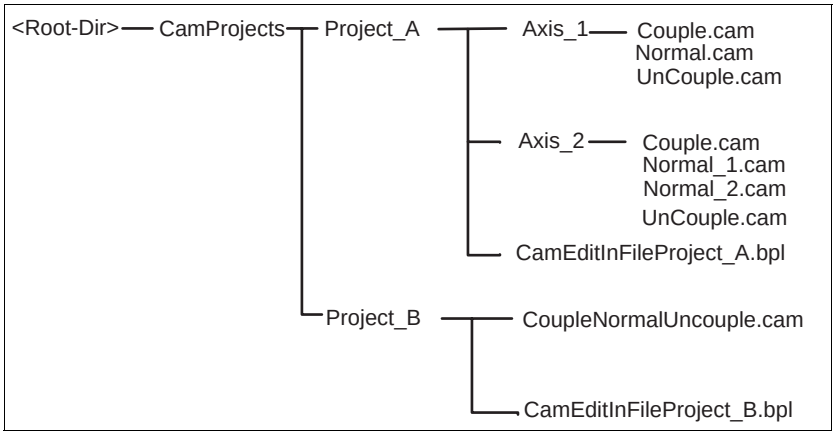

Figure 5.5 Project directory structure

Backup of the project data created on the PC is recommended.

PC data backup

The user must back up the following data if they are created in the course of the application:

- Cam profile description file(s)
- TLCT parameter file
- CoDeSys application
- Application of the fieldbus master controller

It is reset to the factory setting if the TLC controller is repaired.

5.4 TLCT Commissioning Software

The menus and input options for the TLCT commissioning software are listed below. For more information see chapter 7 „Examples“.

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5.4.1 Curve selection dialogue

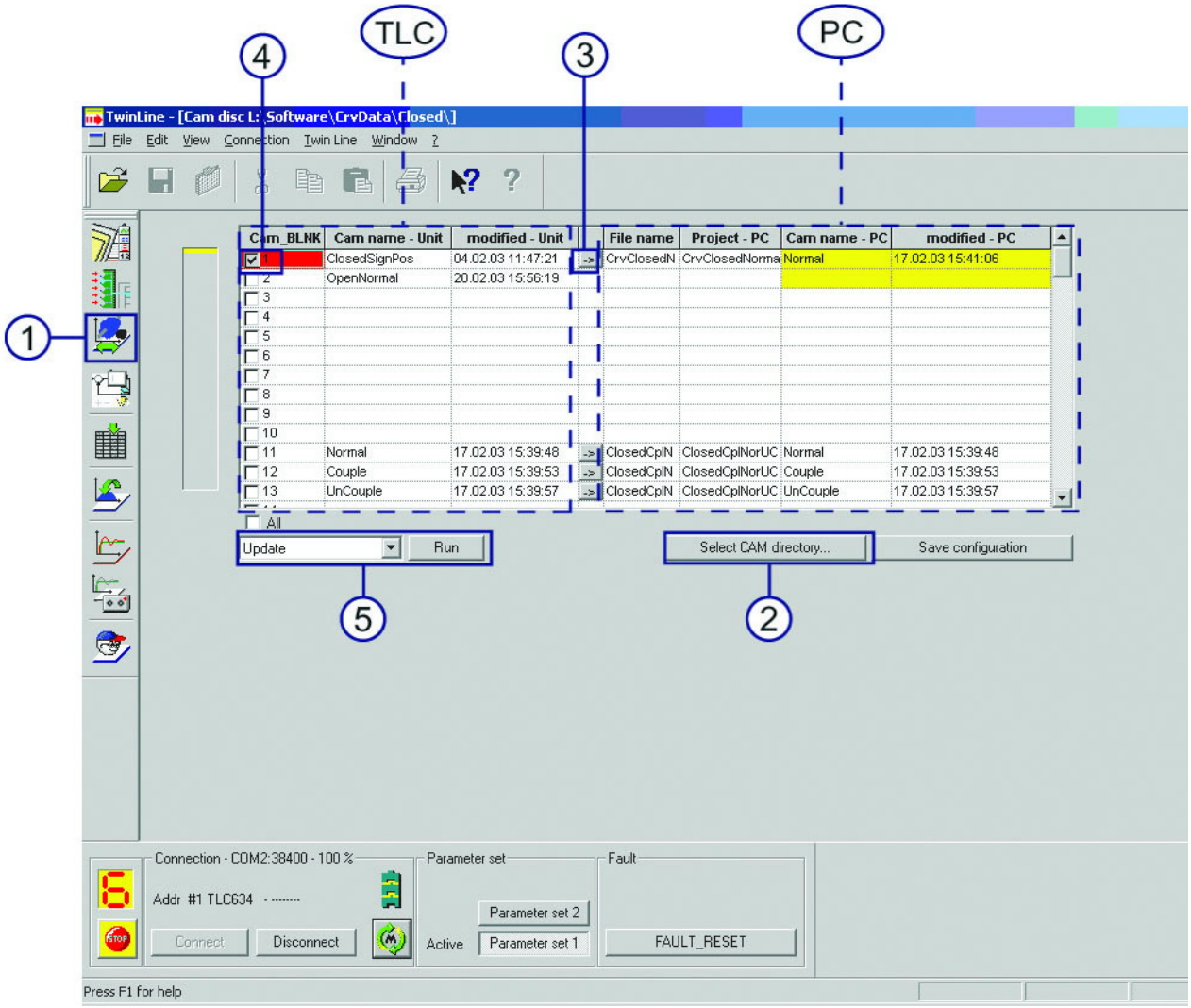

Figure 5.6 Curve selection dialogue

1 Open curve selection dialog

2 Select directory with cam profile description files (*.cam)

3 Select cam profile description file

4 Highlight curve number

5 a. download selected curve(s) to the controller
b. Save curves in controller to prevent loss from power failure

TLC: curve data on controller

PC: cam profile description files on PC

5.4.2 Parameter setting dialogue

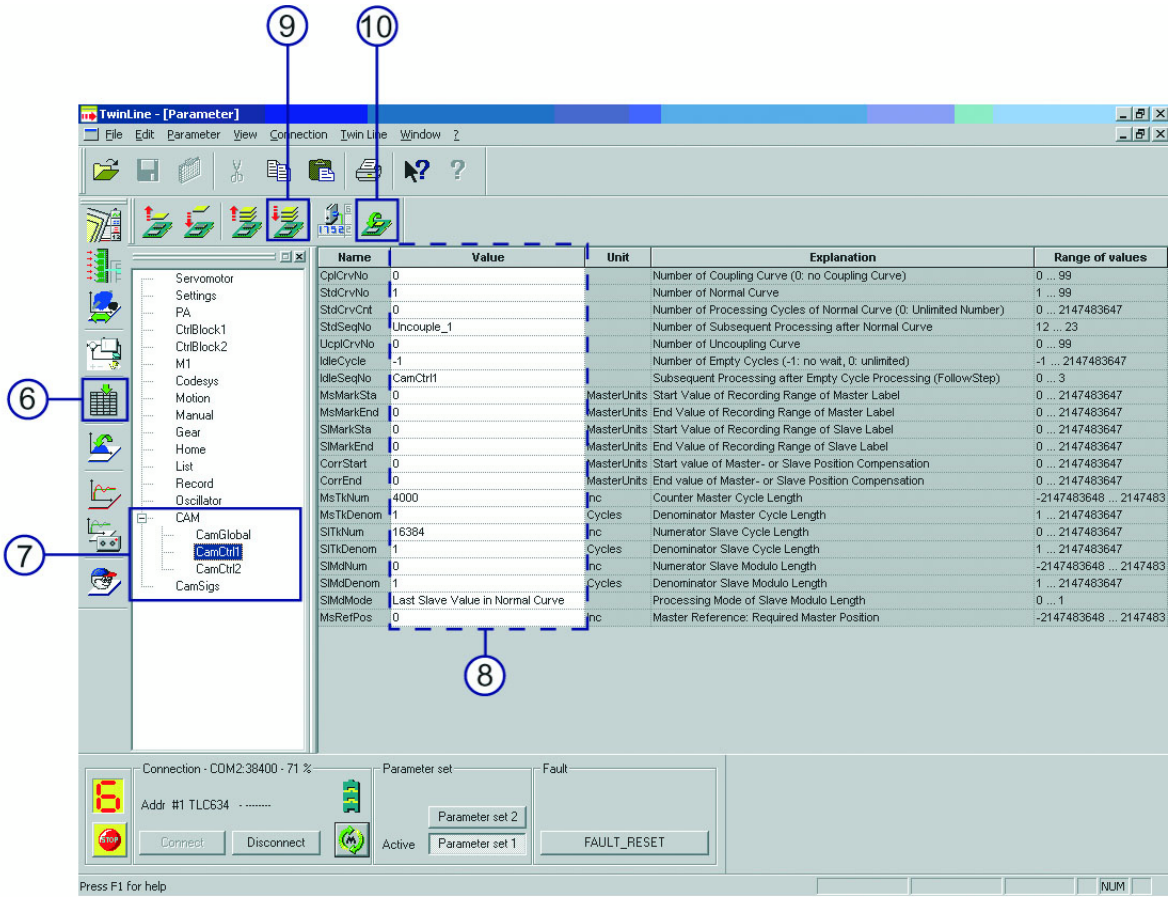

Figure 5.7 Parameter setting dialogue

6 Open parameter setting dialogue

7 Select parameter range

8 Edit parameters

9 Download parameters to controller

10 Save parameters in controller to protect them against power failure

5.4.3 Positioning dialogue

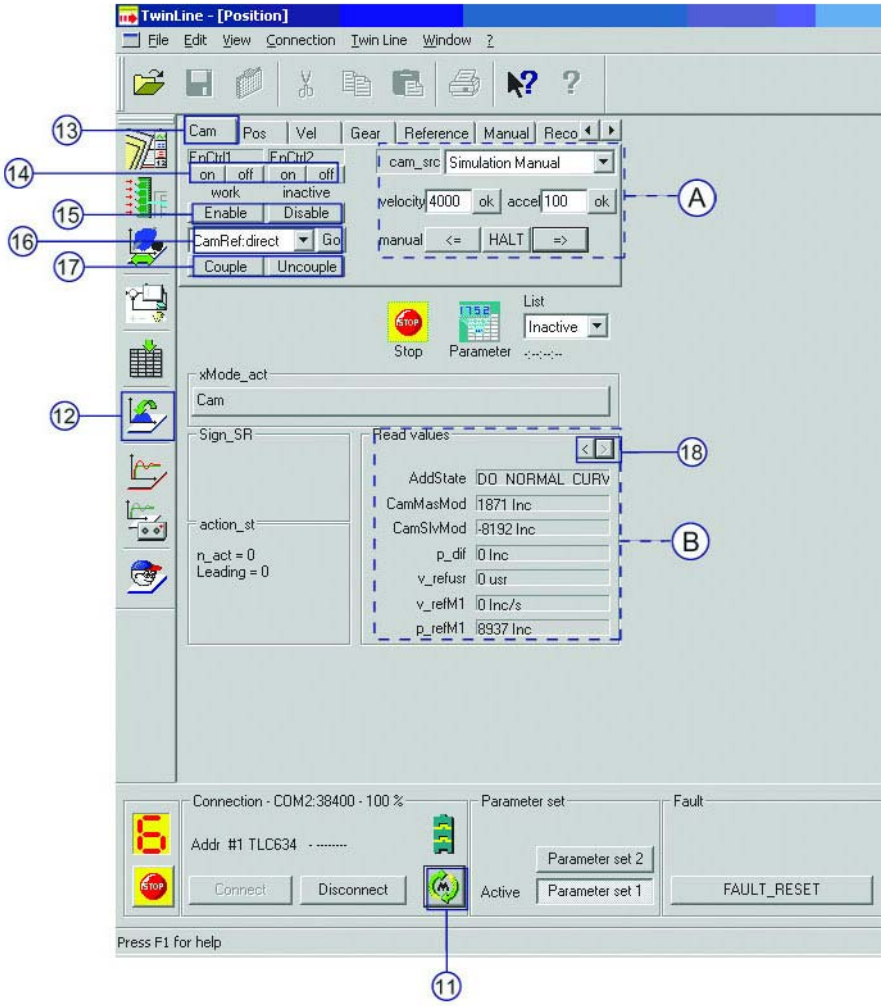

Figure 5.8 Positioning dialogue

11 Enable power amplifier

12 Open positioning dialogue

13 Select cam positioning dialogue

14 Activate CamCtrl blocks

15 Enable operating mode 'cam'

16 Run cam referencing

17 Set couple request (`CoupleReq`)

18 Select read values

A: Master simulation

B: Read values

5.5 Examples

For examples see page 7-1

6 Operation

6.1 Processing cam profile description data

The cam profile description data are downloaded to the Twin Line controller via the RS232 port using TLCT. Select the curves for download in the curve selection dialogue window. The maximum number of curves that can be saved in the controller depends on the number of interpolation points.

Interpolation points	max. number of curves
256	80
1024	20
8192	3

Table 6.1 Number of curves depending on the number of interpolation points

Error memory

The data are checked for plausibility and completeness by a command interpreter. The command interpreter reports any deviations as errors. Different interpretation errors are saved in the error memory of the device with detailed supplementary information.

Structure of the supplementary information (qualifier)

Bytes 0..2: line number of cam profile description file

Byte 3: Curve number

For line number = 0 and curve number = 0 there is no connection between error and line number at the time of interpretation.

Example:
Error: 0x1A03 = invalid token
Supplementary information: 0x0A000033 = error in curve 10, line 51

The cam profile description data downloaded to the controller are saved in RAM. This data can be backed up in flash memory to prevent loss from power failure. See also chapter 5.4.1 “Curve selection dialogue“

The curves saved in RAM can be deleted individually or all at once. To delete the curves deleted from RAM from the flash module also, a bakkup process must be started.

If the power supply to the unit fails during the save process, all curve data will be lost.

6.2 Format of curve values and parameters

The master and slave values can be in the cam editor as rational numbers.

However, the controller can only process whole number values. For this reason the decimal places must also be input in the cam editor.

The cam editor postprocessor converts the master and slave values to whole-number values with the information on the number of decimal places. It saves the data in this format in the cam profile description file.

The curves can only be profiled if the number of decimal places is identical in all curves used.

The controller values are output in the same whole-number format. The calculation can be reversed to retrieve rational number values with the number of decimal points for uses such as visualisation.

Decimal places

The settings for the conversion factors of the decimal places for master and slave values can be taken from the following parameters.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.MsFactor	52:9 ($34:09_h$)	Conversion factor of decimal places master Value imported from curve header data. C_M_VAL_EXPO.	UINT16 0..10	- 0	R/-/-
CamGlobal.SlvFactor	52:10 ($34:0A_h$)	Conversion factor of decimal places slave Value imported from curve header data. C_S_VAL_EXPO.	UINT16 0..10	- 0	R/-/-

Table 6.2 Parameters for converting decimal places

Example:

The settings for the master values are in degrees with 6 decimal places. The settings for the slave values are in mm with 3 decimal places.

Thus the following tokens are in the cam profile description file:

- `C_M_VAL_EXPO = 6`
- `C_S_VAL_EXPO = 3`

Conversion of the master values input by the user:

- Cam editor - user-defined value: 123.456789 degrees
- Cam profile description file - integer value: 123456789 MasterUnits

Conversion of the slave values input by the user:

- Cam editor - user-defined value: 54.321 mm
- Cam profile description file - integer value: 54321 SlaveUnits

6.3 Conversion of user-defined values to positions

The values input in MasterUnits or SlaveUnits are adapted to the system conditions by adjustable evaluation factors. The controller operates internally with master and slave increments [Inc].

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The maximum master or slave value of the cam profile description is directly related to the maximum number of increments of the master or slave position.

Master values

The following parameters are used for conversion of the master values in Figure 6.3:

- `CamGlobal.MsFactor, 52:9`
  Conversion factor of the decimal places
- `CamCtrl1.MsTkNum, 53:16`
  Master Cycle length - Numerator
- `CamCtrl1.MsTkDenom, 53:17`
  Master Cycle length - Denominator
- `CamDat.MsMaxVal, 1401:10`
  Maximum master value in the curve (curve number 1)

The following values are assumed in the example:

- Maximum master value 360.000000 degrees -> 360000000
- Master cycle length (numerator / denominator) 4000 Inc -> 4000 / 1

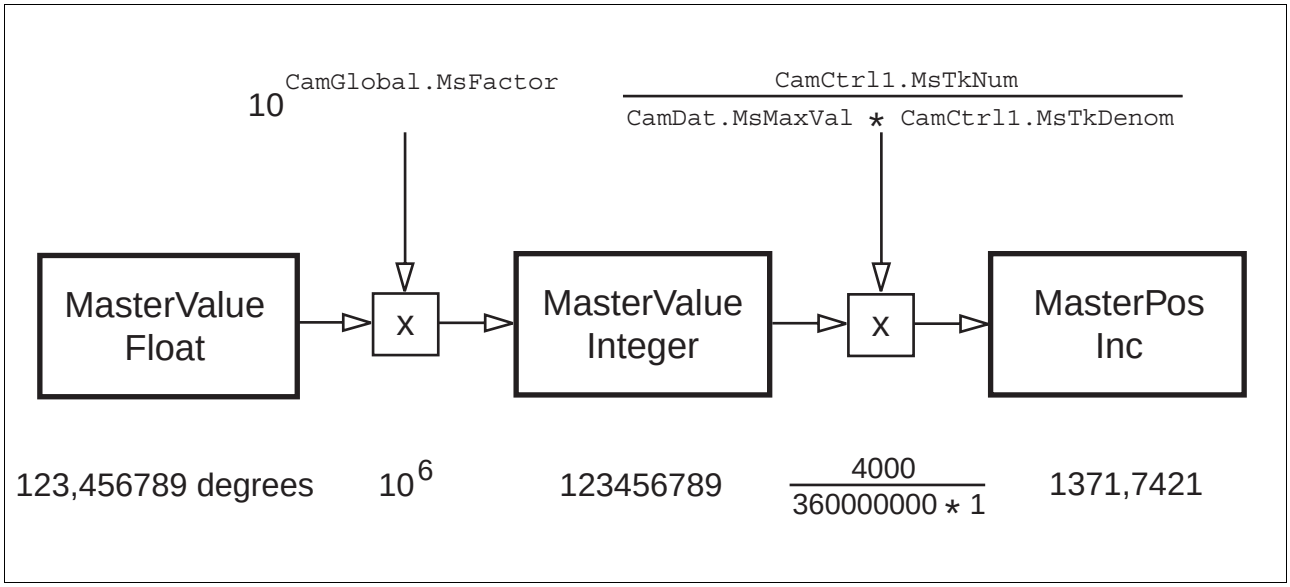

Figure 6.3 Conversion of master values to master positions

Slave values

The following parameters are used for conversion of the slave values in Figure 6.4:

- `CamGlobal.SlvFactor, 52:10`
  Conversion factor of the decimal places
- `CamCtrl1.SlTkNum, 53:18`
  Slave cycle length numerator
- `CamCtrl1.SlTkDenom, 53:19`
  Slave cycle length denominator

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- `CamDat.SlMaxVal, 1401:16`
  Maximum slave value in curve as absolute value (curve number: 1)

The following values are assumed in the example:

- Maximum slave value 200.000 degrees -> 200000
- Slave cycle length (numerator / denominator) 16384 Inc -> 16384 / 1

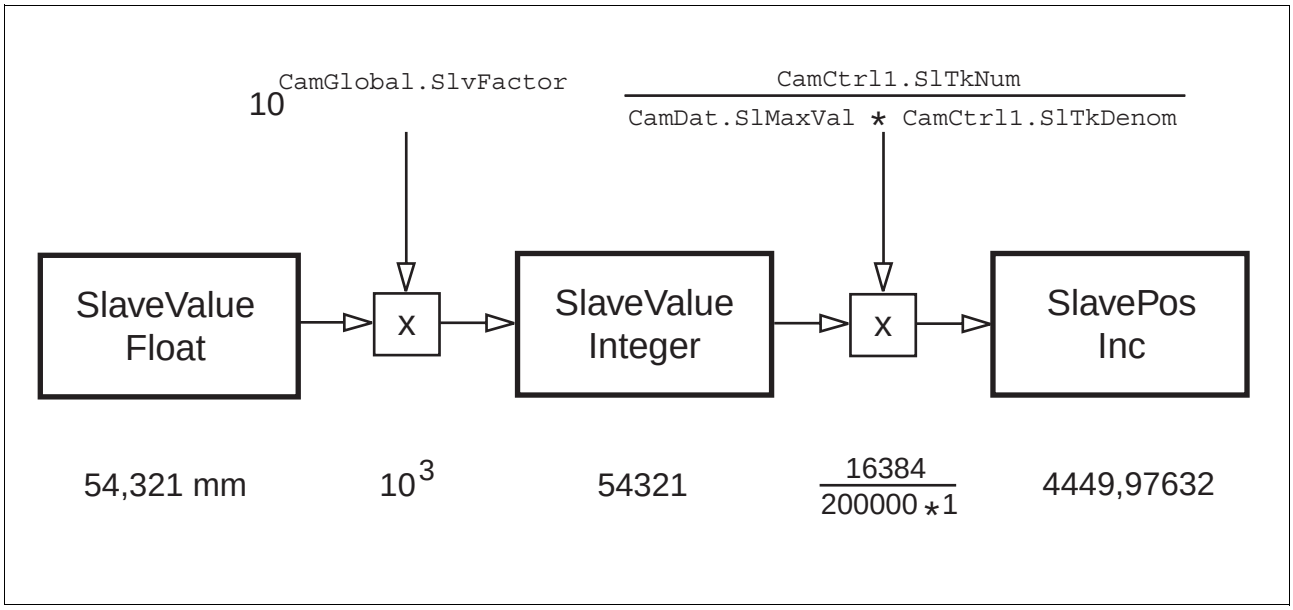

Figure 6.4 Conversion of slave values to slave positions

6.4 Internal controller structure diagram

Figure 6.5shows the controller-internal layout of the cam function in the TLC63x.

The operating modes explained in the unit documentation in the chapter "Status monitoring in movement mode" are only generally indicated.

The input circuitry to the jerk filter is identical in the servo motor and stepping motor devices. The power amplifier structure of the TLC61x stepping motor devices can be found in the device documentation.

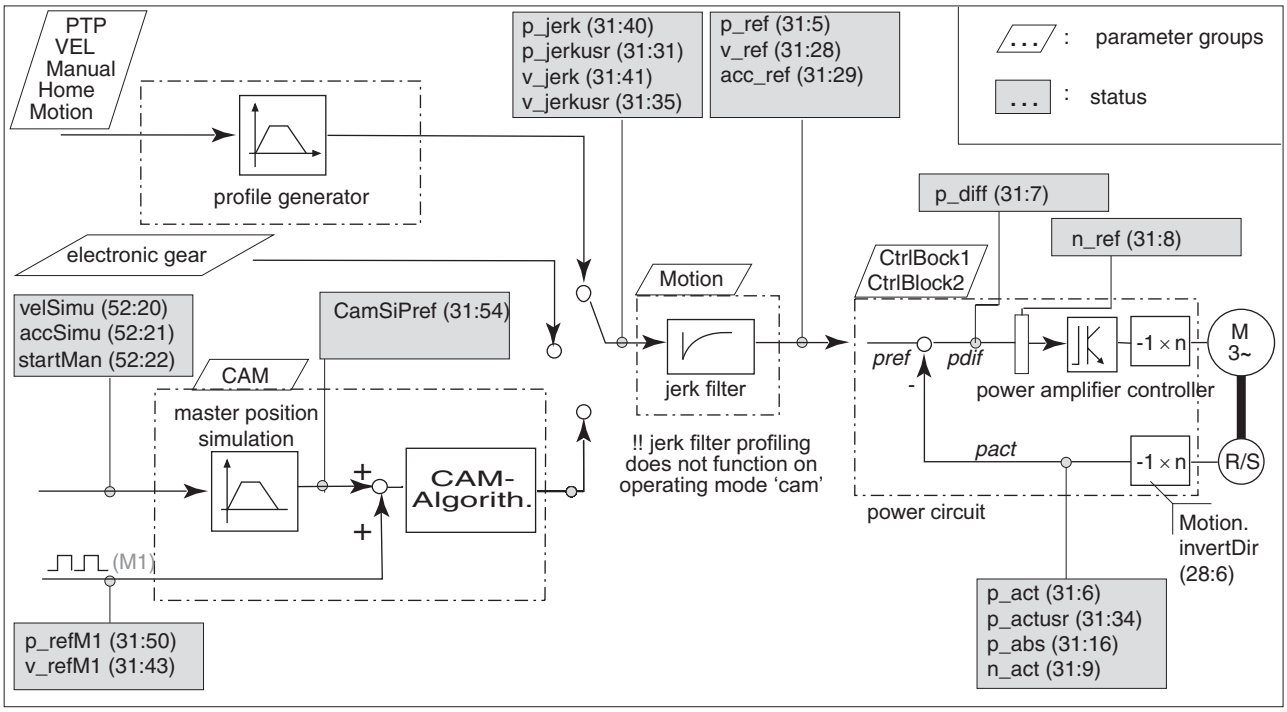

Figure 6.5 Internal controller structure diagram

The default reference position is normally set by a setpoint module at slot M1.

The following modules and signal forms are therefore possible:

- RS422-C A-B signals
- PULSE-C: pulse-direction or "pulse forward/pulse back" signals

Because the PULSE-C module does not process an index pulse,
CAM referencing to such a signal is not possible.

Position overrun

The internal processing of the encoder, setpoint and actual values is done as data type INT32 (-2147483648.. 2147483647).

A position overrun of the reference position of the M1 encoder does not influence the cam profiling.

The profiling of an open curve profile can also result in the value range being exceeded. A position overrun in the setpoint values (`Status.p_ref, 31:5`) or actual values (`Status.p_act, 31:6`) is also possible.

Only one warning is saved in the error memory, because any defined reference point can no longer be uniquely approached in a different operating mode.

An absolute positioning is no longer possible after a position overrun by `P_ref`. For this reason a slave referencing must be run in this case before running a compensation movement in PTP mode.

6.5 Cam configuration

Configuration and activation of the desired profiling sequence and also evaluation of the current profiling status can be done with various parameters. The following operating channels are available for this.

- TLCT (commissioning software)
- Fieldbus
- CoDeSys (programming software)

These settings are related to the following curves, depending on the parameter group in which the settings are made:

- one single curve
- all curves registered in a cam control block

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- all curves

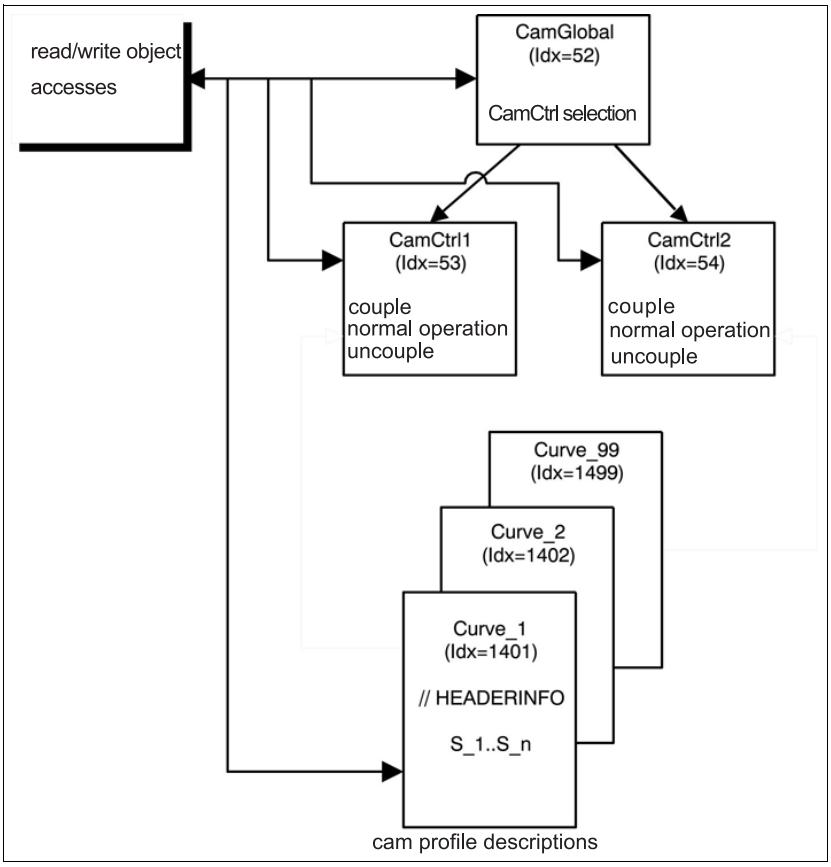

Figure 6.6 Cam configuration

6.5.1 Parameter group`CamGlobal`

The CamGlobal parameter group is used to control curve profiling and for setting global parameters.

A list of all parameters of this parameter group can be found in 9.2.4 “Parameter groupCamGlobal“.

6.5.2 Parameter group `CamCtrl1` and `CamCtrl2`

Two identical cam control blocks (parameter groups `CamCtrl1` and `CamCtrl2`) are available for entering curve combinations. For example, if `CamCtrl1` is used for the current process, `CamCtrl2` can be used for preparation of a new process. The parameter CamGlobal.ChoiceCtrl, 52:7 can be used to specify the cam control block used to start the process.

You can download multiple cam profile descriptions to the controller. The curve number is used to select individual curves in the cam control blocks.

Parameter range

- CamCtrl1: Idx 53
- CamCtrl2: Idx 54

A list of all parameters of this parameter group can be found in 9.2.1 “Parameter group CamCtrl1 and CamCtrl2“.

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6.5.3 Parameter group `CamDat` (CAM curve data)

The parameter group `CamDat` can be used to read values of the individual cam tables (header information). These values are only available when a cam profile description file with the associated curve number has been downloaded to the controller. All individual curve numbers contain their own index range.

Parameter range Idx1401 to 1499 (corresponds to curve numbers 1 to 99).

A list of all parameters of this parameter group can be found in 9.2.2 “Parameter groupCamDat“.

The parameters for reading the curve data are only described for curve number 1 in this manual. This corresponds to index 1401.

The index/subindex of a parameter of the group `CamDat` that is to be read for any curve number is calculated as follows:

For example, you want to calculate “the number of equidistant curve intervals” for curve number 5.

Step 1: calculate the index by the simple total
Idx =1400 + curve number, i.e. 1400 + 5 = 1405.

Step 2: calculate the subindex from the table in chapter 9.2.2 “Parameter groupCamDat“. For the "number of equidistant curve intervals" (parameter type `CamDat:Count`) the result is Six = 14.

Thus the number of equidistant curve intervals of curve number 5 is calculated by Idx:Six = 1405:14.

6.6 Evaluating the master and slave values

The master and slave values of the cam profile description file must be adapted to the conditions of the system or drive.

- The change of value of the encoder position, which must correspond to a master cycle, must be set via the master cycle length.

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- The motor deviation, which must be executed when the maximum slave value in the curve is reached, is set by the slave cycle length.

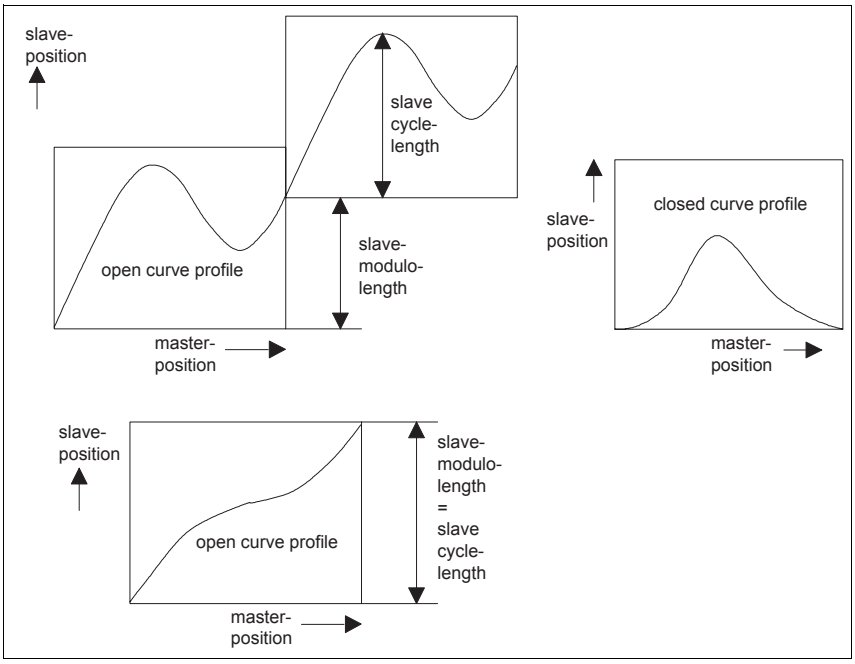

Figure 6.7 Open and closed curve profile with cycle and modulo length

The slave modulo length is the change in the slave position between the last and the first curve point. With a closed curve profile the slave modulo length = 0.

The settings can be made separately for the cam control blocks `CamCtrl1` and `CamCtrl2`. The values are offset on activation of the cam control block (parameter `CamCtrl1.EnCtrl, 53:1` or `CamCtrl2.EnCtrl, 54:1`)

The information is based on the maximum master and slave values. The setting can be made with numerator and denominator value. This allows non-integer ratios.

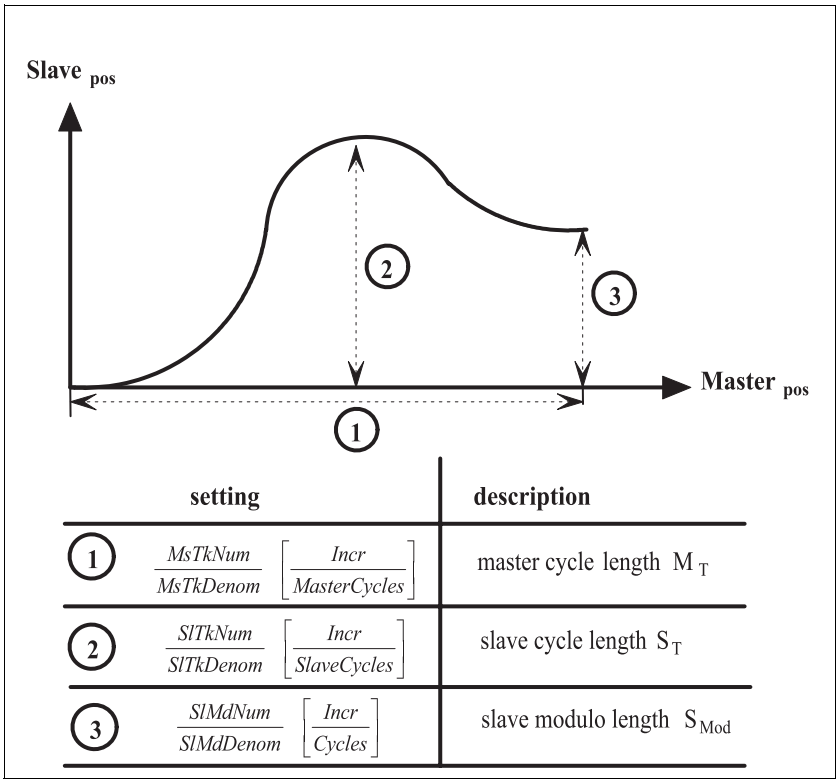

Figure 6.8 Evaluating the master and slave values

6.6.1 Master cycle length

The master cycle length describes how many position increments of the reference position correspond to one curve cycle of the master value or the maximum master value. The value change of the encoder position that corresponds to one or more master cycles is specified for every cam control block with 2 parameters:

- numerator master cycle length
  `CamCtrl1.MsTkNum, 53:16` or
  `CamCtrl2.MsTkNum, 54:16`
- denominator master cycle length
  `CamCtrl1.MsTkDenom, 53:17` or
  `CamCtrl2.MsTkDenom, 54:17`

Direction inversion

The command variable is reversed in direction by input of a negative value for the master cycle length. It is not necessary to change the command source wiring.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.MsTkNum	53:16 ($35:10_h$)	Numerator master cycle length Additional limits: abs(MsTkNum/MsTkDenom) >= 10 Negative values execute the direction inversion function of the master positions The maximum master value of the curve corresponds to the change of the master position (encoder position) by one master cycle length (numerator/denominator) E.g.: master value: 0 ... 360000 Numerator: 40000 Denominator: 1 40000 Master inc. correspond to the master value 360000 or one master cycle.	INT32	Inc 4000	R/W/ per.
CamCtrl1.MsTkDenom	53:17 ($35:11_h$)	Denominator master cycle length For detailed description see CamCtrlx.MsTkNum	INT32 1 ..2147483647	Cycles 1	R/W/ per.

Table 6.9 Parameters for calculating the master cycle length

A list of all parameters of this parameter group can be found in 9.2.1 “Parameter group CamCtrl1 and CamCtrl2“.

Formula

$$\text{MasterCycleLength} = \frac{\text{MsTkNum}}{\text{MsTkDenom}} = \frac{\text{ValueRangeEncoderPositionPerCycle}}{\text{NumberOfMasterCycles}}$$

The setting applies for all curves of a cam control block

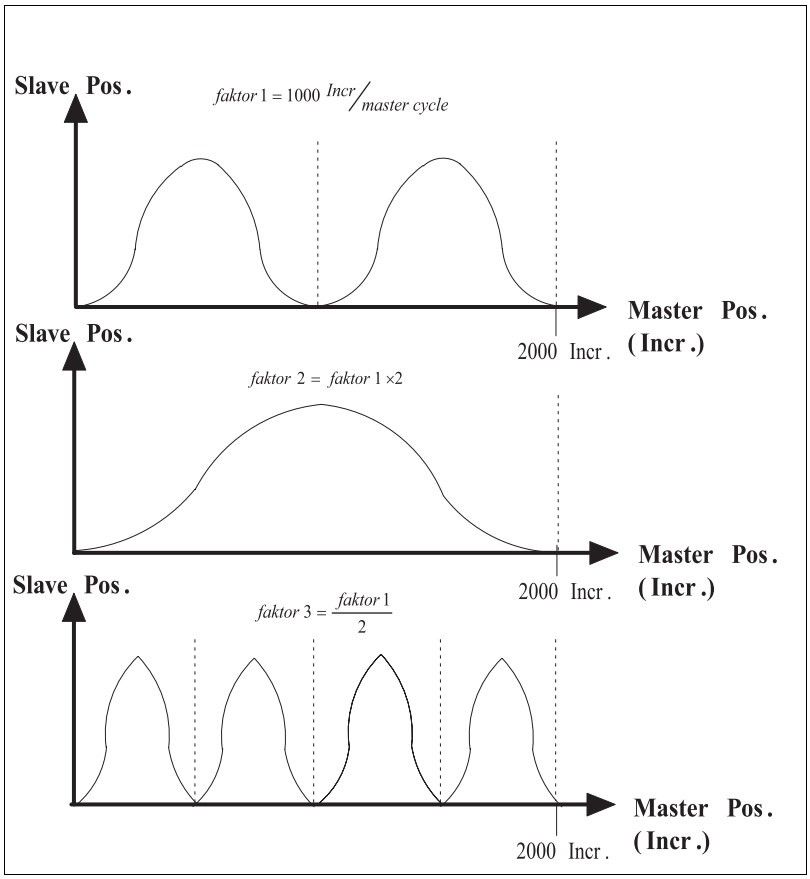

Figure 6.10 Characteristics on changing the length of the master cycle

6.6.2 Slave cycle length

The slave cycle length describes the number of position increments by which the slave position changes between 0 and the maximum slave value.

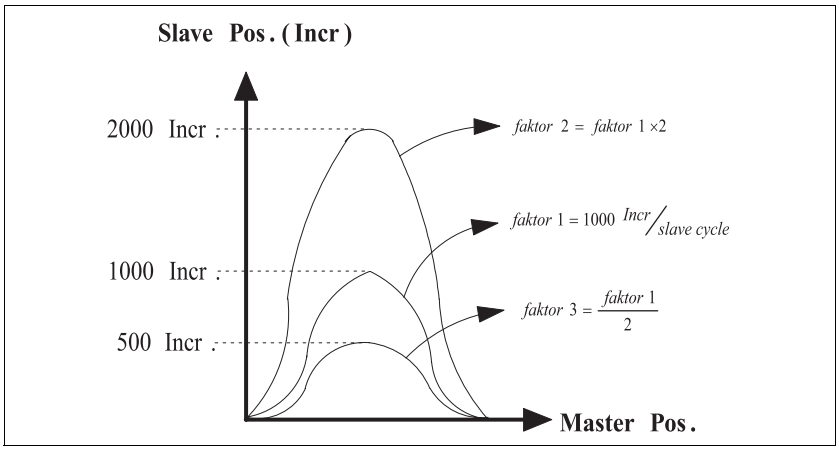

Figure 6.11 Characteristics on changing the length of the slave cycle

The maximum value change of the slave position that corresponds to one or more slave cycles is specified for every cam control block by two parameters:

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- numerator slave cycle length
  `CamCtrl1.SlTkNum, 53:18` or
  `CamCtrl2.SlTkNum, 54:18`
- denominator slave cycle length
  `CamCtrl1.SlTkDenom, 53:19` or
  `CamCtrl2.SlTkDenom, 54:19`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.SlTkNum	53:18 ($35:12_h$)	Numerator slave cycle length Additional limits: SlTkNum/SlTkDenom > 1 The position of the maximum slave value of the curve causes the slave to deviate by one slave cycle length (numerator/denominator) E.g.: Slave value: 0 ... 1000000 Numerator: 16384 Denominator: 1 The motor deviation by 16384 Inc corresponds to the maximum slave curve value of 1000000.	INT32 0..2147483647	Inc 10000	R/W/ per.
CamCtrl1.SlTkDenom	53:19 ($35:13_h$)	Denominator slave cycle length For detailed description see CamCtrlx.SlTkNum	INT32 1 ..2147483647	Cycles 1	R/W/ per.

Table 6.12 Parameters for calculating the slave cycle length

A list of all parameters of this parameter group can be found in 9.2.1 “Parameter group CamCtrl1 and CamCtrl2“.

Formula

$$\text{SlaveCycleLength} = \frac{\texttt{SlTkNum}}{\texttt{SlTkDenom}} = \frac{\text{ValueRangeSlavePosition}}{\text{NumberOfSlaveCycles}}$$

To generate identical motor motions with different drive types, the resolution of the drive system must be considered.

Example
The slave cycle length must correspond to one motor revolution.
Set the AC servo motor with SinCos to equal 16384, the stepping motor to 19200.

This setting is based on the normal curve where multiple curves are used in one cam control block.

Example: slave cycle length = 10000 / 1

	Couple curve	Normal curve	Uncouple curve
maximum slave value [SlaveUnits]	50000	100000 => maximum slave value	25000
resulting slave position [Inc]	5000	10000	2500

Table 6.13 Example of slave cycle length

6.6.3 Slave modulo length

The slave modulo length is the position difference between start position and end position of a curve cycle. The following considerations assume that the slave value of the first curve point = 0.

The end position of an open curve profile forms the start position for the next curve during another profiling.

This end position is normally generated from the maximum slave value, the last slave value and the slave cycle length in the controller.

Because of the limited number of decimal places for the slave values in the cam profile description file, deviations from the specified rational values may occur. In the case of open curve profiles, this leads to the slave position differing from the desired values over multiple cycles. If the slave position of the last curve point can be described exactly as a break with whole number numerators and denominators, this error can be prevented. If this is the case, the numerators and denominators must be set in the parameters for the slave modulo length.

You can set the following with the parameters `CamCtrl1.SlMdMode, 53:22` or `CamCtrl2.SlMdMode, 54:22` (processing mode of the slave modulo length):

Case 1: the last slave value from the cam profile description file of the normal curve should be used to generate the slave modulo length.

Case 2: the fraction from numerator/denominator from setting the parameters of the slave modulo length will be used as the slave position of the last curve value.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.SlMdMode	53:22 ($35:16_h$)	Processing mode of the slave modulo length 0: Automatic calculation from curve values. Last slave value, max. slave value and the slave cycle length are used to generate the slave modulo length internally (calculation of the slave position of the last curve point) 1: Special user-defined parameter setting: The setting of the slave modulo length from CamCtrlx.SlTkNum and CamCtrlx.SlTkDenom is used as slave modulo length or slave position of the last curve point	UINT16 0..1	- 0	R/W/ per.

Table 6.14 Parameters for selecting the profiling method of the slave modulo length

The end value of the slave position (slave modulo length) is calculated from the following values and shown in [Inc]:

- SlaveValueLast: Slave value of the last point
- SlaveValueMax: Maximum slave value of all curves
- SlaveCycleLength: Slave cycle length

Case 1: Profiling mode of the slave modulo length = 0

The position of the last curve point is calculated internally in the controller from the maximum slave value, the last slave value and the slave cycle length.

Formula

$$\text{SlaveModuloLength [Inc]} = \frac{\text{SlaveValueLast [SlaveUnits]}}{\text{SlaveValueMax [SlaveUnits]}} \times \text{SlaveCycleLength}$$

Case 2: Profiling mode of the slave modulo length = 1

If the slave position drifts over several cycles because of the deviations described on page 6-14, and if the slave position of the last curve point can be exactly described as a fraction with integer numerator and denominator, configure numerator and denominator with the following parameters.

- Numerator slave modulo length
  `CamCtrl1.SlMdNum, 53:20` or
  `CamCtrl2.SlMdNum, 54:20`
- Denominator slave modulo length
  `CamCtrl1.SlMdDenom, 53:21` or
  `CamCtrl2.SlMdDenom, 54:21`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.SlMdNum	53:20 ($35:14_h$)	Numerator slave modulo length Setting a special slave modulo length is only effective for processing the normal curve. To ensure that the settings of the slave modulo length are used CamCtrlx.SlMdMode = 1 must be set Example: Slave cycle length: 16384/1, this must correspond to the max. slave value of 1000. If the last curve value is now exactly at 1/3 of the max. value, the slave value must be input as 333,3333.. This value can be assigned as break to the last curve point with the slave modulo length. Setting >16384 * 1 / 3	INT32	Inc 0	R/W/ per.
CamCtrl1.SlMdDenom	53:21 ($35:15_h$)	Denominator slave modulo length For detailed description see CamCtrlx.SlMdNom	INT32 1 ..2147483647	Cycles 1	R/W/ per.

Table 6.15 Parameters for calculating the slave modulo length as common break

Example:

Maximum slave value = 100 mm

Decimal places = 6

Slave cycle length = 16384 / 1

The slave position of the last curve point must be exactly 1/3 of the maximum slave position.

Thus the following slave values are in the cam profile description file:

SlaveValueMax[SlaveUnits] = 100.000.000
SlaveValueLast[SlaveUnits] = 33.333.333 (< > 1/3)

Because of the limited number of decimal places, SlaveValueLast clearly does not exactly match the desired 1/3 value of SlaveValueMax.

During profiling mode of the slave modulo length = 0 a curve position of the last slave = 16384 * 3333333 / 10000000 would be obtained. This results in a visible drift over multiple cycles.

In processing mode of the slave modulo length = 1 drift can be avoided by setting the slave modulo length = 16384 / 3
(numerator = 16384, denominator = 3).

6.7 Sequence of cam profiling

6.7.1 Cam control blocks

The sequence of the cam profiling and the curve used in this process is set via cam control blocks. Two cam control blocks `CamCtrl1` and `CamCtrl2` are available here.

The other cam control block is available to prepare a second cam profiling session during an active cam profiling session.

Each cam control block can have different states (inactive, ready, work) see chapter 6.7.2 “Profiling states of a cam control block“.

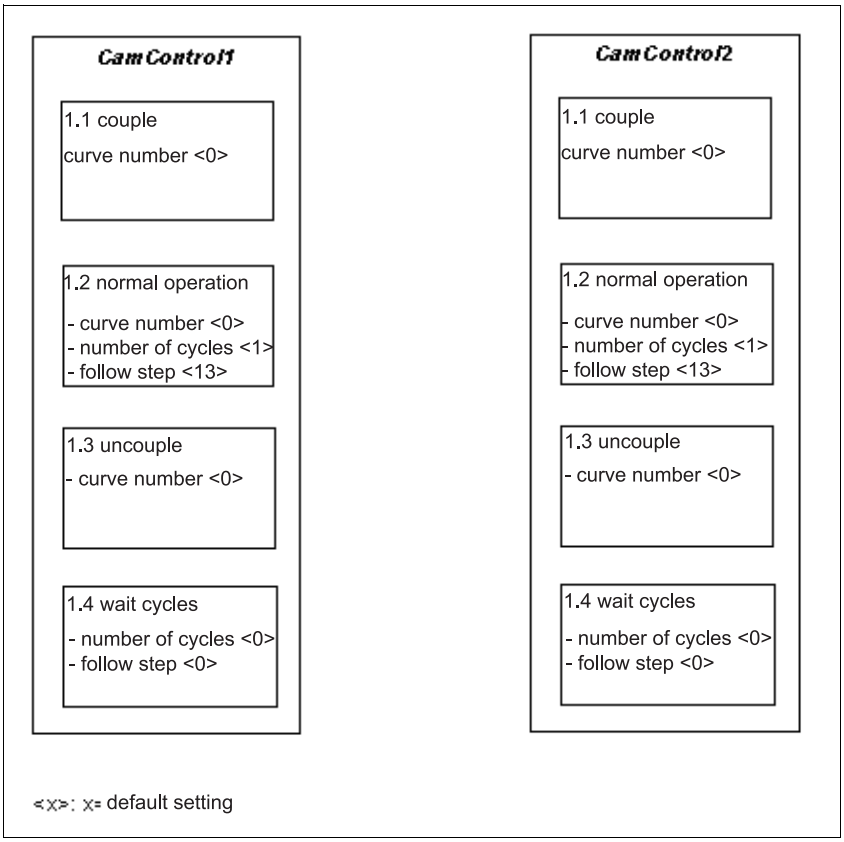

Figure 6.16 Setting the cam profiling sequence

Partial blocks Every cam control block comprises four partial blocks:

- Couple process
- Normal operating mode
- Uncouple process
- Wait cycles and follow step

Couple process

A slave motor can be coupled in a running movement of the master corresponding to the curve. This couple process is necessary when the start position of the slave at the time of the master cycle is unequal to the slave position of the normal curve at this time.

The couple curve is automatically executed when the following conditions are met:

- One couple curve exists.
- "CAM" operating mode is "Enabled".
- CAM reference is defined.
- The couple request is "Enabled".
- The master modulo condition is met.

The number of the couple curve is input with the parameter `CamCtrl1.CplCrvNo, 53:3` or `CamCtrl1.CplCrvNo, 54:3`.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.CplCrvNo	53:3 ($35:03_h$)	Number of couple curve (0: no couple curve) 0: no curve defined 1 to 99: Number of curve If no couple curve is defined the CAM status machine switches to processing the normal curve.	UINT16 0..99	- 0	R/W/ per.

Table 6.17 Parameters for showing the number of the couple curve

Normal operating mode

On completion of the couple process the normal curve is automatically enabled.

After exceeding the maximum master position the cam profiling can be continued as follows:

- If the curve is to be processed multiple times, it is started at the beginning of the curve.
- It is switched to the next profiling step.

For some applications the couple and uncouple curve may not be required.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.StdCrvNo	53:4 ($35:04_h$)	Number of normal curve 1 to 99: number of curve	UINT16 1..99	- 1	R/W/ per.
CamCtrl1.StdCrvCnt	53:5 ($35:05_h$)	Number of processing cycles of normal curve (0: unlimited number) 0: unlimited number <>0: defined number of cycles Only master cycles completely processed as normal curve are counted, i.e. the cycle is not counted if the status DO_COUPLE_CURVE or DO_UNCOUPLE_CURVE is being processed within the cycle.	INT32 0 ..2147483647	- 0	R/W/ per.
CamCtrl1.StdSeqNo	53:6 ($35:06_h$)	Number of follow step after normal curve permissible setting in CamCtrl1: 13: 1.3 Uncouple CamCtrl1 (default) 22: 2.2 Normal curve CamCtrl2 permissible setting in CamCtrl2: 23: 2.3 Uncouple CamCtrl2 (default) 12: 1.2 Normal curve CamCtrl1	UINT16 12..23	- 13	R/W/ per.

Table 6.18 Parameters for normal operating mode

Uncouple process

The slave motor can be uncoupled from a master movement.

The slave motor starts the uncouple process in accordance with the uncouple curve at a previously defined master position.

The uncouple process is required when the end position of the slave motor at the time of the maximum master position is unequal to the slave position of the normal curve at this time.

The uncouple curve is automatically started when the following conditions are met:

- An uncouple curve exists.
- The couple request is "disabled".

- Uncouple position M_A is overrun.

The number of the uncouple curve is input with the parameter `CamCtrl1.UcplCrvNo, 53:7` or `CamCtrl2.UcplCrvNo, 54:7`.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.UcplCrvNo	53:7 ($35:07_h$)	Number of uncouple curve 0: no curve defined 1 to 99: Number of curve If no uncouple curve is defined the CAM status machine switches to processing the wait cycles.	UINT16 0..99	- 0	R/W/ per.

Table 6.19 Parameters for the uncouple process

Wait cycles and follow step

One or more master cycles without slave motions can be set between the curve processes. The number of wait cycles is input with the parameter `CamCtrl1.IdleCycle, 53:8` or `CamCtrl2.IdleCycle, 54:8`.

On completion of the wait cycles the cam profiling can be terminated or continued with another partial block.
The follow step after wait cycle processing is input with the parameter `CamCtrl1.IdleSeqNo, 53:9` or `CamCtrl2.IdleSeqNo, 54:9`.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.IdleCycle	53:8 ($35:08_h$)	Number of wait cycles (-1: no wait, 0: unlimited) -1 : no wait 0: unlimited 1 to 2147483647: number of master cycles	INT32 -1 ..2147483647	- -1	R/W/ per.
CamCtrl1.IdleSeqNo	53:9 ($35:09_h$)	Follow step and wait cycle processing (FollowStep) settings in CamCtrl1 and CamCtrl2: 0: switch to status DO_CAM_DISABLE 1: Process CamCtrl1 (default in CamCtrl1) 2: Process CamCtrl2 (default in CamCtrl2) 3: GlobalDefined (setting CamGlobal.SelCtrBlk)	UINT16 0..3	- 1	R/W/ per.

Table 6.20 Parameters for the wait cycles and the concluding follow step

Profiling examples

Example 1: No switch between cam control blocks, couple and uncouple curves are used. Using cam control block 1

- Couple process with curve 1

  CamCtrl1.CplCrvNo = 1

- Normal profiling with curve 2, this must be profiled 20 times

  CamCtrl1.StdCrvNo = 2

  CamCtrl1.StdCrvCnt = 20

- Uncouple process with curve 3

  CamCtrl1.UcplCrvNo = 3

- Wait for 3 master cycles, then start couple process

  CamCtrl1.IdleCycle = 3

  CamCtrl1.IdleSeqNo = 1

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The cam control block with which the cam profiling of the CAM operating mode must begin can be input with the parameter `CamGlobal.ChoiceCtr, 52:7` .

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.ChoiceCtr	52:7 ($34:07_h$)	Selection of the CAM cam control block (1 or 2) at the start of the CAM operating mode 1: CamCtrl 1 2: CamCtrl 2 cam control block at which CAM operating mode should be started at startup	UINT16 1..2	- 1	R/W/ per.

Table 6.21 Parameters for specifying the cam control block when starting "CAM" operating mode

Parameter description `CamGlobal.SelCtrBlk`

While cam profiling is running the user can specify dynamically with `CamGlobal.SelCtrBlk` the Ctrl-Block to be used for continuing processing on completion of processing the current CtrlBlocks or whether the process should stopped. To activate dynamic switchover the parameters for the follow step after wait cycle processing must be set in `CamCtrl1/2.IdleSeqNo` to `GlobalDefined`.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.SelCtrBlk	52:52 ($34:34_h$)	User spec. selection of follow step after wait cycle processing 0: switch to status DO_CAM_DISABLE 1: Process CamCtrl1 2: Process CamCtrl2 Global specification of the CAM process after completion of wait cycle processing (FollowStep). The setting is used if CamCtrl1/2.IdleSeqNo is set to 'GlobalDefined'. When CAM operating mode is enabled, the setting of CamGlobal.ChoiceCtr is imported. I.e. the setting with which the CAM process was started is used after wait cycle processing in the same CtrlBlock. The setting of continuing processing must be made before the transition to the status 'WAIT_FOR_REFERENCE'.	UINT16 0..2	- 0	R/W/-

Table 6.22 User spec. selection of follow step after wait cycle processing

6.7.2 Profiling states of a cam control block

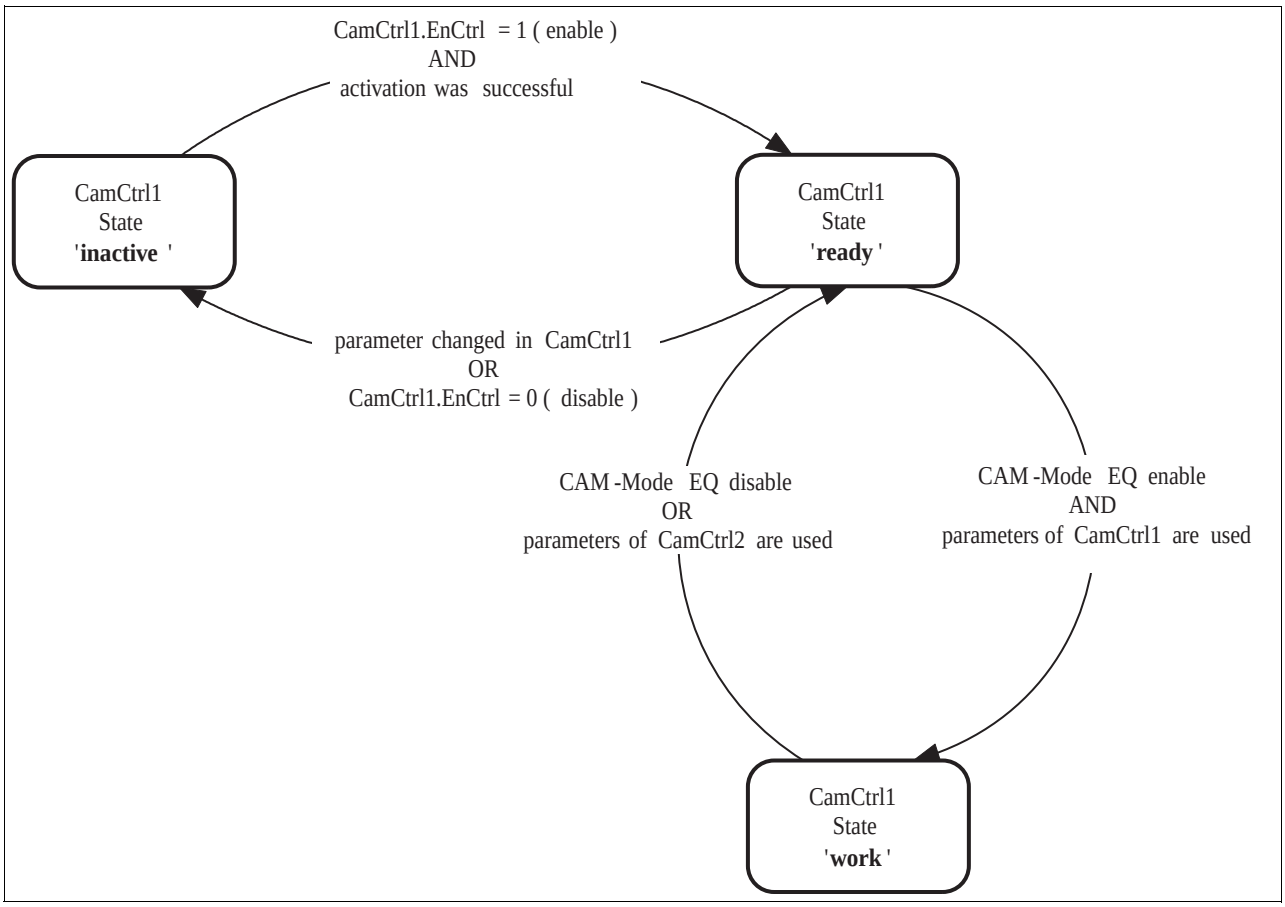

Figure 6.23 Profiling states of a cam control block

Every cam control block can have adopt different states:

inactive: This profiling state is used to set parameters of a cam control block.

ready: The cam control block is ready for cam profiling.

work: The cam control block is being used for the current cam profiling.

Comments:

The cam control block must be enabled after parameters have been set (Parameter CamCtrl1.EnCtrl and CamCtrl2.EnCtrl). The cam control block switches to the "ready" processing status.

When the parameter values are changed in the "ready" processing status, the cam control block automatically switches to the "inactive" processing status.

Parameters cannot be changed in the cam control block in the "work" processing status.

The current processing status of the cam control block can be read with the parameters `CamCtrl1.StateCtr, 53:2` or `CamCtrl2.StateCtr, 54:2`.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.EnCtrl	53:1 ($35:01_h$)	Activation of the CamCtrlBlocks Write access: 0: Deactivating block To be able to use the CamCtrlBlock for a cam profile the settings must be enabled. The profiling state can be found with CamCtrlx.StateCtrl.	UINT16 0..1	- 0	R/W/-
CamCtrl1.StateCtrl	53:2 ($35:02_h$)	Status of activation and processing status of the CamCtrl-Block Bit0: Status of activation of the CamCtrlBlock: 0: status change CamCtrlBlock active 1: status change CamCtrlBlock complete Bit8..9: processing status of CamCtrlBlock 0: inactive 1: ready 2: work If an error is found during the interpretation, it is registered in the error memory. In addition, the error number is returned at every read access.	UINT16 0..1	- -	R/-/-

Table 6.24 Parameters for the profiling states of a cam control block

6.7.3 Cam status machine

The cam profiling is run with the cam status machine. The individual states and the transition conditions for status change can be found in the following description. For the sake of clarity the description does not show the option for changing to curves of a different CamCtrlBlock.

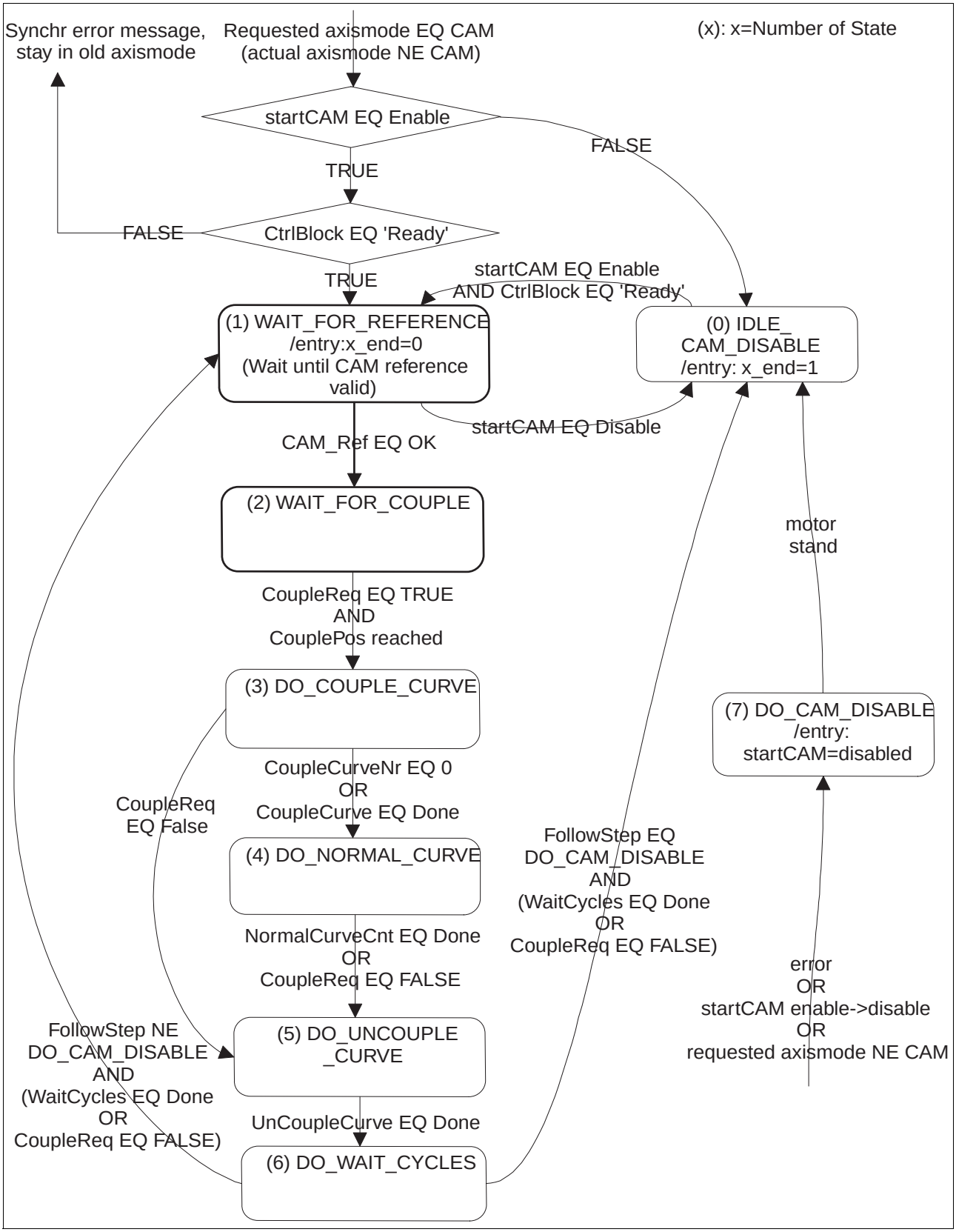

Figure 6.25 Cam status machine

Explanation of states

0: IDLE_CAM_DISABLE	Cam profiling inactive or complete, drive stops.
1: WAIT_FOR_REFERENCE	Waiting for cam referencing
2: WAIT_FOR_COUPLE	Waiting for couple condition
3: DO_COUPLE_CURVE	Profiling couple curve or couple process active
4: DO_NORMAL_CURVE	Profiling normal curve
5: DO_UNCOUPLE_CURVE	Profiling uncouple curve or uncouple process active
6: DO_WAIT_CYCLES	Profiling wait cycles
7: DO_CAM_DISABLE	Cam profiling complete or interrupted, drive is stopped

Table 6.26 Explanation of states

The current status of the cam status machine can be queried with the parameter CamGlobal.AddState, 52:6.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.AddState	52:6 ($34:06_h$)	Additional status information on status machine Status information : 0: IDLE_CAM_DISABLE 1: WAIT_FOR_REFERENCE 2: WAIT_FOR_COUPLE 3: DO_COUPLE_CURVE 4: DO_NORMAL_CURVE 5: DO_UNCOUPLE_CURVE 6: DO_WAIT_CYCLES 7: DO_CAM_DISABLE	UINT16 0 ..	- 0	R/-/-

Table 6.27 Parameters for status information with the cam status machine

6.8 Internal cam profiling

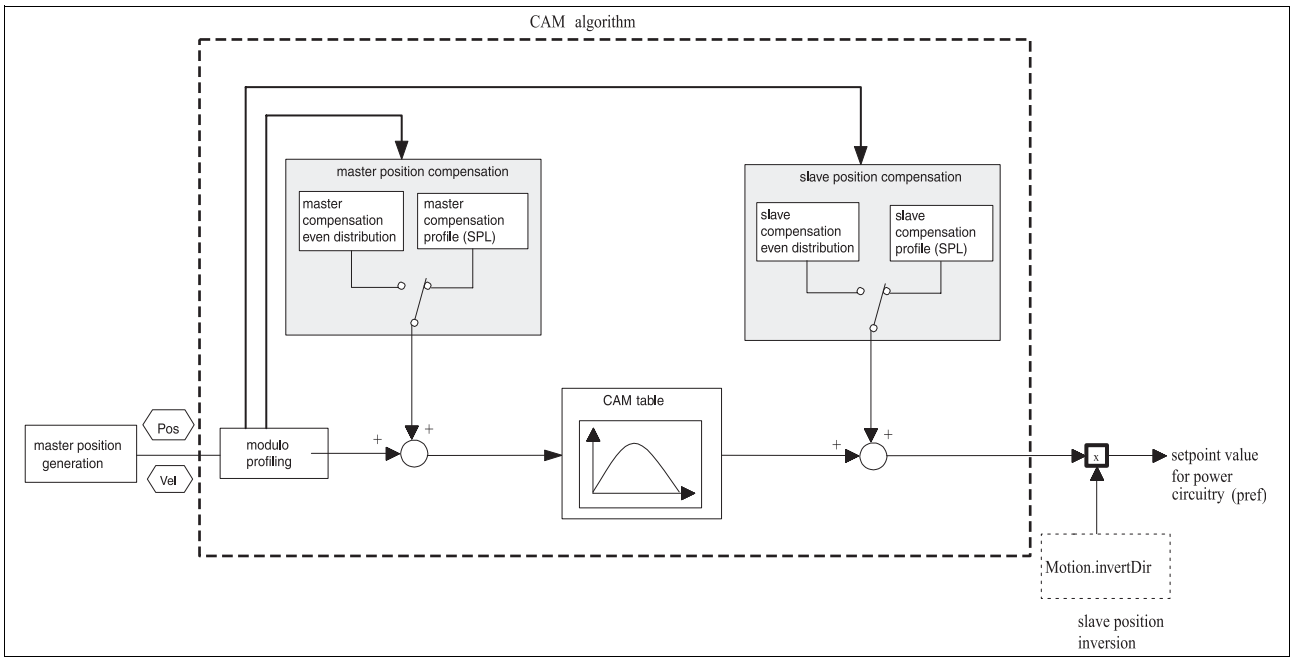

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Figure 6.28 Structural diagram of internal cam profiling

For a detailed description of the " Generating master position" function can be found in the chapter 6.12 “Profiling master position“.

For a detailed description of the "master position compensation" and "slave position compensation" functions see chapter 6.14 “Compensating master and slave position“.

Master position The internally used master position is the sum of the encoder position M1 and the position of the master simulation. If the motion must be conducted via the master position simulation only, ensure that no encoder pulses are received during this period.

The master position is only processed after a cam referencing has been run.

Slave position Before activating the cam profiling, the drive can be positioned to the start position for cam profiling by, for example, referencing mode. Once cam referencing has been completed, this slave position is used as the start position for the cam profiling.

6.8.1 Reversing motor direction of rotation

The direction of rotation of the motor is reversed with the parameter `Motion.invertDir, 28:6` . The relevant parameter description can be found in the ’Parameters’ chapter of the unit documentation.

6.8.2 Characteristics during a reverse motion of the master

If the direction of rotation of the master reverses during cam profiling, the current cam is also profiled in the reverse direction.

However, any previously completed master or slave position compensation processes can not be retracted (undone).

6.8.3 Residual values

Residual values may occur as a result of non-whole-number cycle or modulo lengths on transition to the next master cycle.

The internal controller residual value processing of the master and slave position ensures that any residual values are taken into account in the continuing process.

6.8.4 Switching between the two cam control blocks

When switching to a curve in the other cam control block, the position of the last curve point of the current curve is used as the position of the first curve point of the following curve.

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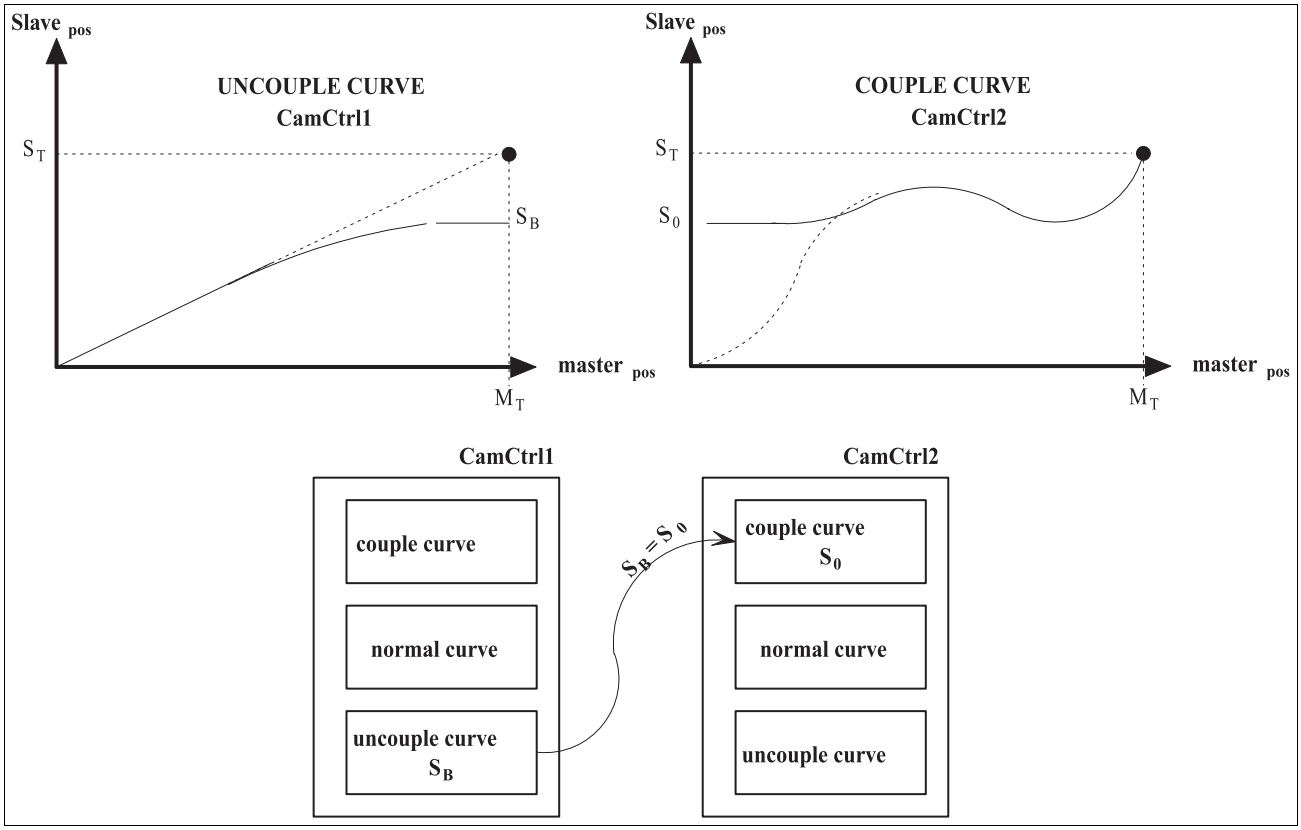

Figure 6.29 Profiling the slave position when switching to the other cam control block

6.8.5 Resetting at the start of the curve after interruption

In the event of an interruption, such as the result of an error, the slave is brought to a standstill as quickly as possible regardless of the curve shape.

If necessary, the drive must be set to the desired next start position of the slave (P_x in Figure 6.30) to be able to continue the process correctly during the next master modulo situation.

The new start position depends on the application. The values required to calculate the position can be read from the controller.

The master position must not change during the restart process.

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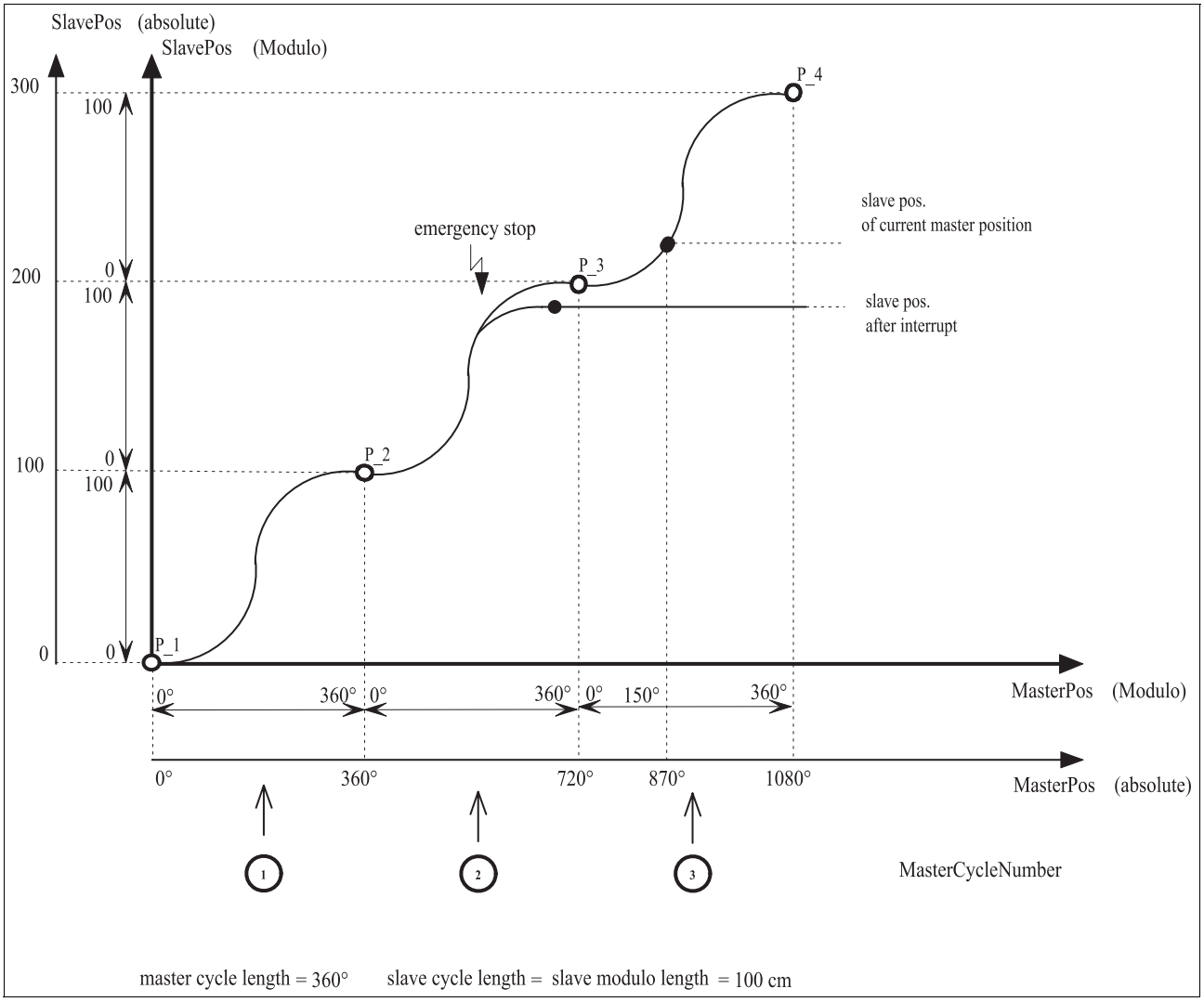

Figure 6.30 Calculating the slave position at the start of the master cycle

For example, a suitable position for restart can be calculated in the CoDeSys application. Use the following values for this:

- Absolute slave position in the first point of the master cycle at which the interruption occurred.
- Number of master cycles at the time of interruption
- Current number of master cycles

The last used slave modulo length is also required as a common break for calculation over multiple intervals.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.MsCycAct	31:55 (1F:37$_h$)	CAM: Current or last correctly started master cycle number The number of processed master cycles or detected modulo conditions provides the value. Master cycles are only counted in the following states: - DO_COUPLE_CURVE - DO_NORMAL_CURVE - DO_UNCOUPLE_CURVE In the event of an interruption in processing this counter also contains the number of the cycle in which the interruption occurred When processing the WAIT_FOR_REFERENCE status the counter is reset.	INT32	- 0	R/-/-
Status.MsCycCalc	31:56 (1F:38$_h$)	CAM: theoretical master cycle number corresponding to the current master position The number of processed master cycles or detected modulo conditions provides the value. The value is only updated if the operating mode 'cam' is activated! Master cycles are only counted in the following states: - DO_COUPLE_CURVE - DO_NORMAL_CURVE - DO_UNCOUPLE_CURVE - DO_CAM_DISABLE - IDLE_CAM_DISABLE In the event of an interruption of the process this counter contains the number of the master cycle that would have been set with error-free processing. In the event of interruption a comparison with Status.MsCycAct can show how many cycles the master has moved in the meantime. The counter is reset on processing the WAIT_FOR_REFERENCE state.	INT32	- 0	R/-/-
Status.SlvPosS0	31:57 (1F:39$_h$)	CAM: Slave absolute position with master modulo situation of the currently processed master cycle A valid value is only available after execution of the CAM referencing. The value corresponds to the absolute position of the slave at the first curve point of the profiled curve. In the event of interruption of the profiling the position corresponds to the slave position of the cycle in which the interruption occurred.	INT32	Inc 0	R/-/-
Status.CamSlMdNu	31:59 (1F:3B$_h$)	CAM: current numerator of the slave modulo length The current internally used slave modulo length (slave position of the last curve point) can be calculated. This is derived depending on the setting of CamCtrlx.SlMdMode. The value is required for resetting after an interruption of profiling for calculation of an absolute slave position in a follow interval. A reasonable value is only available after initial activation of operating mode 'cam'.	INT32 0 ..2147483647	Inc 0	R/-/-
Status.CamSlMdDe	31:60 (1F:3C$_h$)	CAM: current denominator of the slave modulo length For description see Status.CamSlMdNu	INT32 1 ..2147483647	Cycles 1	R/-/-

Table 6.31 Parameters for determining the start position of the slave after interruption

In the example in Figure 6.30 you can continue to operate at slave position P_4. This slave position P_4 is calculated in increments as follows:

$$P\_4 = SlvPosS0 + (MsCycCalc - MsCyCAct + 1) \times \frac{SlMdNum}{SlMdDenom}$$

Because a range overrun can occur between the current slave position (`Status.p_ref, 31:5`) and the calculated position at P_4, the compensation movement should be executed via a relative positioning.

$$p\_relPTP\ [Inc] = P\_4 - p\_ref$$

Read value for setpoint position of the rotor position [Inc.]:`Status.p_ref, 31:5`

The drive can be traversed to this position with a relative positioning in PTP mode.

PTP relative positioning [usr]:`PTP.p_relPTP, 35:3`

If a special user-defined standardisation is used, the setpoint position in increments must be converted to user-defined units ("usr").

6.9 Cam referencing

A reference from the position of the master and the slave must be defined to run cam profiling.

After starting the controller, the guidance sensor and the motor are normally at a random position, i.e. there is still no relationship between the two position values.

The cam referencing procedure assigns defined values based on the curve shape to the current mechanical positions.

The slave position from which the cam profiling must be started can be defined in referencing mode or approached in PTP mode. This position corresponds to the standstill position S0 during the subsequent profiling.

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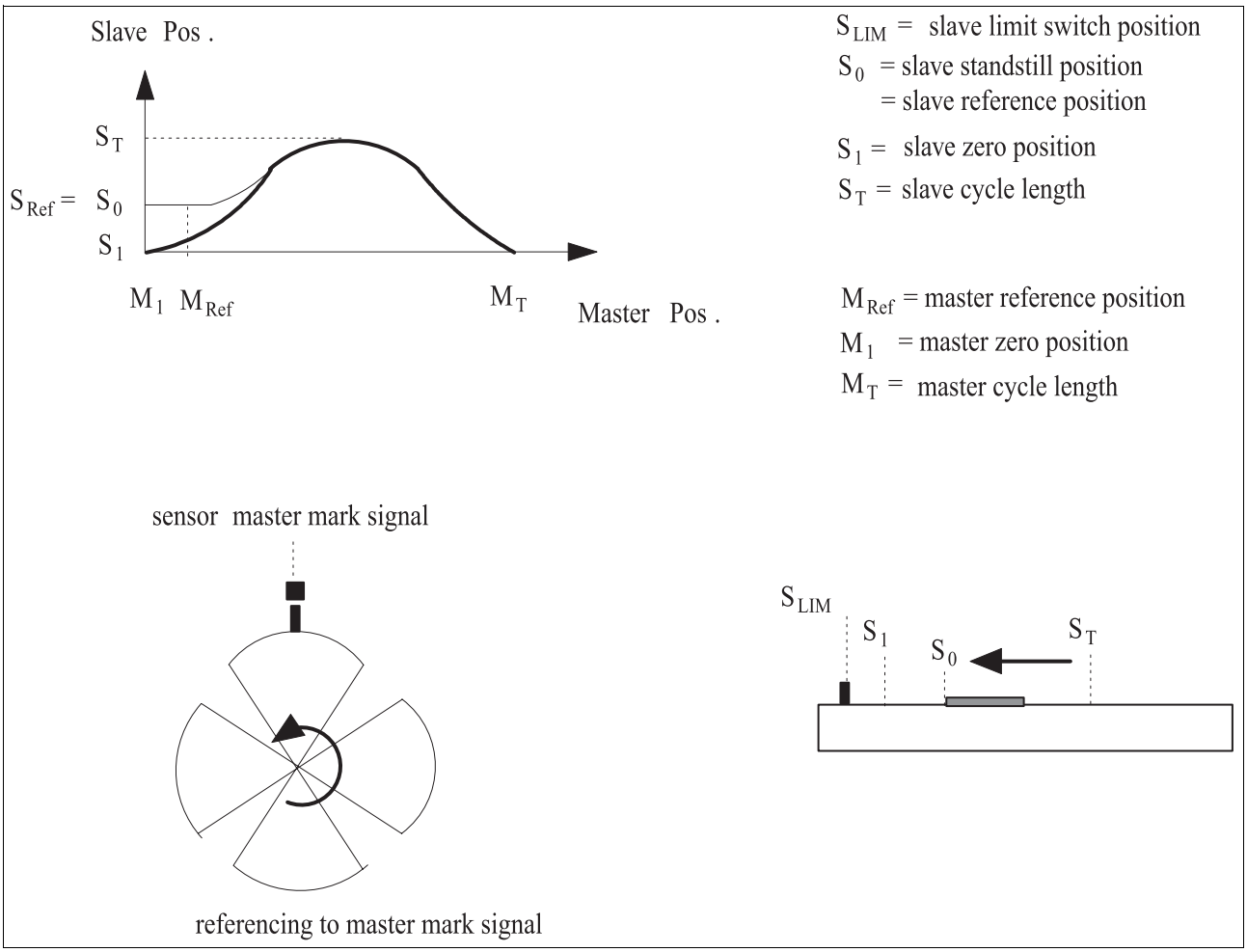

Figure 6.32 Cam referencing

If there is no couple curve, the standstill position S0 corresponds to the first curve point of the normal curve.

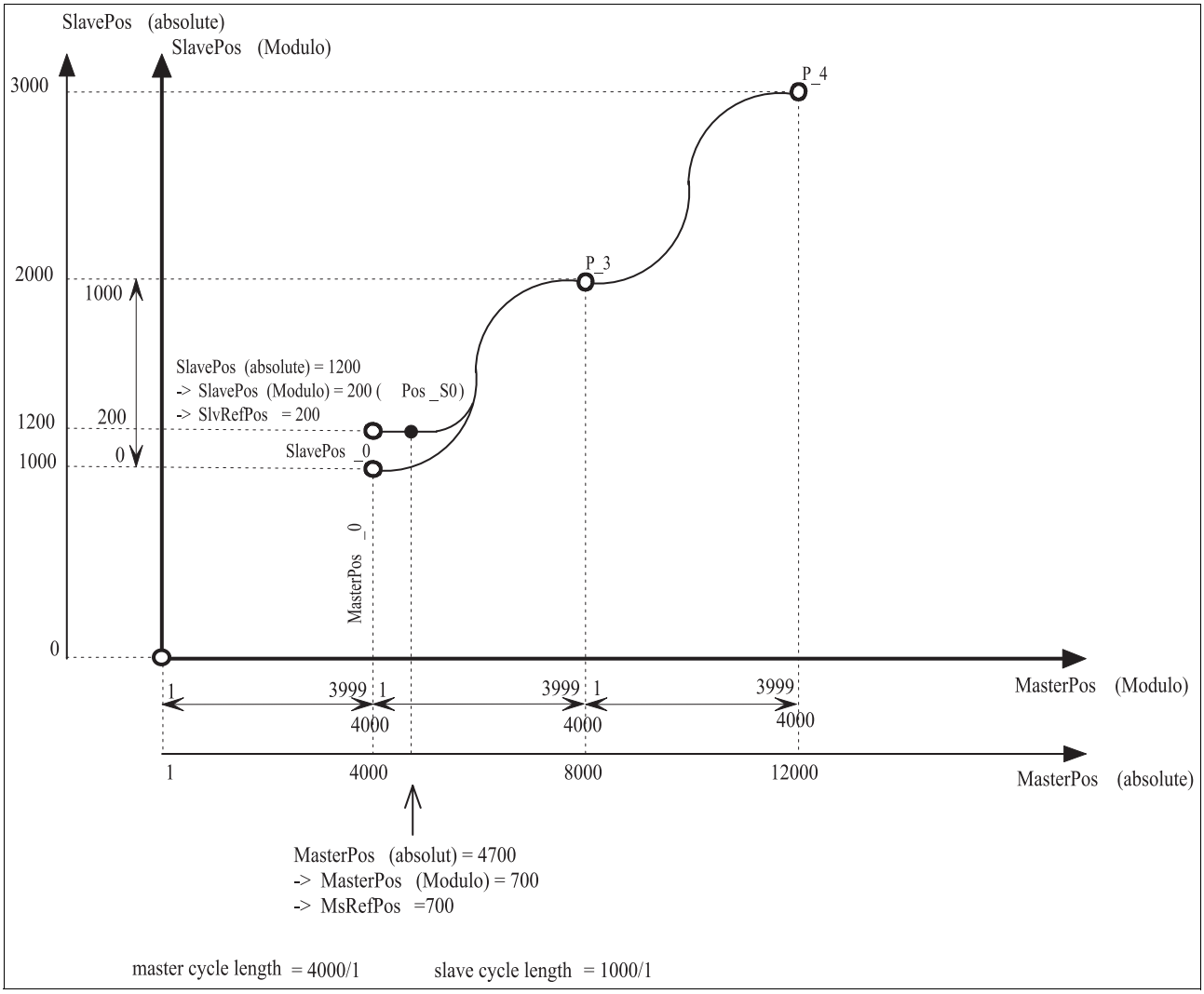

Figure 6.33 Cam referencing position handling

In the example from 6-31 the coupling procedure should be run from the absolute slave position `SlavePos(absolute) = 1200`.

The slave is traversed to this position by PTP positioning after a referencing. This position must correspond to the standstill position S0 of 200 Inc.

The current absolute master position of 4700 Inc must correspond to the master position of 700 Inc in the curve that is to be profiled, therefore MsRefPos is set to this value.

The import of the specified reference positions can be set directly when the motor is at a standstill. While a master is not moving the reference position must be imported from the system by an external signal. The input `CAPTURE1` and the `Indexpuls` at the RS422 encoder module on the M1 port are available as import signals.

For setting the master cycle signal for the referencing see the chapter 6.13 “Position capture at master and slave cycle“

The cam referencing can be run via the following methods:

- Directly setting the configured value

- Setting the configured value when activating the master cycle signal, `CAPTURE1` or `Indexpuls` at M1 can be set as signal source.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.RefMode	52:12 (34:0C$_h$)	Cam referencing: Processing mode Processing mode: importing the configured master and slave position 1: direct (with this write access) 2: with master cycle signal single mode 3: with master cycle signal multi-mode Setting parameters of the master reference value: CamCtrl1/2.MsRefPos	UINT16 1..3	Inc 1	R/W/-
CamGlobal.MsRefClr	52:15 (34:0F$_h$)	Automatically delete CAM reference 0 : inactive 1 : active Detection whether CAM reference should be automatically deleted when the CAM status machine switches to the WAIT_FOR_REFERENCE status. For example, this is required if a new profiling cycle or controlled couple process must be triggered by a new master mark signal.	UINT16 0..1	- 0	R/W/ per.
CamCtrl1.SlPosS0	53:23 (35:17$_h$)	Standstill position slave S0 in Inc and slave reference position Slave position of the first curve point of the couple curve in Inc. If there is no couple curve the position of the normal curve is returned. Attention: Value is only available after activation of the CamCtrlBlock. 0 is returned until the time of activation.	INT32 0 ..2147483647	Inc 0	R/-/-
CamCtrl1.MsRefPos	53:24 (35:18$_h$)	Master reference: master position ABS to be set (master reference position) <= ABS(master cycle length) Master value is set directly depending on CamGlobal.MsRefMode or when the master reference signal (CAPTURE1) is received.	INT32	Inc 0	R/W/ per.

Table 6.34 Cam referencing parameters

6.10 Couple request (`CoupleReq`)

The processing of the curves input into the cam control blocks can be enabled or disabled by a couple request `CoupleReq`, compare Figure 6.25. The type of couple source can be configured.

The couple request can be carried out as follows:

- Direct parameter access via the field bus, TLCT or CoDeSys access channels
- Via the COUPLE input at the signal interface

The couple requests of the individual access channels are internally managed separately. The couple request is only disabled when the couple requests of all access channels are disabled.

The couple request over field bus or TLCT is automatically deleted if the connection at the interface is broken.

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The couple request of a CoDeSys application is automatically deleted after a reset.

The use of the `COUPLE` input is disabled by default and can be enabled with the parameter `CamGlobal.EnCpleInp, 52:27`.

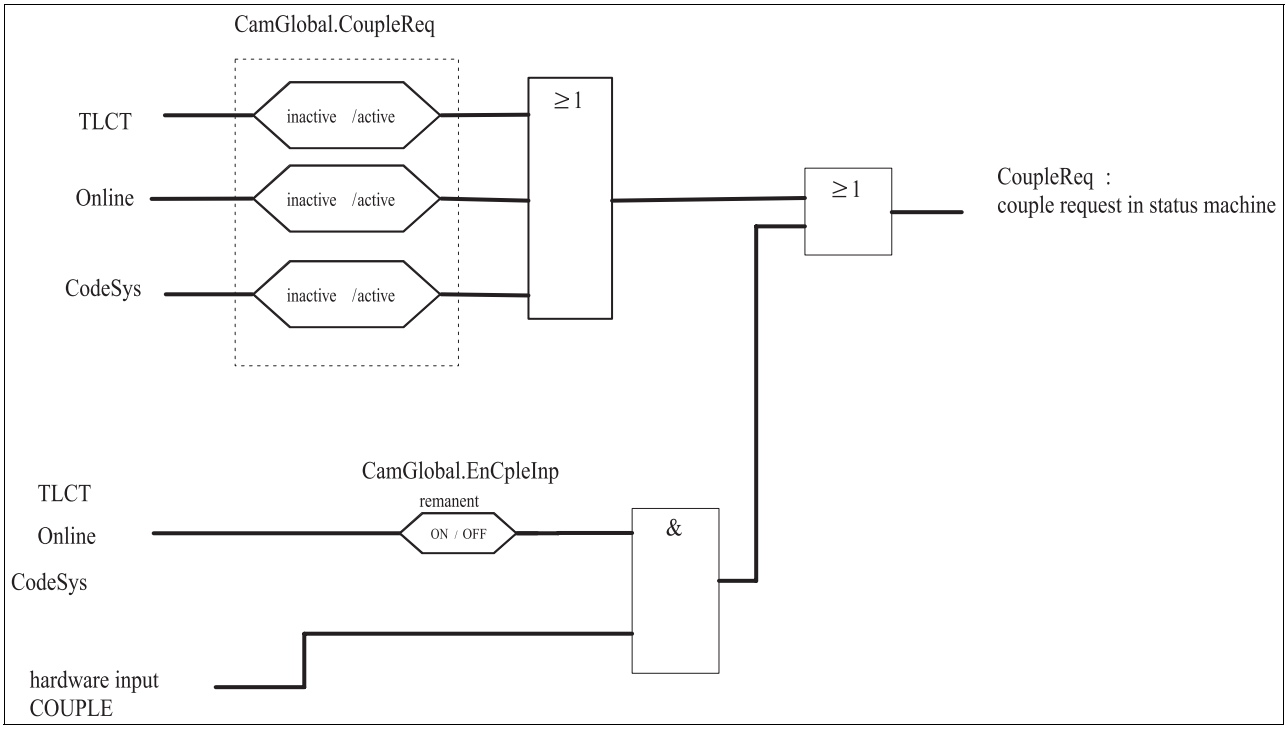

Figure 6.35 Couple request (CoupleReq)

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.EnCpleInp	52:27 (34:1B$_h$)	Enable input "COUPLE" 0 : Hardware input COUPLE not assigned 1 : COUPLE hardware input assigned	UINT16 0..1	- 0	R/W/ per.
CamGlobal.CoupleReq	52:28 (34:1C$_h$)	Request for coupling (CoupleReq) Write access: (isolation by access channel) 0 : disable CoupleReq 1 : enable CoupleReq Read access: (setting OR status of all CoupleReq) 0: CoupleReq disabled 1: CoupleReq enable During read access the internal couple request is returned. This corresponds to setting the OR status of the CoupleReq over the various access channels incl. COUPLE input (if enabled)	UINT16 0..1	- 0	R/W/-

Table 6.36 Parameters for the couple request

6.11 Start and monitor "CAM" operating mode

The "CAM" operating mode is started with the parameter `CamGlobal.startCAM, 52:1`.

The operating-mode-specific processing status can be monitored with the parameter `CamGlobal.StateCam, 52:2`. The operating-mode-independent parameter `Status.driveStat, 28:2` is also available.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.startCAM	52:1 ($34:01_h$)	Start CAM operating mode 0: disable 1: activate	UINT16 0..1	- -	R/W/-
CamGlobal.stateCAM	52:2 ($34:02_h$)	Acknowledgement: CAM operating mode Bit15: cam_err Bit14: cam_end Bit 7: error SW_STOP Bit 6: error SW_LIMN Bit 5: error SW_LIMP Bit3: error REF Bit2: error HW_ STOP Bit1: error LIMN Bit0: error LIMP Coding Bit 13..Bit15 corresponding to the coding in the global status word (Status.driveStat)	UINT16	- -	R/-/-
Status.driveStat	28:2 ($1C:02_h$)	Status word for the operating status HIGH-UINT16: assignment see Bit0..15 in Status.xMode_act LOW-UINT16: status word status machine Bit0..3: number of the current status of the status machine. Bit4: reserved Bit5: fault by internal monitoring Bit6: fault by external monitoring Bit7: warning active Bit8: reserved Bit9: remote control active (only unit types >=CDP2xx) Bit10..11: reserved Bit12::15: axis-operating mode-specific processing status Coding corresponds to the assignment of Bits12..15 in the operating-mode-specific acknowledgement data (e.g. CamGlobal.StateCAM (52:2) in CAM operating mode) Coding status word status machine Bit0..3: 1: Start 2: Not Ready To Switch On 3: Switch On Disabled 4: Ready to Switch On 5: Switched On 6: Operation Enable 7: Quick Stop Active 8: Fault Reaction Active 9: Fault 10..15: not assigned	UINT32	- -	R/-/-

Table 6.37 Parameters for starting and monitoring operating mode 'cam'

6.12 Profiling master position

The guidance sensor position is normally applied via the encoder module M1. The guidance sensor position can be simulated for commissioning with encoder module M1.

Two options are available:

- Manual:
  continuous change at constant speed
- Profile:
  defined change at a preset value

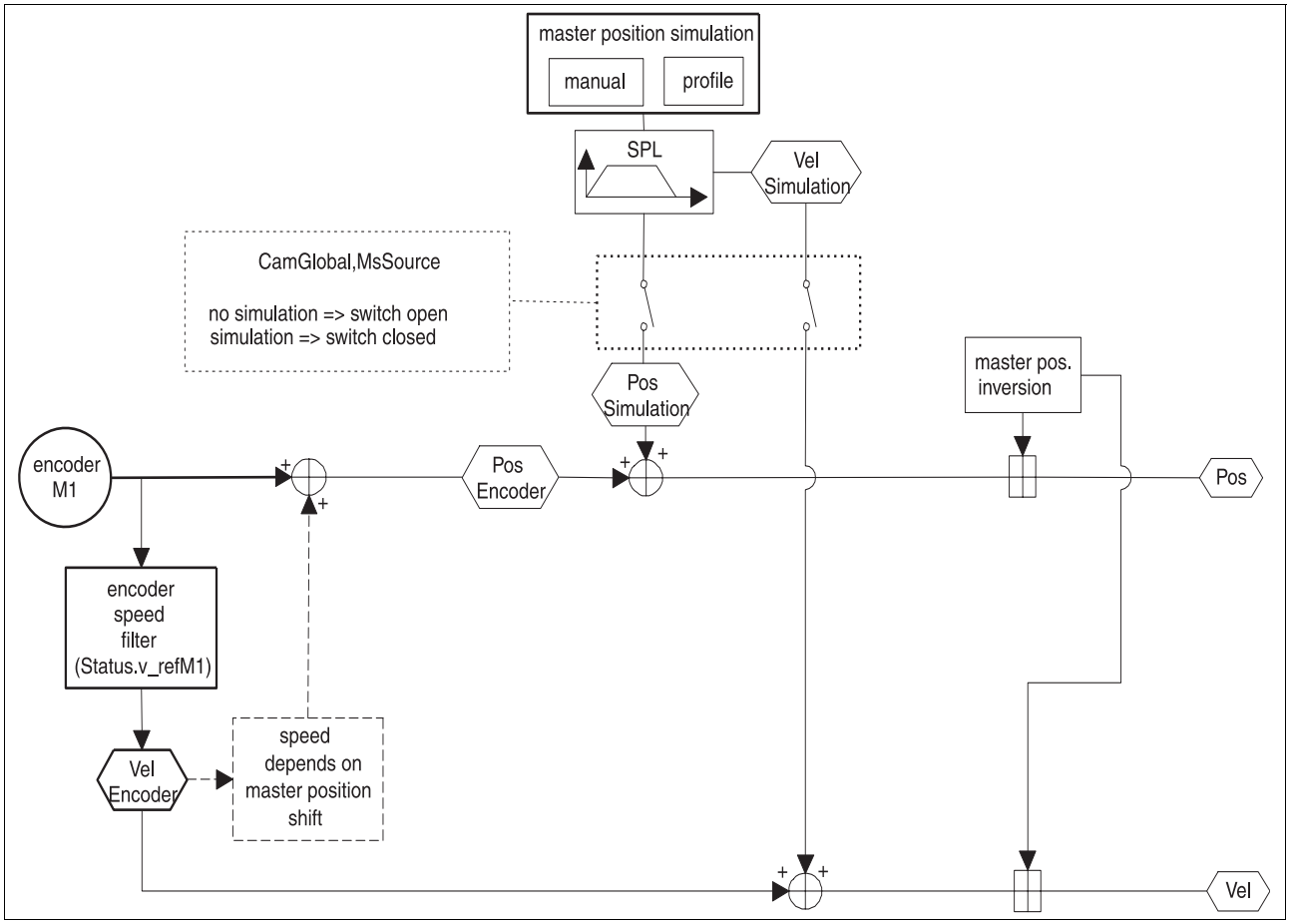

Figure 6.38 Master position profiling

During active simulation of the master position changes in the encoder signals continue to be profiled.

The master position is reversed by input of a negative master cycle length.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.CamSiPref	31:54 (1F:36$_h$)	CAM: actual position of master position simulation	INT32	Inc-	R/-/-
CamGlobal.MsSource	52:16 (34:10$_h$)	Master position source (module M1, simulation manual/profile) 0: setpoint value via encoder module slot M1 only 1: simulation manual 2: simulation profile The parameter CamGlobal.SimEncMod can be used to set what should be done when the simulation is activated with the incoming encoder pulses	UINT16 0..2	- 0	R/W/ -
CamGlobal.velSimu	52:20 (34:14$_h$)	Setpoint speed of master simulation Use for manual and profile simulation Shown in master increments/s	INT32 1..1600000	Inc/s 1000	R/W/ -
CamGlobal.accSimu	52:21 (34:15$_h$)	Acceleration of master simulation Use for manual and profile simulation Shown in 1000 master increments/s^2	UINT32 3..2147483647	1000 Inc/s^2 10	R/W/ -

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.SimuSetPo	52:47 (34:2F$_h$)	Master simulation dimension setting setpoint and actual position of the profile generator for the master simulation are set to the default value. This does not change the master modulo position.	INT32	Inc 0	R/W/ -
CamGlobal.SimEncMod	52:53 (34:35$_h$)	Processing mode of encoder position at M1 during master simulation 0: pos. changes at encoder considered 1: pos. changes at encoder always rejected The master simulation is set with the parameter 'CamGlobal.MsSource'	UINT16 0..1	- 0	R/W/ per.

Table 6.39 General settings for profiling the master position

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.startMan	52:22 (34:16$_h$)	Start master position simulation manual Coding the write data: Bit1: neg. direction of rotation Bit0: pos. direction of rotation Write access with 0 finishes process	UINT16 0..3	- 0	R/W/-
CamGlobal.stateMan	52:23 (34:17$_h$)	Acknowledgement of master position simulation manual Bit15: simul_master_manu_err Bit14: simul_master_manu_end	UINT16	- -	R/-/-

Table 6.40 Special settings for the manual master simulation

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.p_absSimu	52:24 (34:18$_h$)	Start master position simulation profile absolute Write access triggers absolute positioning in master increments	INT32	Inc 0	R/W/ -
CamGlobal.stateProf	52:25 (34:19$_h$)	Acknowledgement of master position simulation profile Bit15: simul_master_profil_err Bit14: simul_master_profil_end Bit13: simul_master_profil_target_reached (setpoint reached)	UINT16	- -	R/-/-
CamGlobal.p_relProf	52:26 (34:1A$_h$)	Start simulation of master position profile relative Write access triggers relative positioning in master increments	INT32	Inc 0	R/W/ -

Table 6.41 Special settings for the profile master simulation

6.13 Position capture at master and slave cycle

For example, the positions of print or parser marks can be captured by signals from the process. This is the prerequisite for mark synchronisation (cycle synchronisation or register control).

The capture unit with two fast recording channels implemented on the controller hardware is also used for cam profiling. The principle parameter setting is made with the previously existing parameters (see unit documentation TLC6xx, Chapter "Fast position capture").

This capture unit can also be used for the CAM referencing at the next master cycle signal at the `CAPTURE1` input or the index pulse at M1 and is not available for fast position capture during this process.

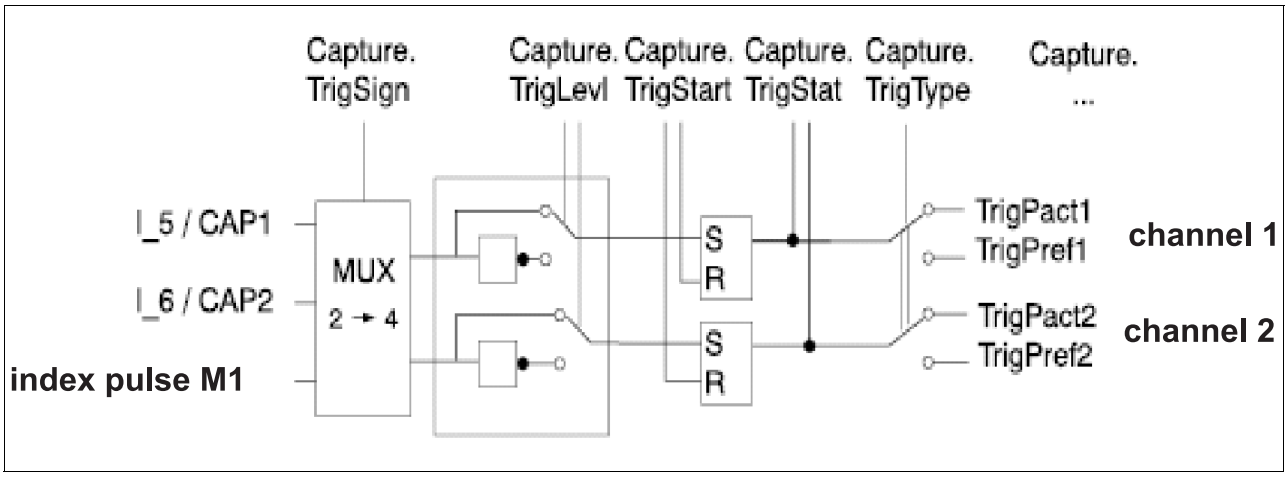

Figure 6.42 Fast position capture, signal schema and parameters (extract from the unit documentation)

In the event of multiple mark signals on the product one single mark signal can be filtered out by setting parameters of a recording range. The master value is always used as the value for the recording range. For example, a recording of the slave position can be enabled in the range 60..90° of the master value. If the mark signal is enabled outside this range, no recording is made.

You can start the recording and read the current profiling status. As soon as a recording has been made, you can read the associated recording position as modulo position. For example, a compensation of the slave position can be initiated from the difference of capture position and expected modulo position
(e.g. slip compensation).

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6.13.1 Using existing parameters for the recording

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Capture.TrigSign	20:13 (14:0D$_h$)	Selection of trigger signals for position save Bits 0,1: Channel 1: setting trigger source Bits 2,3: Channel 2: setting trigger source Coding selection trigger source: value=0: Cap1 -> input CAPTURE1 value=1: Cap2 -> input CAPTURE2 value=2: Mod1 -> index pulse setpoint position encoder (M1) only with stepper motor units (TLCx1x): value=3: Mod2 -> index pulse actual position encoder (M2) Default Bit0..3: 4 (Bit0,1=0:CAPTURE1 and Bit2,3=1:CAPTURE2) list of all possible values: value channel1 channel2 0 Cap1 Cap1 1 Cap2 Cap1 2 Mod1 Cap1 3 Mod2 Cap1 4 Cap1 Cap2 5 Cap2 Cap2 6 Mod1 Cap2 7 Mod2 Cap2 8 Cap1 Mod1 9 Cap2 Mod1 10 Mod1 Mod1 11 Mod2 Mod1 12 Cap1 Mod2 13 Cap2 Mod2 14 Mod1 Mod2 15 Mod2 Mod2	UINT16 0..15	- 4	R/W/-

Table 6.43 Parameters for setting the recording range

The following specifications have been made for profiling in operating mode 'cam':

- The master cycle signal can be applied via `CAPTURE1` or the index pulse at M1. The recording is always made on channel 1.
- The slave cycle signal is applied via `CAPTURE2`. The recording is always made on channel 2.

The capture unit must not be otherwise assigned for a recording of the master or slave mark signals or cam referencing to master mark signal.

The following processes must not be active:

- reference movement to index pulse with TLC61x stepping motor units
- Fast position capture enabled by the user

The following signal circuits of the master and slave mark signals are possible:

Signal circuitry	Use	Setting
Only master mark signal at CAPTURE1 signal input	Master position compensation or CAM referencing	0
Only master mark signal via index pulse at M1	Master position compensation or CAM referencing	2
Only slave mark signal at CAPTURE2 signal input	Slave position compensation	5
Master cycle signal at CAPTURE1 signal input and slave mark signal at CAPTURE2 signal input	CAPTURE2: Slave position compensation	4
Master cycle signal via index pulse at M1 and slave mark signal at CAPTURE2 signal input	CAPTURE2: Slave position compensation	6

Table 6.44 Signal circuitry of the master and slave mark signals

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Capture.TrigType	20:14 (14:0E$_h$)	Position source for save 0: actual position encoder 1: setpoint position encoder	UINT16 0..1	- 1	R/W/-

Table 6.45 Parameters for the position source

Always set the "1" as position source during controller execution with encoder module at M1.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Capture.TrigLevl	20:15 (14:0F$_h$)	Signal level for trigger channels Bit 0: Channel 1: setting the trigger level Bit 1: Channel 2: setting the trigger level Assignment of bits: 0: triggering at 1->0 switch 1: triggering at 0->1 switch (default)	UINT16 0..3	- 3	R/W/-

Table 6.46 Parameters for the signal level of trigger channels

Set the signal level at channel 1 in accordance with the profiling level of the master mark signal, and the level at channel 2 depending on the profiling level of the slave mark signal.

6.13.2 Recording range of the master mark

The position capture during the master mark signal is only run when the master mark signal occurs in the defined recording range of the master mark.

Two parameters per cam control block are available for specifying the recording range of the master mark:

- Start value of capture range
  Parameter `CamCtrl1.MsMarkSta, 53:10` or `CamCtrl2.MsMarkSta, 54:10`
- End value of capture range
  Parameter `CamCtrl1.MsMarkEnd, 53:11` or `CamCtrl2.MsMarkEnd, 54:11`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.MsMarkSta	53:10 (35:0A$_h$)	Start value of capture range of master mark Start of range of master values within which the capture of the master cycle signal is enabled. If CamCtrlx.MsMarkSta and CamCtrlx.MsMarkEnd = 0, then the entire master cycle is considered the range (range check inactive)	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.MsMarkEnd	53:11 (35:0B$_h$)	End value of capture range of master mark End of range of master values within which the capture of the master cycle signal is enabled.	INT32 0 ..2147483647	Master Units 0	R/W/ per.

Table 6.47 Parameters for specifying the recording range of the master mark

6.13.3 Recording range of the slave mark

The position capture during the slave mark signal is only run when the slave mark signal occurs in the defined recording range of the slave mark.

If multiple slave mark signals occur in the recording range of the slave mark, only the position of the first slave mark signal is recorded.

Two parameters per cam control block are available for specifying the recording range of the master mark:

- Start value of capture range
  Parameter `CamCtrl1.SlMarkSta, 53:12` or `CamCtrl2.SlMarkSta, 54:12`
- End value of capture range
  Parameter `CamCtrl1.MsMarkEnd, 53:13` or `CamCtrl2.SlMarkEnd, 54:13`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.SlMarkSta	53:12 (35:0C$_h$)	Start value of capture range of slave mark Start of range of master values within which the capture of the slave cycle signal is enabled. If CamCtrlx.MsMarkSta and CamCtrlx.MsMarkEnd = 0, then the entire master cycle is considered the range (range check inactive)	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.SlMarkEnd	53:13 (35:0D$_h$)	End value of capture range of slave mark End of range of master values within which the capture of the slave cycle signal is enabled.	INT32 0 ..2147483647	Master Units 0	R/W/ per.

Table 6.48 Parameters for specifying the recording range of the slave mark

6.13.4 Starting and monitoring recording

Recording can be started before activation of the operating mode 'cam' with parameter CamGlobal.CaptStart, 52:40.

The internal capture is enabled during the transition from the `WAIT_FOR_COUPLE` status to `DO_COUPLE_CURVE` or `DO_NORMAL_CURVE`.

The parameter `CamGlobal.CaptStat, 52:41` can be used to check whether a valid recording position is available.
A second write access to `CamGlobal.CaptStart, 52:40` enables recording again.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.CaptStart	52:40 ($34:28_h$)	Start recording positions of master and slave cycle signals Bit 0: capture of master cycle signal (channel 1) Bit 1: capture of slave cycle signal (channel 2) Values for Bit 0 and 1: 0 = process inactive or complete 1 = process enabled Info: A write access with Bit0=Bit1=0 can disable the recording for both cycle signals The range of master values within which a capture can be set separately for CamCtrl1 and CamCtrl2. -> CamCtrl1.SlMarkSta and CamCtrl1.SlMarkEnd	UINT16 0..3	- 0	R/W/-
CamGlobal.CaptStat	52:41 ($34:29_h$)	Status recording positions of master and slave cycle signals Bit 0: recording master cycle signal (channel 1) Bit 1: recording slave cycle signal (channel 2) Values for Bit 0 and 1: 0 = recording pos. not available 1 = recording position available	UINT16 0..3	- 0	R/-/-
CamGlobal.CaptMsPos	52:42 ($34:2A_h$)	Master position with master cycle signal as modulo value Output of recorded position of the setpoint position encoder (M1 encoder) with modulo processing via master cycle length. If the cam is inactive, the master cycle length from the CamCtrl1/2 block is used. It is entered in CamGlobalChoiceCtr. If the cam is active, the value from the currently profiled CamCtrl1/2 is used as the master cycle length.	INT32	Inc-	R/-/-
CamGlobal.CaptSlPos	52:43 ($34:2B_h$)	Slave position with slave cycle signal as modulo value Slave modulo position at time slave cycle signal received	INT32	Inc-	R/-/-

Table 6.49 Parameters for starting and monitoring the recording

6.14 Compensating master and slave position

The master and slave position can be compensated during operation.

The activation points of the compensation values are shown in Figure 6.28

Types of compensation

There are two types of compensation:

- Even distribution of the compensation path within a configurable master value range
- Superimposition of a compensation over a profile (speed, acceleration). The master value at which the start should be executed (not available yet!!!)

The specified compensation positions are processed as relative values, i.e. a change for the specified value is made.

The compensation position must be set before reaching the master value range to ensure that the compensation is run in the current master cycle. Otherwise the compensation will not be run until the next master cycle.

Specifying compensation range

Two parameters per cam control block are available for specifying the compensation range:

- Start value of capture range
  Parameter `CamCtrl1.CorrStart, 53:14` or `CamCtrl2.CorrStart, 54:14`
- End value of capture range
  Parameter `CamCtrl1.CorrEnd, 53:15` or `CamCtrl2.CorrEnd, 54:15`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.CorrStart	53:14 (35:0E$_h$)	Start value of compensation range of master or slave position compensation Additional condition: CorrStart < CorrEnd Exception: CorrStart=CorrEnd=0 Start of range of master values within which a specified master or slave position compensation is executed. If CamCtrlx.CorrStart and CamCtrlx.CorrEnd = 0, the compensation is run over the entire master value range.	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.CorrEnd	53:15 (35:0F$_h$)	End value of compensation range of master or slave position compensation see also CamCtrlx.CorrStart End of range of master values within which a specified master or slave position compensation is executed	INT32 0 ..2147483647	Master Units 0	R/W/ per.

Table 6.50 Parameters for specifying the compensation range

Compensating master position

The compensation of the master position is executed in the states DO_COUPLE_CURVE, DO_NORMAL_CURVE, DO_UNCOUPLE_CURVE and DO_WAIT_CYCLES.

Setting options:

- Processing mode of master position compensation
- Start and end value of the compensation range of the master position

- Master position change

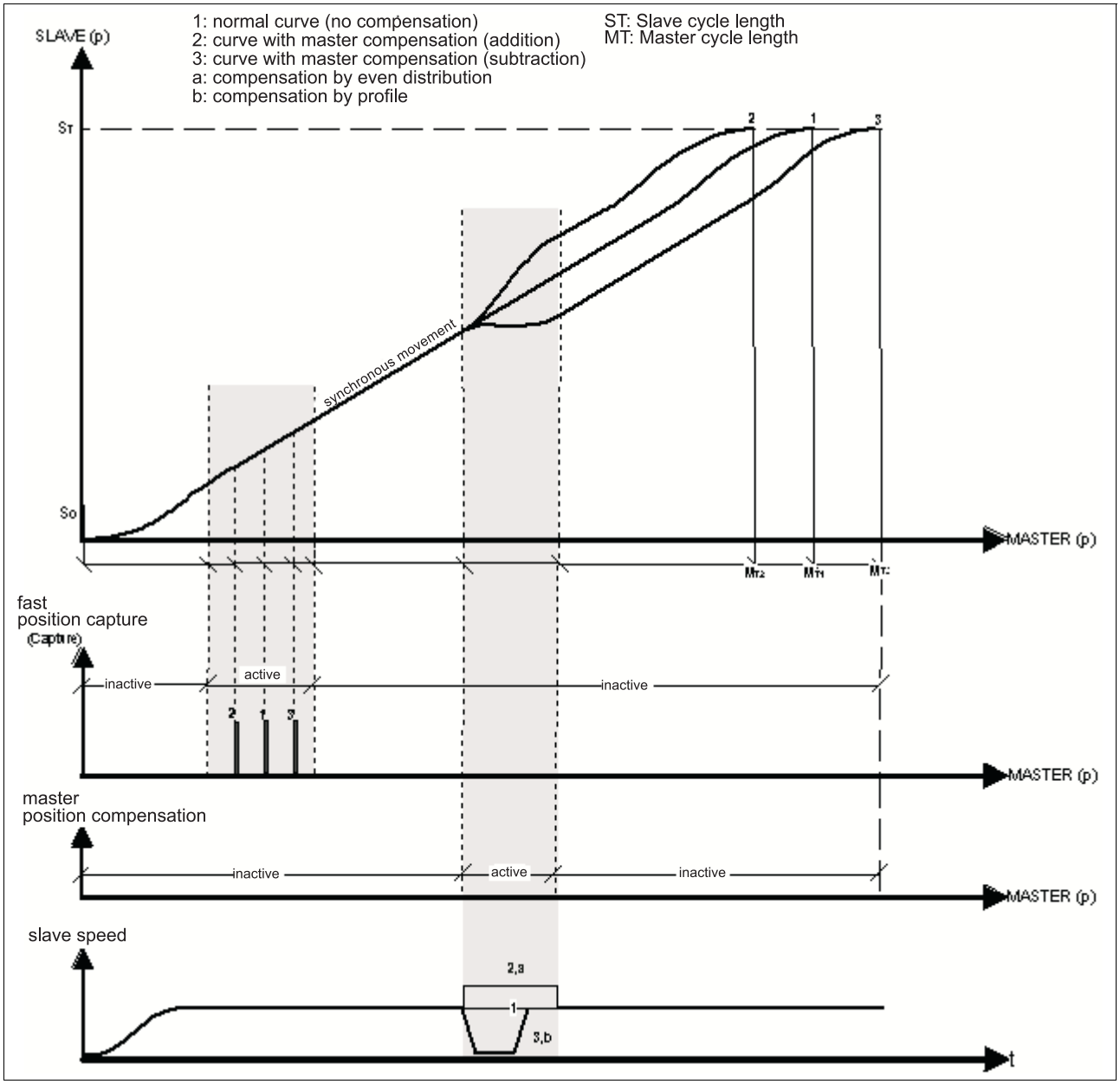

Figure 6.51 Master position compensation

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.MsCorrMod	52:30 (34:1E$_h$)	Master position compensation: processing mode Processing mode of master position compensation: 0: inactive 1 : even distribution, position compensation preset with CamGlobal.MsCorrPos	UINT16 0..1	- 0	R/W/ per.
CamGlobal.MsCorrPos	52:31 (34:1F$_h$)	Master position compensation: compensation position in master cycle Master position compensation per master cycle: the position is input in master increments	INT32	Inc 0	R/W/ -

Table 6.52 Parameters for master position compensation

Compensating slave position

The slave position compensation is run in the DO_NORMAL_CURVE state.

Setting options:

- Processing mode of slave position compensation
- Start and end value of the compensation range of the slave position
- Slave position change

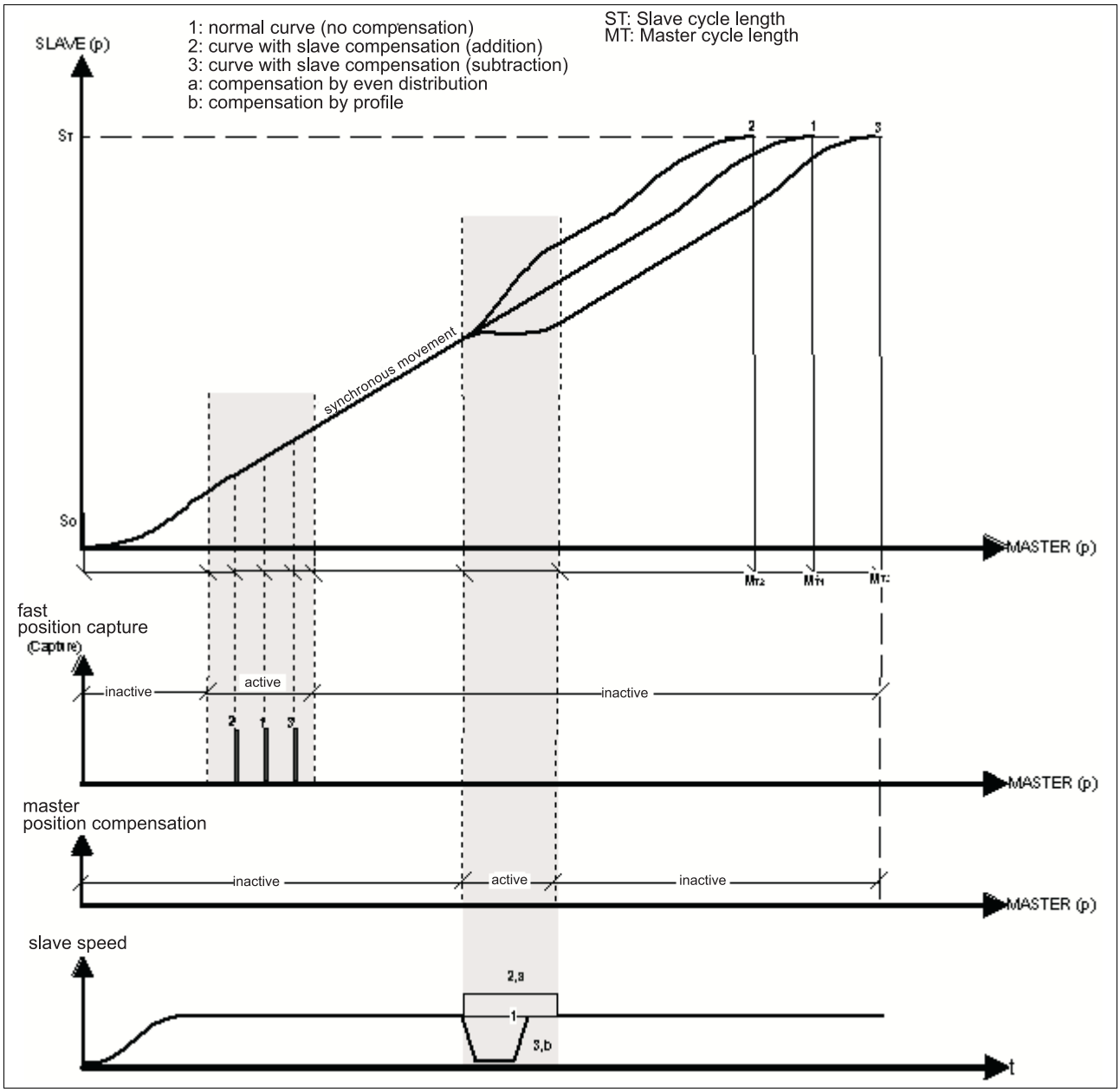

Figure 6.53 Compensation of the slave position

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.SlCorrMod	52:34 ($34:22_h$)	Slave position compensation: processing mode Processing mode of slave position compensation: 0: inactive 1 : even distribution Setting parameters of slave position compensation: CamGlobal.SlCorrPos	UINT16 0..1	- 0	R/W/ per.
CamGlobal.SlCorrPos	52:35 ($34:23_h$)	Slave position compensation: compensation position in master cycle Slave position compensation per master cycle: the position is input in slave increments	INT32	Inc 0	R/W/ -

Table 6.54 Parameters for slave position compensation

6.15 Master and slave position as modulo value

Master and slave position can also be output as modulo value - i.e. based on a cycle.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.CamMasMod	31:52 ($1F:34_h$)	CAM: modulo value of master position in Inc Value shows curve of master position over a master cycle valid value only readable if: - CAM operating mode set - Master reference available in all other cases if 0 is returned	INT32 0 ..2147483647	Inc-	R/-/-
Status.CamSlvMod	31:53 ($1F:35_h$)	CAM: modulo value of slave position in Inc Value shows curve of slave position over a master cycle valid value only readable if: - CAM operating mode set - Slave reference available - Couple signal active in all other if 0 is returned	INT32 0 ..2147483647	Inc-	R/-/-
Status.CamMsMdMu	31:62 ($1F:3E_h$)	CAM: modulo value of master position in MasterUnits See description of read value Status.CamMasMod The read value is however returned in MasterUnits instead of in Inc. The master cycle length from the current active CamCtrlBlock is used, the max. master value from the currently used cam profile description. Read access returns 0 as long as the CamCtrlBlock to be processed is in status 'disable'	INT32 0 ..2147483647	Master Units -	R/-/-
Status.CamSlMdSu	31:63 ($1F:3F_h$)	CAM: modulo value of slave position in SlaveUnits See description of read value Status.CamSlvMod The read value is however returned in SlaveUnits instead of in Inc. The slave cycle length from the current active CamCtrlBlock is used, the max. slave value from the currently used cam profile description. Read access returns 0 as long as the CamCtrlBlock to be processed is in status 'disable'	INT32	Slave Units -	R/-/-

Table 6.55 Parameters for the modulo value of the master and slave position

6.16 Cam signals

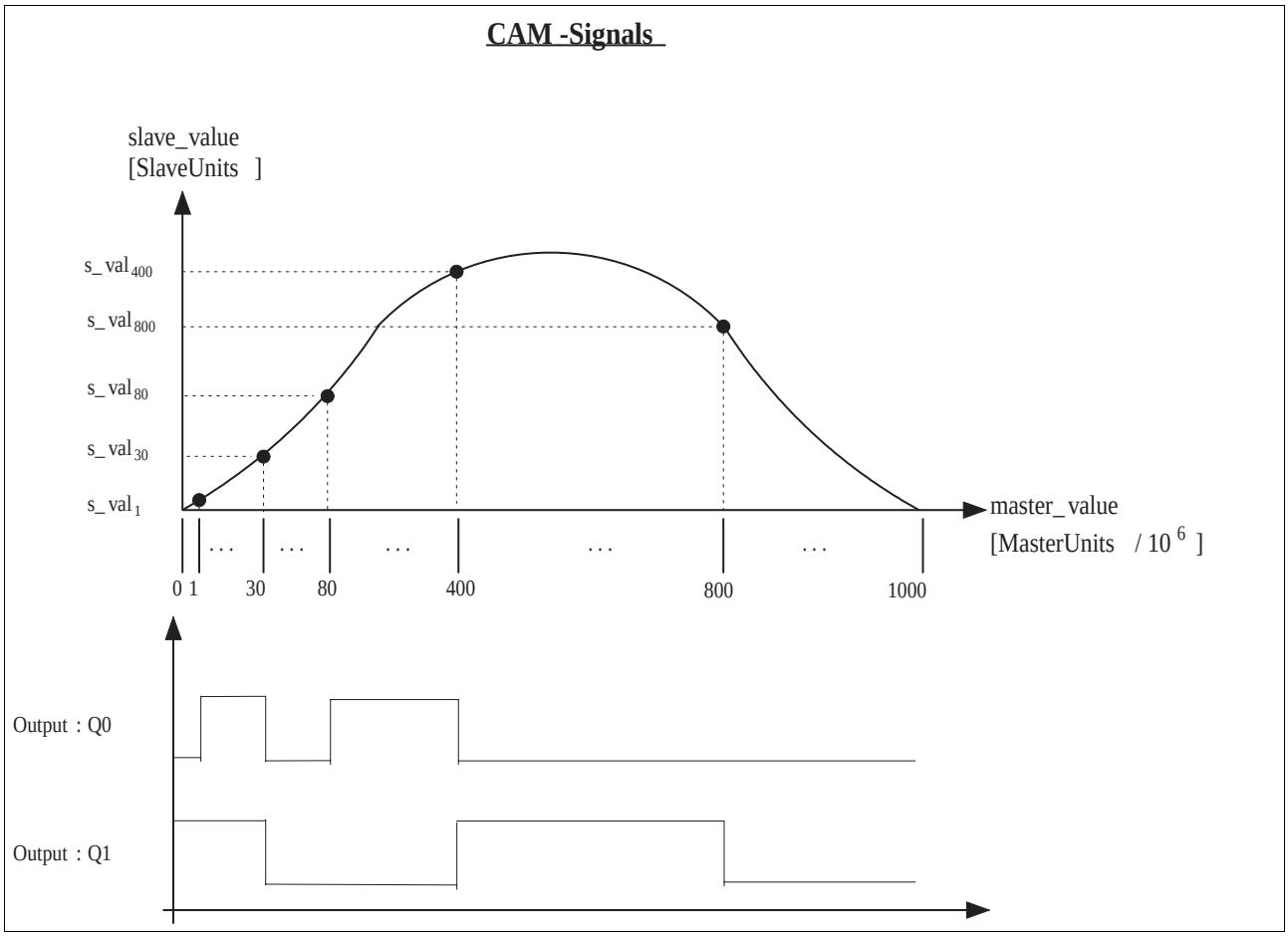

Figure 6.56 Profiling the cam signals

The Q0 and Q1 with 4 configurable turn-on ranges each are available. The turn-on ranges are given in MasterUnits.

The master value range within which the associated output should be enabled is defined in the parameter range `CamSigs`. Activating a cam control block imports the current signal settings and uses them for the profiling.

Activating outputs

`Parameter CamSigs.EnCamSigs, 55:1` can be used to enable the outputs for the cam processing. The enabled outputs are then no longer available for direct write accesses to the output word 0 (I/O.QW0).

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamSigs.EnCamSigs	55:1 (37:01$_h$)	Activation of cam signals at output word 0 Bit0: Q_0 Bit1: Q_1 Assignment: 0: cam signal output not enabled 1: cam signal output enabled Cam signal is output as long as input, output or normal curve is being processed. The cam signal has priority over a signal setting that was made by directly writing to the outputs (I/O.QW0). Forcing the output signal always has priority over the cam signal.	UINT16 0..3	- 0	R/W/ per.

Table 6.57 Parameters for activating the cam signal outputs

Forcing to one of the enabled outputs has higher priority than the cam signal.

The cam signals are output in the DO_COUPLE_CURVE, DO_NORMAL_CURVE and DO_UNCOUPLE_CURVE states.

Otherwise the setting is output in the output word 0 (I/O.QW0).

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamSigs.Out0_MsA1	55:3 (37:03$_h$)	Q0.0: turn-on range_A -> master value_1 A turn-on range is defined by the master value_1 and master value_2 setting. This turn-on range is inactive with the setting master value_1 EQ master value_2. If master value_x GT is max. master value, then master value_x is limited to the max. master value. If master value_1 GT is master value_2, then the signal is still activated between the two master values. The settings of the turn-on ranges are imported for internal profiling by activating the CamCtrlBlock (CamCtrlx.EnCtrl).	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsA2	55:4 (37:04$_h$)	Q0.0: turn-on range_A -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.

Table 6.58 Parameters for the turn-on ranges of the cam signal outputs, extract

The other setting for turn-on ranges for Q.0.0 and Q.0.1 are in chapter 9.2.5 “Parameter groupCamSigs“.

6.17 Additional settings and processes

6.17.1 Filtering encoder speed

A smoothened encoder speed can be generated with a PT1 element with a configurable time constant. The input speed of the filter is derived from the changes of the encoder position per sample cycle.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
M1.filterval	21:40 (15:28$_h$)	Filter value for calculating M1 encoder speed (0: Off) 0: not active >0: active, value corresponds to Tn [ms] (corresponds to the time constant of the PT1 link) resolution: +/- 31 Inc./s In CAM mode the filter must not be disabled!!!	UINT16 0..32767	ms 10	R/W/ per.
Status.v_refM1	31:43 (1F:2B$_h$)	Speed Input quantity at module on M1 The speed is smoothed by a filter; the filter can be configured with M1.filterval	INT32	Inc/s -	R/-/-

Table 6.59 Parameters for filtering the encoder speed

The filter must not be disabled in operating mode 'cam'

.

6.17.2 Optimising drive control (TLC63x only)

The drive controller must be optimised to ensure that the motor follows the curve exactly. The settings for speed and acceleration pilot control are available for this.

Depending on the application the movement behaviour can be improved even more by varying the controller parameters from the controller optimisation.

Velocity feed forward on position control

The velocity feed forward reduces the speed-dependent following distance. The settings are made with the parameters `CtrlBlock1.KFPp, 18:18` or `CtrlBlock2.KFPp, 19:18`.

The relevant parameter description can be found in the "Parameters"chapter of the unit documentation.

Acceleration feed forward on speed control

The acceleration feed forward compensates for the acceleration-dependent following distance and the acceleration-dependent speed difference. The setting can be made separately in the two controller parameter blocks via the factors `CtrlBlock1/2.KFAp2`.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CtrlBlock1.KFAp2	18:25 (12:19$_h$)	Acceleration feed forward on speed control	UINT16 0..32767	As*min/ rev 0	R/W/ per.

Table 6.60 Parameter group controller parameter CtrlBlock1

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CtrlBlock2.KFAp2	19:25 (13:19$_h$)	Acceleration feed forward on speed control	UINT16 0..32767	As*min/ rev 0	R/W/ per.

Table 6.61 Parameter group controller parameter CtrlBlock2

6.17.3 Optimising gear controller (TLC61x only)

The following parameters with the parameter group Gear (electronic gear operating mode) can be used for the motor movement to set the permissible maximum speed, the maximum values for acceleration and deceleration and the speed filter: parameter for:

`Gear.n_maxGear, 38:5`	Maximum speed
`Gear.a_maxGear, 38:6`	Maximum value for acceleration/deceleration
`Gear.Flt_nGear, 38.9 = 0`	Disabling filter processing

The relevant parameter description can be found in the "Parameters" chapter of the unit documentation.

If the speed or acceleration resulting from the cam profiling exceeds the configured maximum values, they will be limited to the configured maximum values.

7 Examples

7.1 Example of a cam profile description file

```
//C_NUM=1<CR>
//P_NAME=NormalDemo1<CR>
//C_VERSION=1.01<CR>
//COMMENT FILENAME=NormalDemo.cam<CR>
//C_DATE=20.02.02<CR>
//C_TIME=15:48:14<CR>
//COMMENT=Nolte NC-Kurventechnik GmbH<CR>
//COMMENT=OPTIMUS MOTUS (R) Software<CR>
//C_CYCLE_TIME=200.000000 ms<CR>
//C_NAME=normalcurve<CR>
//COMMENT C_TYPE=s<CR>
//COMMENT C_UNIT=mm<CR>
//COMMENT=<CR>
//COMMENT D_GEARRATIO=1.000000000000<CR>
//D_JRED=0.001000 kg*m2<CR>
//D_MCONST=0.000000 Nm<CR>
//D_NMAX=3000.000000 U/min<CR>
//D_MMAX=20.000000 Nm<CR>
//D_MEFFMAX=5.000000 Nm<CR>
//C_M_VAL_MAX=360000000<CR>
//C_M_VAL_EXPO=6<CR>
//C_S_VAL_EXPO=6<CR>
//C_M_COUPLE_ME=0<CR>
//C_M_COUPLE_MS=0<CR>
//C_M_COUPLE_MA=0<CR>
//C_COUNT=1024<CR>

0<CR>

10<CR>...
999999<CR>
1000000<CR>
```

7.2 Example of process sequence

Description

The following movement path must be used as a normal curve in the controller.

The cam profile description file of this sample curve can be found on the CD in: \CAM\CrvData\Closed\CrvClosedNormal.cam

For illustrations and descriptions of the TLCT operating dialogues see chapter 5.4 „TLCT Commissioning Software“.

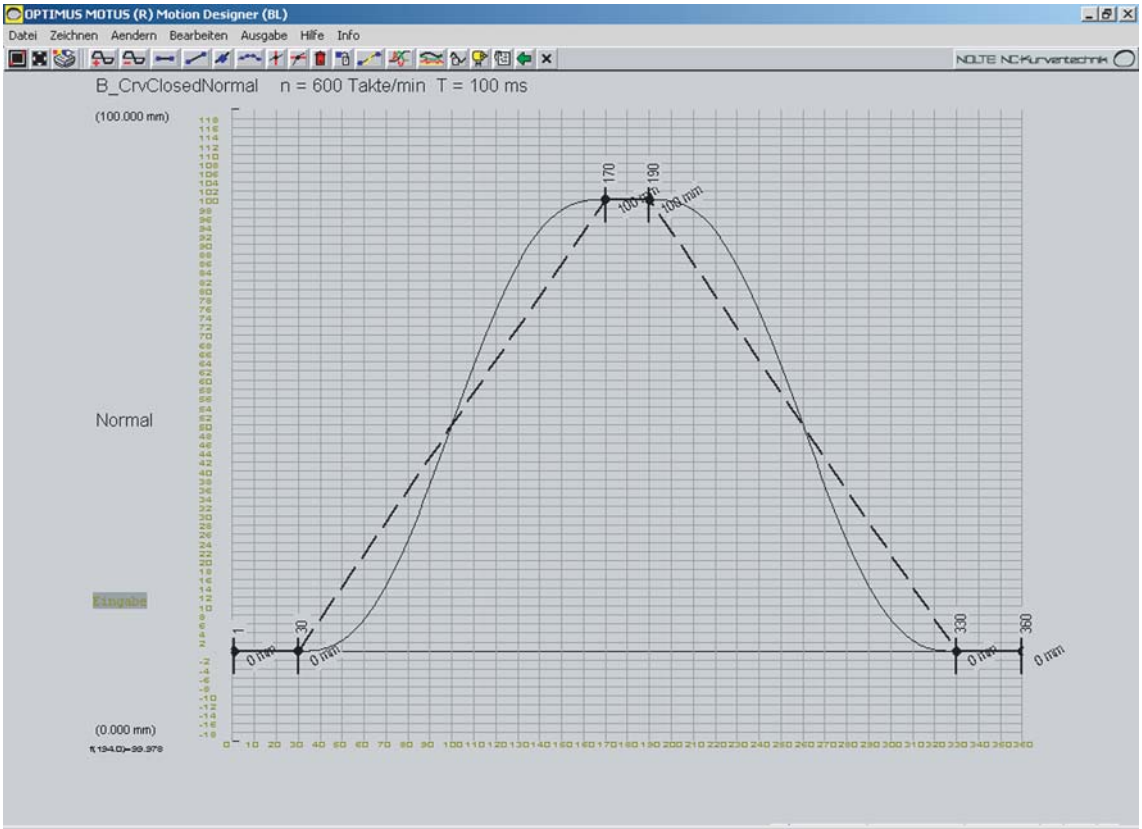

Figure 7.1 CAM editor - view of the sample curve

Assumptions

The example uses the following assumptions and conditions:

- The curve must be saved safe from power failure.
- A change of the master position by 4000 increments corresponds to the master cycle of 360°.

  Master cycle length:

  `CamCtrl1.MaTkNum` = 4000 and

  `CamCtrl1.MsTkDenom` = 1

- A change of the slave position by 100 mm corresponds to one motor revolution.

  In a servo motor with SinCos one revolution corresponds to 16384 increments.

  Slave cycle length:

`CamCtrl1.SlTkNum` = 16384 and

`CamCtrl1.SlTkDenom` = 1

- The slave position is referenced by a reference movement to LIMN.
- Cam referencing is done by direct setting of the current master position = 0.
- The couple request must be made over the COUPLE input.
- The normal curve is configured and profiled with CamCtrl1.
- The curve must be processed three times.
- The end of the curve processing is controlled with `Status.driveStat` or with `CamGlobal.stateCam` (Bit14=1).

Profiling sequence

- TLCT: Positioning dialogue

  Activating the power amplifier

- TLCT: Positioning dialogue reference

  Running reference movement to LIMN

- TLCT: Curve selection dialogue

  Selection of the sample curve in the specified CD directory.

  Transfer curve to controller Save curve in controller to prevent loss by power failure.

- TLCT: Parameter setting dialogue

  Setting the cam profiling parameters:

  CamGlobal.ChoiceCtr = 1 (CamCtrl1)
  CamGlobal.MsRefClr = 0 (inactive)
  CamGlobal.EnCpleInp = 1 (COUPLE input assigned)

  CamCtrl1.CplCrvNo = 0
  CamCtrl1.StdCrvNo = 1
  CamCtrl1.StdCrvCnt = 3
  CamCtrl1.StdSeqNo = 13 (Uncouple1)
  CamCtrl1.UcplCrvNo = 0
  CamCtrl1.IdleCycle = -1
  CamCtrl1.IdleSeqNo = 0 (DO_CAM_DISABLE)
  CamCtrl1.MsTkNum = 4000
  CamCtrl1.MsTkDenom = 1
  CamCtrl1.SlTkNum = 16384
  CamCtrl1.SlTkDenom = 1
  CamCtrl1.SlMdMode = 0 (last slave value in normal curve)
  CamCtrl1.MsRefPos = 0

- TLCT: cam positioning dialogue

  Activation of CamCtrlBlock1 with "on" button under "EnCtrl1"

  Processing status: switches from "inactive" to "ready"

- TLCT: cam positioning dialogue

  Activation of CAM operating mode with "Enable" button

  Processing status: switches from "ready" to "work"

- TLCT: cam positioning dialogue

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Cam referencing: selection of "CamRef: direct"

Activation with "go" button

- TLCT: cam positioning dialogue

  Activation of cam profiling with "Enable" button

- Connecting 24V to COUPLE input.
- Changing the command variable at M1 in a positive direction runs a slave movement corresponding to the preset curve.
- TLCT: cam positioning dialogue

  Processing states and values can be observed with read values.

8 Diagnostics and troubleshooting

This manual only contains the error messages for operating mode 'cam'. See the TLC61x or TLC63x manuals for all other error messages and diagnostic instructions.

Evaluation of errors

If an error is detected during interpretation of the cam profile description file, the status query returns an error message. A warning is also entered into the error memory. The position of the error (line number) is saved as a qualifier for additional information. If a CamCtrlBlock with an error is activated, a warning is also entered into the error memory.

8.1 Error numbers from E1500 to E1CFF

Error number	Error class	Meaning
E1500	1	SAM: error of class 1 forced
E1501	2	SAM: error of class 2 forced
E1502	3	SAM: error of class 3 forced
E1503	4	SAM: error of class 4 forced
E1504	3	SAM: error during safe standstill: insufficient braking ramp (Quick-Stop)
E1505	1	SAM: safe mode stop violated
E1506	1	SAM: safe reduced setup speed exceeded
E1507	1	SAM: safe limited continuous jogging exceeded
E1508	1	SAM: safe limited absolute position exceeded
E1509	1	SAM: end positions exceeded
E150A	2	SAM: EMERGENCY STOP triggered
E150B	0	SAM: not ready for Fault Reset
E150C	0	SAM: not ready for SAM disable
E150D	3	SAM: safe service stop after error violated
E150E	0	SAM: parameters cannot be read
E150F	0	SAM: parameters cannot be written in this status
E1510	0	SAM: incorrect password
E1511	0	SAM: timeout during parameter download (default values loaded)
E1512	0	SAM: parameter not present
E1513	0	SAM: parameter checksum cannot be written in this status
E1514	0	SAM: parameter checksum incorrect (default values loaded)
E1515	0	SAM: Warning: overtemperature
E1516	0	SAM: Warning: Overtemperature
E1517	2	SAM: 24 VDC overvoltage
E1518	2	SAM: 24VDC undervoltage
E1519	2	SAM: short circuit to GND at channel A outputs
E151A	4	SAM: System error: 5V power supply

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Error number	Error class	Meaning
E151B	4	SAM: System error: 5V undervoltage
E151C	2	SAM: overvoltage SAM24VDC (SW)
E151D	2	SAM: SAMSTART: max. allowable pulse duration exceeded
E151E	4	SAM: System error: RAM (cross connection)
E151F	4	SAM: System error: stack overflow
E1520	4	SAM: System error: program sequence control (communication)
E1521	4	SAM: System error: program sequence control (idle task)
E1522	4	SAM: System error: program sequence control (MS task)
E1523	2	SAM: output cross connection
E1524	2	SAM: System error: Input
E1525	4	SAM: System error: PROM checksum error
E1526	0	SAM: parameter out of range
E1527	2	SAM: parameter block checksum error
E1528	2	SAM: System error: SPI Framing Error
E1529	2	SAM: unequal input states
E152A	2	SAM: short circuit at output (unequal states)
E152B	3	SAM: error in position detection (unequal values)
E152C	3	SAM: error in speed detection (unequal values)
E152D	2	SAM: error in IO current measurement
E152E	2	SAM: System error: error in SAM24VDC measuring (unequal values)
E152F	2	SAM: System error: power amplifier enable/SAM jumper
E1530	4	SAM: System error: SAM24VDC overvoltage shut-off
E1531	2	SAM: System error: SPI short circuit
E1532	2	SAM: System error: UART short circuit
E1533	0	SAM: EEPROM checksum incorrect (default values loaded)
E1534	0	SAM: SAM module replaced (default values loaded)
E1535	4	SAM: System error: position capture (commutation position)
E1536	4	SAM: unequal parameter checksum
E1537	0	SAM: SAM boot program: illegal address
E1538	1	SAM: safe reduced automatic speed exceeded
E1539	2	SAM: SAMSTART input low instead of high (Auto Start)
E153A	2	SAM: SAMSTART input high instead of low (Safe Start)
E153B	2	SAM: safety door acknowledgement: max. allowable pulse duration exceeded
E153C	4	SAM: System error: unequal status of SAM status machines
E153D	0	SAM: FAULT RESET not possible (error cannot be acknowledged)
E153E	2	SAM: incorrect voltage at inputs
E153F	2	SAM: output AUX_OUT_A (cross connection to other output)
E1540	2	SAM: output INTERLOCK_OUT (cross connection to other output)
E1541	2	SAM: output RELAY_A (cross connection to other output)
E1542	2	SAM: output SAFETY24V_A (cross connection to other output)

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Error number	Error class	Meaning
E1543	2	SAM: output AUX_OUT_A (cross connection to 24V)
E1544	2	SAM: output INTERLOCK_OUT (cross connection to 24V)
E1545	2	SAM: output RELAY_A (cross connection to 24V)
E1546	2	SAM: output SAFETY24V_A (cross connection to 24V)
E1547	2	SAM: System error: channel A output driver defective
E1548	2	SAM: System error: input ESTOP_A
E1549	2	SAM: System error: input GUARD1_A
E154A	2	SAM: System error: input SETUPENABLE_A
E154B	2	SAM: System error: input SETUPMODE_A
E154C	2	SAM: System error: input SAFETY_REF_A
E154D	2	SAM: System error: input GUARD2_A
E154E	2	SAM: System error: input INTERLOCK_IN_A
E154F	2	SAM: System error: input GUARD1CONF_A
E1550	2	SAM: short circuit at channel B outputs to GND
E1551	4	SAM: System error: UART overrun/framing error
E1552	2	SAM: ResEnc (encoder) is configured with 0
E1553	2	SAM: System error: CPU synchronisation
E1554	2	SAM: no moor motion since 36h
E1555	2	SAM: System error: timeout high-priority tests (5 sec)
E1556	2	SAM: System error: timeout low-priority tests
E1557	2	SAM: dec_Qstop (minimum deceleration) is configured with 0
E1558	2	SAM: output AUX_OUT_B (cross connection to other output)
E1559	2	SAM: output INTERLOCK_OUT (cross connection to other output)
E155A	2	SAM: output RELAY_B (cross connection to other output)
E155B	2	SAM: output SAFETY24V_B (cross connection to other output)
E155C	2	SAM: output AUX_OUT_B (cross connection to 24V)
E155D	2	SAM: output INTERLOCK_OUT (cross connection to 24V)
E155E	2	SAM: output Relay_B (cross connection to 24V)
E155F	2	SAM: output SAFETY24V_B (cross connection to 24V)
E1560	2	SAM: System error: channel B output driver defective
E1561	2	SAM: System error: input ESTOP_B
E1562	2	SAM: System error: input GUARD1_B
E1563	2	SAM: System error: input SETUPENABLE_B
E1564	2	SAM: System error: input SETUPMODE_B
E1565	2	SAM: System error: input SAFEFUNCIN_B
E1566	2	SAM: System error: input GUARD2_B
E1567	2	SAM: System error: input INTERLOCK_IN_B
E1568	2	SAM: System error: input GUARD1CONF_B
E1569	2	SAM: System error: SAM24VGND sense interrupted
E156A	4	SAM: System error: Temperature sensor

Error number	Error class	Meaning
E156B	2	SAM: 24VDC - SAM24VDC difference too great
E156C	2	SAM: SAM24VDC overvoltage (HW)
E156D	4	SAM: temperature shutoff (HW)
E156E	4	SAM: System error: inequality in SamOpMode
E156F	2	SAM: System error: AD converter
E1570	4	SAM: unequal software versions
E1571	3	SAM: safe mode stop violated in case of error
E1572	4	SAM: System error: software not compatible to hardware
E1573	1	SAM: error during safe deceleration: insufficient braking ramp (PLC)
E1574	2	SAM: safe service stop repeatedly violated in sequence
E1575	4	SAM: error accumulation during safe standstill: insufficient braking ramp (Quick-Stop)
E1576	3	SAM: INTERLOCK_IN is not high (time out when t_Relay=2)
E1577	2	SAM: input INTERLOCK_IN high although configured to ignore
E1578	2	SAM: setup speed (n_maxRed) is greater than automatic speed (n_maxAuto)
E1579	4	SAM: System error: unknown status of SAM status machine
E157A	2	SAM: SAM24VDC undervoltage
E157B	4	SAM: System error: ENABLE_ALL 5VGate shutoff
E157C	4	SAM: System error: ENABLE_ALL temp shutoff
E157D	4	SAM: System error: asynchronous communication (UART/SPI)
E157E	4	SAM: System error: RAM (Bit)
E157F	2	SAM: SAM24VGND not connected
E1800	0	Subindex not available (no function linked)
E1801	0	write access not allowed because of access level
E1802	0	Incorrect password for commissioning or service
E1803	0	Illegal interface initialisation parameter
E1804	4	Memory for receive/sent buffer not assigned
E1805	2	Interface not initialised (com_init aufr.)
E1806	0	precondition not met
E1807	0	Error in selection parameter
E1808	2	send buffer too small
E1809	2	send string not converted
E180A	2	receive buffer too small
E180B	0	Serial interface: overrun error
E180C	0	Serial interface: framing error
E180D	0	Serial interface: parity error
E180E	0	Serial interface: receive error
E180F	0	Serial interface: protocol error
E1810	0	Serial interface: transmission error
E1811	0	access allowed only with active axis mode
E1812	4	access to non-configured object (this=NIL)

Error number	Error class	Meaning
E1813	0	DSP clock missed once
E1814	4	DSP clock total failure
E1815	0	trace object invalid
E1816	1	resource or function not ready
E1817	0	parameter value incorrect
E1818	0	Not calculable value
E1819	0	Function only allowed at standstill
E181A	0	Position overrun present/occurred
E181B	0	Error during processing manual movement ->Qualifier
E181C	0	Actual position is not yet defined
E181D	0	External source is active
E181E	0	drive is interrupted or blocked
E181F	0	Error while processing reference movement ->Qualifier
E1820	1	error in processing position list
E1821	0	Function not available with this unit type
E1822	0	Reference movement is active
E1823	0	CanMaster: invalid object number
E1824	0	CanMaster: invalid object ID
E1825	0	Processing not allowed in current axis mode
E1826	0	Error in connection with software limit switch
E1827	0	Recording position of hardware limit switch not defined
E1828	0	limit switch not enabled
E1829	0	Reference movement error with /LIMP
E182A	0	Reference movement error with /LIMN
E182B	0	CanMaster: invalid object attribute
E182C	0	CanMaster: DefineObject reports error
E182D	0	CanMaster: initialisation reports error
E1832	4	HWU_install PSOS error
E1833	4	Sys. error no space for work data
E1834	0	field bus module: FIFO debug message
E1835	4	field bus module: FIFO timeout
E1836	4	field bus module: error during boot procedure
E1837	4	field bus module: error during initialisation
E1838	4	field bus module: incorrect communication parameter
E1839	4	field bus module: indicates error
E183A	4	field bus module: does not indicate
E183B	4	field bus module: unknown FIFO object received
E183C	4	field bus module: state machine indicates error
E183D	4	Service request write object to DSP with error
E183E	4	service request read object to DSP with error

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Error number	Error class	Meaning
E1840	4	Data interfaces do not match (size)
E1841	0	change to new user mode still active
E1842	4	Overrun with path calculation for ramp description
E1843	0	Interruption/QuickStopActive by LIMP
E1844	0	Interruption or QuickStop Active by LIMN
E1845	0	Interruption or QuickStop Active by REF
E1846	0	Interruption or QuickStop Active by STOP
E1847	0	Ext. monitoring signal LIMP with neg. direction of rotation
E1848	0	Ext. monitoring signal LIMN with pos. direction of rotation
E1849	0	internal position range exceeded
E184A	4	DSP bootstrap loader timeout
E184B	4	DSP indicates wrong program version
E184C	3	EEPROM contains corrupt data
E184D	4	internal overflow
E184E	0	Axis access by other interface locked
E184F	0	reference movement error by HWSTOP
E1850	0	reference movement error at/by REF
E1851	3	error during gear calculation
E1852	3	DSP timeout
E1853	3	Illegal value change in gear calculation
E1854	0	Command not allowed during processing (xxxx_end=0)
E1855	2	Initialisation error with parameter IxSix ->Qualifier
E1856	0	access only possible with PowerDisabled
E1857	0	access possible only with PowerEnabled
E1858	0	Quick-stop active status activated
E1859	0	FaultReaction status or fault active
E185A	0	processing only possible in gear mode
E185B	0	input AUTOM or automatic processing active
E185C	0	input AUTOM inactive or manual processing active
E185D	0	login still unsuccessful
E185E	0	PSOS task not found
E185F	0	Setpoint position generation interrupted
E1860	0	interruption or QuickStopActive by SWLIM
E1861	0	interruption or QuickStop Active by SWSTOP
E1862	0	interruption or QuickStopActive by internal SWSTOP
E1863	0	access only possible in OperationEnable status
E1864	0	reference encoder module not available
E1865	0	more then one HWLIM/REF signal active
E1866	0	call with direction bits=0 before new manual movement required
E1867	0	List control: finishing number set lower than starting number

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Error number	Error class	Meaning
E1868	0	List control: position values not in sequential ascending or descending order
E1869	0	List control: current position is behind position of last selected list entry
E186A	0	List control: signal list is active
E186B	0	Current list control disabled because of change of user operating mode
E186C	2	Timeout while waiting until the drive is in the standstill window
E186D	1	Error while switching the user operating mode -> Qualifier
E186E	4	Device type was not defined
E186F	1	Processing in current operating status of status machine not possible
E1870	0	External memory module not present
E1871	1	illegal set number
E1872	0	External Memory FRAM error
E1873	0	internal position adaptation to 0 because of range overrun
E1874	0	External Memory FLASH error
E1875	0	external memory RAM error
E1876	1	unable to process synchronous start signal
E1877	0	reference switch /REF not found between /LIMP and /LIMN
E1878	0	Reference movement to /REF with reversal of rotation direction, illegal limit switch /LIM enabled
E1879	0	Reference movement to /REF without reversal of rotation direction, tripping of /LIM or /REF not allowed
E187A	0	processing not possible: invalid or missing actual position encoder
E187B	0	processing not possible during reference movement to index pulse
E187C	0	processing not possible: fast position detection is active
E187D	1	index pulse not found
E187E	1	Reproducibility of index pulse motion insecure, index pulse too close to switch
E187F	0	Access through this operator channel not permitted
E1880	0	CANopen object directory overrun
E1881	0	Processing not possible because of invalid or missing setpoint position encoder at M1
E1882	0	Movement interrupted by StopMotion
E1A00	0	RAM too small for internal curve table
E1A01	0	Interpreter error: no data for interpretation
E1A02	0	Interpreter error: no C_NUM token in first line
E1A03	0	Interpreter error: invalid token
E1A04	0	Interpreter error: header // not found
E1A05	0	Interpreter error: invalid value
E1A06	0	Interpreter error: no C_COUNT token in last header line
E1A07	0	Interpreter error: no slave value entered
E1A08	0	Interpreter error: not enough slave values
E1A09	0	Interpreter error: mandatory entries in header incomplete
E1A0A	0	Interpreter error: invalid value of C_COUNT parameter
E1A0B	0	Imprecision during calculation of slave modulo value at curve no. ->Qualifier

Error number	Error class	Meaning
E1A0C	0	Curve already present
E1A0D	0	Illegal curve number
E1A0E	0	Curve not present
E1A0F	0	ME less than 0 or greater than max. master value
E1A10	0	MS less than 0 or greater than max. master value
E1A11	0	MA less than 0 or greater than max. master value
E1A12	0	Error during conversion of user-defined curve to internal curve in line ->Qualifier
E1A13	0	ME greater than MS
E1A14	0	No download file with curve data
E1A15	0	Activation of CamCtrlBlock: configured curve is not available
E1A16	0	Activation of CamCtrlBlock: C_M_VAL_EXPO or C_S_VAL_EXPO not identical in curve headers
E1A17	0	Activation of CamCtrlBlock: C_COUNT not identical in curve headers
E1A18	0	Activation of CamCtrlBlock: C_M_VAL_MAX not identical in curve headers
E1A19	0	Illegal master values on setting master or slave position compensation range (Ctrlx.Corr-Start or Ctrlx.CorrEnd)
E1A1A	0	Illegal master values for master mark recording range (Ctrlx.MsMarkSta or Ctrlx.MsMar-kEnd)
E1A1B	0	Illegal master values for slave mark recording range (Ctrlx.SlMarkSta or Ctrlx.SlMarkEnd)
E1A1C	0	Curve number in file more than once
E1A1D	0	Curve interpreter already active
E1A1E	0	Error in C_CYCLE_TIME header entry: invalid value
E1A1F	0	Invalid master simulation mode
E1A20	0	Activation of CamCtrlBlock: additional call during profiling
E1A21	0	Processing not allowed if CamCtrlBlock is in status 'work'
E1A22	0	Used CamCtrlBlock not in status 'ready'
E1A23	0	Illegal number of curve points for internal curve data
E1A24	0	Illegal setting of master cycle length (Ctrlx.MsTkNum or Ctrlx.MsTkDenom)
E1A25	0	Illegal setting of slave cycle length (Ctrlx.SlTkNum or Ctrlx.SlTkDenom)
E1A26	0	Illegal setting of slave cycle modulo length (incl. Ctrlx.SlMdNum or Ctrlx.SlMdDenom)
E1A27	0	Illegal setting of master reference
E1A28	0	Illegal setting of slave reference
E1A29	0	Write access only allowed in status 'WAIT_FOR_REFERENCE'
E1A2A	0	Function allowed only at master simulation standstill
E1A2B	0	Internal position adaptation of master simulation to 0 because range exceeded
E1A2C	0	Actual position of master simulation not yet defined
E1A2D	0	Illegal setting for referencing at master cycle signal (Capture.TrigSign or Capture.TrigType)
E1A2E	0	Profiling not possible during referencing or fast position capture of cam profile
E1A2F	1	Illegal change of master position
E1A30	1	Illegal change of slave position
E1A31	0	Profiling mode for master position compensation not set (CamGlobal.MsCorrMod)

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Error number	Error class	Meaning
E1A32	0	Profiling mode for slave position compensation not set (CamGlobal.SlCorrMod)
E1A33	0	Activation of CamCtrlBlock: max. slave value in couple/uncouple curve greater than in normal curve
E1A34	0	Curve data incompatible to current operating system
E1A35	1	New CamCtrlBlock during conversion not in status 'ready'
E1A36	0	CAM_LAST_ERROR
E1C00	0	Flash not in status IDLE
E1C01	0	The CFlash class is not initialised
E1C02	0	Flash: invalid segment number
E1C03	0	Flash: file name too long
E1C04	0	Flash: Checksum error in the boot configuration
E1C05	0	Flash: error during deletion
E1C06	0	Flash: command cannot be executed in current operating mode
E1C07	0	Flash: error during write
E1C08	0	Flash: Invalid handle
E1C09	0	Flash: not enough free memory. Delete files with browser command 'filedelete'!
E1C0A	0	Flash: invalid segment content
E1C0B	0	No external memory module
E1C0C	0	Firmware and application program incompatible
E1C0D	0	Flash: no valid user-defined data
E1C0E	0	Flash: no data
E1C0F	0	Flash: file not present
E1C10	0	Memory management: invalid memory region
E1C11	0	Memory management: Address out of valid memory range
E1C12	0	Memory management: Out of range
E1C13	0	Memory management: Invalid initialisation
E1C20	0	Insufficient memory space for user-defined data
E1C21	0	Invalid memory address from application
E1C30	0	Axis busy
E1C31	0	Stop axis when reaching a breakpoint
E1C32	0	Error in current hardware configuration
E1C33	0	CAN module not present
E1C34	0	Lower limit Array undershoot
E1C35	0	Upper limit Array exceeded
E1C36	0	PSOS error message
E1C37	0	Invalid retaining range
E1C38	0	Application: division by zero
E1C39	0	Cycle time exceeded in application
E1C3A	0	Insufficient marker range
E1C3B	0	Invalid function call

Error number	Error class	Meaning
E1C40	0	Axis not in valid operating mode
E1C41	0	Incorrect axis operating mode
E1C42	0	User-defined data backup active
E1C43	0	Input parameter outside value range
E1C44	0	Parameter not allowed with local axis
E1C50	0	The following must be set in the TLCT: parameter >M4->profilCan = CAN bus
E1C51	0	CAN SDO buffer overflow
E1C52	0	CAN invalid node ID
E1C53	0	CAN invalid object
E1C54	0	Error of an external CAN node
E1C55	0	CAN object not initialised
E1C56	0	Maximum number of CAN objects reached
E1C57	0	CAN invalid PDO number
E1C58	0	CAN PDO variable > 4 function code was not transferred
E1C59	0	CAN synchronous time window > SYNC period
E1C5A	0	CAN unknown NMT service
E1C5B	0	CAN action in current NMT status not allowed
E1C5C	0	CAN Heartbeat time monitoring exceeded
E1C5D	0	CAN Exceeded the number of Heartbeat consumers
E1C5E	0	Command is not permitted in the current CAN state
E1C5F	0	Timeout SDO response
E1C60	0	No event task initialised
E1C71	0	Invalid hardware configuration
E1C72	0	Invalid module in hardware configuration
E1C73	0	Invalid parameter in hardware configuration
E1C74	0	Invalid data type in hardware configuration
E1C75	0	Invalid data length in hardware configuration

9 Parameters

9.1 Parameter display

The following indications are described as follows:

Group.Name Parameter name consisting of the name of the parameter group (="Group") and the name of the specific parameter (="Name").

Idx Index value of a parameter

Six Subindex value of a parameter

Explanation and unit [] Detailed explanation of the parameter and its unit.

Value range In the case of parameters without values the applicable value range depends on the data type.

Data type	Byte	Min value	Max value
INT16	2 Byte / 16 Bit	-32768	32767
UINT16	2 Byte / 16 Bit	0	65535
INT32	4 Byte / 32 Bit	-2.147.483.648	2.147.483.647
UINT32	4 Byte / 32 Bit	0	4.294.967.295

Default values Preset values for the parameters before initial commissioning, factory settings.

R/W Note on reading and writing the values
"R/-" values are read-only
"R/W" values are read and write.

per. Information on whether the value of the parameter is non-volatile, i.e. is retained in memory after switching the unit off. The user must back up the data in the non-volatile memory before switching off the device to ensure that the value is saved in non-volatile memory.

Access channel It is only used for information affecting the relevant access channel.

Access channel	Specifications
CoDeSys, field bus	Idx: Sidx
TL CT	Group/name, e.g. "CamCtrl1.MsTkNum"

9.2 Parameter groups

This manual only contains the parameter descriptions for operating mode 'cam'. The parameter descriptions for the other operating modes and for parameters affecting all operating modes can be found in the TLC61x and TLC63x device manual. They are sorted by groups there.

9.2.1 Parameter group `CamCtrl1` and `CamCtrl2`

The two parameter groups are identical except for the index (Idx). Idx 53 applies for `CamCtrl1`, Idx 54 for `CamCtrl2`.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.EnCtrl	53:1 ($35:01_h$)	Activation of the CamCtrlBlocks Write access: 0: Deactivating block To be able to use the CamCtrlBlock for a cam profile the settings must be enabled. The profiling state can be found with CamCtrlx.StateCtrl.	UINT16 0..1	- 0	R/W/-
CamCtrl1.StateCtrl	53:2 ($35:02_h$)	Status of activation and processing status of the CamCtrlBlock Bit0: Status of activation of the CamCtrlBlock: 0: status change CamCtrlBlock active 1: status change CamCtrlBlock complete Bit8..9: processing status of CamCtrlBlock 0: inactive 1: ready 2: work If an error is found during the interpretation, it is registered in the error memory. In addition, the error number is returned at every read access.	UINT16 0..1	- -	R/-/-
CamCtrl1.CplCrvNo	53:3 ($35:03_h$)	Number of couple curve (0: no couple curve) 0: no curve defined 1 to 99: Number of curve If no couple curve is defined the CAM status machine switches to processing the normal curve.	UINT16 0..99	- 0	R/W/ per.
CamCtrl1.StdCrvNo	53:4 ($35:04_h$)	Number of normal curve 1 to 99: number of curve	UINT16 1..99	- 1	R/W/ per.
CamCtrl1.StdCrvCnt	53:5 ($35:05_h$)	Number of processing cycles of normal curve (0: unlimited number) 0: unlimited number <>0: defined number of cycles Only master cycles completely processed as normal curve are counted, i.e. the cycle is not counted if the status DO_COUPLE_CURVE or DO_UNCOUPLE_CURVE is being processed within the cycle.	INT32 0 ..2147483647	- 0	R/W/ per.
CamCtrl1.StdSeqNo	53:6 ($35:06_h$)	Number of follow step after normal curve permissible setting in CamCtrl1: 13: 1.3 Uncouple CamCtrl1 (default) 22: 2.2 Normal curve CamCtrl2 permissible setting in CamCtrl2: 23: 2.3 Uncouple CamCtrl2 (default) 12: 1.2 Normal curve CamCtrl1	UINT16 12..23	- 13	R/W/ per.
CamCtrl1.UcplCrvNo	53:7 ($35:07_h$)	Number of uncouple curve 0: no curve defined 1 to 99: Number of curve If no uncouple curve is defined the CAM status machine switches to processing the wait cycles.	UINT16 0..99	- 0	R/W/ per.
CamCtrl1.IdleCycle	53:8 ($35:08_h$)	Number of wait cycles (-1: no wait, 0: unlimited) -1 : no wait 0: unlimited 1 to 2147483647: number of master cycles	INT32 -1 ..2147483647	- -1	R/W/ per.
CamCtrl1.IdleSeqNo	53:9 ($35:09_h$)	Follow step and wait cycle processing (FollowStep) settings in CamCtrl1 and CamCtrl2: 0: switch to status DO_CAM_DISABLE 1: Process CamCtrl1 (default in CamCtrl1) 2: Process CamCtrl2 (default in CamCtrl2) 3: GlobalDefined (setting CamGlobal.SelCtrBlk)	UINT16 0..3	- 1	R/W/ per.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.MsMarkSta	53:10 (35:0A$_h$)	Start value of capture range of master mark Start of range of master values within which the capture of the master cycle signal is enabled. If CamCtrlx.MsMarkSta and CamCtrlx.MsMarkEnd = 0, then the entire master cycle is considered the range (range check inactive)	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.MsMarkEnd	53:11 (35:0B$_h$)	End value of capture range of master mark End of range of master values within which the capture of the master cycle signal is enabled.	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.SlMarkSta	53:12 (35:0C$_h$)	Start value of capture range of slave mark Start of range of master values within which the capture of the slave cycle signal is enabled. If CamCtrlx.MsMarkSta and CamCtrlx.MsMarkEnd = 0, then the entire master cycle is considered the range (range check inactive)	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.SlMarkEnd	53:13 (35:0D$_h$)	End value of capture range of slave mark End of range of master values within which the capture of the slave cycle signal is enabled.	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.CorrStart	53:14 (35:0E$_h$)	Start value of compensation range of master or slave position compensation Additional condition: CorrStart < CorrEnd Exception: CorrStart=CorrEnd=0 Start of range of master values within which a specified master or slave position compensation is executed. If CamCtrlx.CorrStart and CamCtrlx.CorrEnd = 0, the compensation is run over the entire master value range.	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.CorrEnd	53:15 (35:0F$_h$)	End value of compensation range of master or slave position compensation see also CamCtrlx.CorrStart End of range of master values within which a specified master or slave position compensation is executed	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamCtrl1.MsTkNum	53:16 (35:10$_h$)	Numerator master cycle length Additional limits: abs(MsTkNum/MsTkDenom) >= 10 Negative values execute the direction inversion function of the master positions The maximum master value of the curve corresponds to the change of the master position (encoder position) by one master cycle length (numerator/denominator) E.g.: master value: 0 ... 360000 Numerator: 40000 Denominator: 1 40000 Master inc. correspond to the master value 360000 or one master cycle.	INT32	Inc 4000	R/W/ per.
CamCtrl1.MsTkDenom	53:17 (35:11$_h$)	Denominator master cycle length For detailed description see CamCtrlx.MsTkNum	INT32 1 ..2147483647	Cycles 1	R/W/ per.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamCtrl1.SlTkNum	53:18 ($35:12_h$)	Numerator slave cycle length Additional limits: SlTkNum/SlTkDenom > 1 The position of the maximum slave value of the curve causes the slave to deviate by one slave cycle length (numerator/denominator) E.g.: Slave value: 0 ... 1000000 Numerator: 16384 Denominator: 1 The motor deviation by 16384 Inc corresponds to the maximum slave curve value of 1000000.	INT32 0..2147483647	Inc 10000	R/W/ per.
CamCtrl1.SlTkDenom	53:19 ($35:13_h$)	Denominator slave cycle length For detailed description see CamCtrlx.SlTkNum	INT32 1 ..2147483647	Cycles 1	R/W/ per.
CamCtrl1.SlMdNum	53:20 ($35:14_h$)	Numerator slave modulo length Setting a special slave modulo length is only effective for processing the normal curve. To ensure that the settings of the slave modulo length are used CamCtrlx.SlMdMode = 1 must be set Example: Slave cycle length: 16384/1, this must correspond to the max. slave value of 1000. If the last curve value is now exactly at 1/3 of the max. value, the slave value must be input as 333,3333.. This value can be assigned as break to the last curve point with the slave modulo length. Setting >16384 * 1 / 3	INT32	Inc 0	R/W/ per.
CamCtrl1.SlMdDenom	53:21 ($35:15_h$)	Denominator slave modulo length For detailed description see CamCtrlx.SlMdNom	INT32 1 ..2147483647	Cycles 1	R/W/ per.
CamCtrl1.SlMdMode	53:22 ($35:16_h$)	Processing mode of the slave modulo length 0: Automatic calculation from curve values. Last slave value, max. slave value and the slave cycle length are used to generate the slave modulo length internally (calculation of the slave position of the last curve point) 1: Special user-defined parameter setting: The setting of the slave modulo length from CamCtrlx.SlTkNum and CamCtrlx.SlTkDenom is used as slave modulo length or slave position of the last curve point	UINT16 0..1	- 0	R/W/ per.
CamCtrl1.SlPosS0	53:23 ($35:17_h$)	Standstill position slave S0 in Inc and slave reference position Slave position of the first curve point of the couple curve in Inc. If there is no couple curve the position of the normal curve is returned. Attention: Value is only available after activation of the CamCtrlBlock. 0 is returned until the time of activation.	INT32 0 ..2147483647	Inc 0	R/-/-
CamCtrl1.MsRefPos	53:24 ($35:18_h$)	Master reference: master position ABS to be set (master reference position) <= ABS(master cycle length) Master value is set directly depending on CamGlobal.MsRefMode or when the master reference signal (CAPTURE1) is received.	INT32	Inc 0	R/W/ per.

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Table 9.1 CamCtrl1/2 parameter group

9.2.2 Parameter group `CamDat`

The specified index 1401 applies to curve number 1. The index of the other curve numbers is calculated by 1400 + curve number. For example, in this way the parameters of curve number 5 are available via index 1405.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamDat.MsMaxVal	1401:10 (579:0A_h)	Maximum master value in the curve Value is imported from the curve header data (C_M_VAL_MAX)	INT32	Master Units -	R/-/-
CamDat.MsPosME	1401:11 (579:0B_h)	Master value couple position Value is imported from the curve header data (C_M_COUPLE_ME)	INT32	Master Units -	R/-/-
CamDat.MsPosMA	1401:12 (579:0C_h)	Master value uncouple position Value is imported from the curve header data (C_M_COUPLE_MA)	INT32	Master Units -	R/-/-
CamDat.MsPosMS	1401:13 (579:0D_h)	Master value synchronous position Value is imported from the curve header data (C_M_COUPLE_MS)	INT32	Master Units -	R/-/-
CamDat.Count	1401:14 (579:0E_h)	Number of equidistant cam intervals Value is imported from the curve header data (C_COUNT) Info: Read value+1=number of slave values (e.g.: 1024 cam sections -> 1025 slave values)	UINT16	- -	R/-/-
CamDat.CycleTime	1401:15 (579:0F_h)	Duration of movement cycle Value is imported from the curve header data (C_CYCLE_TIME)	UINT32	- -	R/-/-
CamDat.SlMaxVal	1401:16 (579:10$_h$)	Maximum slave value in the curve as value Value is calculated from slave values in curve, sign discarded by formation of absolute value	INT32	Slave Units -	R/-/-

Table 9.2 CamDat parameter group

9.2.3 Parameter group `CamDtc`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamDtc.CurvErase	1400:5 (578:05$_h$)	Delete curve (Ram) 0: deletes all curves in Ram 1..99: deletes specified curve	UINT32 0..99	- -	R/W/-

Table 9.3 CamDtc parameter group

9.2.4 Parameter group `CamGlobal`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.startCAM	52:1 (34:01$_h$)	Start CAM operating mode 0: disable 1: activate	UINT16 0..1	- -	R/W/-

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.stateCAM	52:2 ($34:02_h$)	Acknowledgement: CAM operating mode Bit15: cam_err Bit14: cam_end Bit 7: error SW_STOP Bit 6: error SW_LIMN Bit 5: error SW_LIMP Bit3: error REF Bit2: error HW_ STOP Bit1: error LIMN Bit0: error LIMP Coding Bit 13..Bit15 corresponding to the coding in the global status word (Status.driveStat)	UINT16	- -	R/-/-
CamGlobal.AddState	52:6 ($34:06_h$)	Additional status information on status machine Status information : 0: IDLE_CAM_DISABLE 1: WAIT_FOR_REFERENCE 2: WAIT_FOR_COUPLE 3: DO_COUPLE_CURVE 4: DO_NORMAL_CURVE 5: DO_UNCOUPLE_CURVE 6: DO_WAIT_CYCLES 7: DO_CAM_DISABLE	UINT16 0 ..	- 0	R/-/-
CamGlobal.ChoiceCtr	52:7 ($34:07_h$)	Selection of the CAM cam control block (1 or 2) at the start of the CAM operating mode 1: CamCtrl 1 2: CamCtrl 2 cam control block at which CAM operating mode should be started at startup	UINT16 1..2	- 1	R/W/ per.
CamGlobal.MsFactor	52:9 ($34:09_h$)	Conversion factor of decimal places master Value imported from curve header data. C_M_VAL_EXPO.	UINT16 0..10	- 0	R/-/-
CamGlobal.SlvFactor	52:10 ($34:0A_h$)	Conversion factor of decimal places slave Value imported from curve header data. C_S_VAL_EXPO.	UINT16 0..10	- 0	R/-/-
CamGlobal.RefMode	52:12 ($34:0C_h$)	Cam referencing: Processing mode Processing mode: importing the configured master and slave position 1: direct (with this write access) 2: with master cycle signal single mode 3: with master cycle signal multi-mode Setting parameters of the master reference value: CamCtrl1/2.MsRefPos	UINT16 1..3	Inc 1	R/W/-
CamGlobal.MsRefClr	52:15 ($34:0F_h$)	Automatically delete CAM reference 0 : inactive 1 : active Detection whether CAM reference should be automatically deleted when the CAM status machine switches to the WAIT_FOR_REFERENCE status. For example, this is required if a new profiling cycle or controlled couple process must be trigge-red by a new master mark signal.	UINT16 0..1	- 0	R/W/ per.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.MsSource	52:16 ($34:10_h$)	Master position source (module M1, simulation manual/profile) 0: setpoint value via encoder module slot M1 only 1: simulation manual 2: simulation profile The parameter CamGlobal.SimEncMod can be used to set what should be done when the simulation is activated with the incoming encoder pulses	UINT16 0..2	- 0	R/W/-
CamGlobal.velSimu	52:20 ($34:14_h$)	Setpoint speed of master simulation Use for manual and profile simulation Shown in master increments/s	INT32 1..1600000	Inc/s 1000	R/W/-
CamGlobal.accSimu	52:21 ($34:15_h$)	Acceleration of master simulation Use for manual and profile simulation Shown in 1000 master increments/s^2	UINT32 3..2147483647	1000 Inc/s^2 10	R/W/-
CamGlobal.startMan	52:22 ($34:16_h$)	Start master position simulation manual Coding the write data: Bit1: neg. direction of rotation Bit0: pos. direction of rotation Write access with 0 finishes process	UINT16 0..3	- 0	R/W/-
CamGlobal.stateMan	52:23 ($34:17_h$)	Acknowledgement of master position simulation manual Bit15: simul_master_manu_err Bit14: simul_master_manu_end	UINT16	- -	R/-/-
CamGlobal.p_absSimu	52:24 ($34:18_h$)	Start master position simulation profile absolute Write access triggers absolute positioning in master increments	INT32	Inc 0	R/W/-
CamGlobal.stateProf	52:25 ($34:19_h$)	Acknowledgement of master position simulation profile Bit15: simul_master_profil_err Bit14: simul_master_profil_end Bit13: simul_master_profil_target_reached (setpoint reached)	UINT16	- -	R/-/-
CamGlobal.p_relProf	52:26 ($34:1A_h$)	Start simulation of master position profile relative Write access triggers relative positioning in master increments	INT32	Inc 0	R/W/-
CamGlobal.EnCpleInp	52:27 ($34:1B_h$)	Enable input "COUPLE" 0 : Hardware input COUPLE not assigned 1 : COUPLE hardware input assigned	UINT16 0..1	- 0	R/W/ per.
CamGlobal.CoupleReq	52:28 ($34:1C_h$)	Request for coupling (CoupleReq) Write access: (isolation by access channel) 0 : disable CoupleReq 1 : enable CoupleReq Read access: (setting OR status of all CoupleReq) 0: CoupleReq disabled 1: CoupleReq enable During read access the internal couple request is returned. This corresponds to setting the OR status of the CoupleReq over the various access channels incl. COUPLE input (if enabled)	UINT16 0..1	- 0	R/W/-
CamGlobal.MsCorrMod	52:30 ($34:1E_h$)	Master position compensation: processing mode Processing mode of master position compensation: 0: inactive 1 : even distribution, position compensation preset with CamGlobal.MsCorrPos	UINT16 0..1	- 0	R/W/ per.

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.MsCorrPos	52:31 (34:1F$_h$)	Master position compensation: compensation position in master cycle Master position compensation per master cycle: the position is input in master increments	INT32	Inc 0	R/W/-
CamGlobal.SlCorrMod	52:34 (34:22$_h$)	Slave position compensation: processing mode Processing mode of slave position compensation: 0: inactive 1 : even distribution Setting parameters of slave position compensation: CamGlobal.SlCorrPos	UINT16 0..1	- 0	R/W/ per.
CamGlobal.SlCorrPos	52:35 (34:23$_h$)	Slave position compensation: compensation position in master cycle Slave position compensation per master cycle: the position is input in slave increments	INT32	Inc 0	R/W/-
CamGlobal.CaptStart	52:40 (34:28$_h$)	Start recording positions of master and slave cycle signals Bit 0: capture of master cycle signal (channel 1) Bit 1: capture of slave cycle signal (channel 2) Values for Bit 0 and 1: 0 = process inactive or complete 1 = process enabled Info: A write access with Bit0=Bit1=0 can disable the recording for both cycle signals The range of master values within which a capture can be set separately for CamCtrl1 and CamCtrl2. -> CamCtrl1.SlMarkSta and CamCtrl1.SlMarkEnd	UINT16 0..3	- 0	R/W/-
CamGlobal.CaptStat	52:41 (34:29$_h$)	Status recording positions of master and slave cycle signals Bit 0: recording master cycle signal (channel 1) Bit 1: recording slave cycle signal (channel 2) Values for Bit 0 and 1: 0 = recording pos. not available 1 = recording position available	UINT16 0..3	- 0	R/-/-
CamGlobal.CaptMsPos	52:42 (34:2A$_h$)	Master position with master cycle signal as modulo value Output of recorded position of the setpoint position encoder (M1 encoder) with modulo processing via master cycle length. If the cam is inactive, the master cycle length from the CamCtrl1/2 block is used. It is entered in CamGlobal-ChoiceCtr. If the cam is active, the value from the currently profiled CamCtrl1/2 is used as the master cycle length.	INT32	Inc-	R/-/-
CamGlobal.CaptSlPos	52:43 (34:2B$_h$)	Slave position with slave cycle signal as modulo value Slave modulo position at time slave cycle signal received	INT32	Inc-	R/-/-
CamGlobal.SimuSetPo	52:47 (34:2F$_h$)	Master simulation dimension setting setpoint and actual position of the profile generator for the master simulation are set to the default value. This does not change the master modulo position.	INT32	Inc 0	R/W/-

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamGlobal.SelCtrBlk	52:52 ($34:34_h$)	User spec. selection of follow step after wait cycle processing 0: switch to status DO_CAM_DISABLE 1: Process CamCtrl1 2: Process CamCtrl2 Global specification of the CAM process after completion of wait cycle processing (FollowStep). The setting is used if CamCtrl1/2.IdleSeqNo is set to 'GlobalDefined'. When CAM operating mode is enabled, the setting of CamGlobal.ChoiceCtr is imported. I.e. the setting with which the CAM process was started is used after wait cycle processing in the same CtrlBlock. The setting of continuing processing must be made before the transition to the status 'WAIT_FOR_REFERENCE'.	UINT16 0..2	- 0	R/W/-
CamGlobal.SimEncMod	52:53 ($34:35_h$)	Processing mode of encoder position at M1 during master simulation 0: pos. changes at encoder considered 1: pos. changes at encoder always rejected The master simulation is set with the parameter 'CamGlobal.MsSource'	UINT16 0..1	- 0	R/W/ per.

Table 9.4 CamGlobal parameter group

9.2.5 Parameter group `CamSigs`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamSigs.EnCamSigs	55:1 ($37:01_h$)	Activation of cam signals at output word 0 Bit0: Q_0 Bit1: Q_1 Assignment: 0: cam signal output not enabled 1: cam signal output enabled Cam signal is output as long as input, output or normal curve is being processed. The cam signal has priority over a signal setting that was made by directly writing to the outputs (I/O.QW0). Forcing the output signal always has priority over the cam signal.	UINT16 0..3	- 0	R/W/ per.
CamSigs.Out0_MsA1	55:3 ($37:03_h$)	Q0.0: turn-on range_A -> master value_1 A turn-on range is defined by the master value_1 and master value_2 setting. This turn-on range is inactive with the setting master value_1 EQ master value_2. If master value_x GT is max. master value, then master value_x is limited to the max. master value. If master value_1 GT is master value_2, then the signal is still activated between the two master values. The settings of the turn-on ranges are imported for internal profiling by activating the CamCtrlBlock (CamCtrlx.EnCtrl).	INT32 0 ..2147483647	Master Units 0	R/W/ per.

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CamSigs.Out0_MsA2	55:4 (37:04$_h$)	Q0.0: turn-on range_A -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsB1	55:5 (37:05$_h$)	Q0.0: turn-on range_B -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsB2	55:6 (37:06$_h$)	Q0.0: turn-on range_B -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsC1	55:7 (37:07$_h$)	Q0.0: turn-on range_C -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsC2	55:8 (37:08$_h$)	Q0.0: turn-on range_C -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsD1	55:9 (37:09$_h$)	Q0.0: turn-on range_D -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out0_MsD2	55:10 (37:0A$_h$)	Q0.0: turn-on range_D -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsA1	55:13 (37:0D$_h$)	Q0.1: turn-on range_A -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsA2	55:14 (37:0E$_h$)	Q0.1: turn-on range_A -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsB1	55:15 (37:0F$_h$)	Q0.1: turn-on range_B -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsB2	55:16 (37:10$_h$)	Q0.1: turn-on range_B -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsC1	55:17 (37:11$_h$)	Q0.1: turn-on range_C -> master value_1 see CamSigs.Out0_MsA1	INT32 0..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsC2	55:18 (37:12$_h$)	Q0.1: turn-on range_C -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsD1	55:19 (37:13$_h$)	Q0.1: turn-on range_D -> master value_1 see CamSigs.Out0_MsA1	INT32 0 ..2147483647	Master Units 0	R/W/ per.
CamSigs.Out1_MsD2	55:20 (37:14$_h$)	Q0.1: turn-on range_D -> master value_2	INT32 0 ..2147483647	Master Units 0	R/W/ per.

Table 9.5 CamSigs parameter group

9.2.6 Parameter group `Capture`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Capture.TrigSign	20:13 (14:0D$_h$)	Selection of trigger signals for position save Bits 0,1: Channel 1: setting trigger source Bits 2,3: Channel 2: setting trigger source Coding selection trigger source: value=0: Cap1 -> input CAPTURE1 value=1: Cap2 -> input CAPTURE2 value=2: Mod1 -> index pulse setpoint position encoder (M1) only with stepper motor units (TLCx1x): value=3: Mod2 -> index pulse actual position encoder (M2) Default Bit0..3: 4 (Bit0,1=0:CAPTURE1 and Bit2,3=1:CAPTURE2) list of all possible values: value channel1 channel2 0 Cap1 Cap1 1 Cap2 Cap1 2 Mod1 Cap1 3 Mod2 Cap1 4 Cap1 Cap2 5 Cap2 Cap2 6 Mod1 Cap2 7 Mod2 Cap2 8 Cap1 Mod1 9 Cap2 Mod1 10 Mod1 Mod1 11 Mod2 Mod1 12 Cap1 Mod2 13 Cap2 Mod2 14 Mod1 Mod2 15 Mod2 Mod2	UINT16 0..15	- 4	R/W/-
Capture.TrigType	20:14 (14:0E$_h$)	Position source for save 0: actual position encoder 1: setpoint position encoder	UINT16 0..1	- 1	R/W/-
Capture.TrigLevl	20:15 (14:0F$_h$)	Signal level for trigger channels Bit 0: Channel 1: setting the trigger level Bit 1: Channel 2: setting the trigger level Assignment of bits: 0: triggering at 1->0 switch 1: triggering at 0->1 switch (default)	UINT16 0..3	- 3	R/W/-

Table 9.6 Capture parameter group

9.2.7 Parameter group`Commands`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Commands.flashSave	11:22 (0B:16$_h$)	Backing up data in flash memory Selection of ranges to be backed up: Bit0: cam description data 0: do not back up 1: back up range All valid cam data in the controller are backed up to prevent loss by power failure. The status of the bakkup can be read with Commands.statFlash.	UINT16 0..1	- -	R/W/-
Commands.statFlash	11:23 (0B:17$_h$)	processing status of Commands.flashSave 0: save process active 1: Save process complete If multiple value ranges must be saved, the completion of the backup must be shown. If an error was detected during the data backup, it is saved in the error memory. In addition, the error number is returned at every read access.	UINT16 0..1	- -	R/-/-

Table 9.7 Commands parameter group

9.2.8 Parameter group`CtrlBlock1`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CtrlBlock1.KFAp2	18:25 (12:19$_h$)	Acceleration feed forward on speed control	UINT16 0..32767	As*min/rev 0	R/W/ per.

Table 9.8 CtrlBlock1 parameter group

9.2.9 Parameter group`CtrlBlock2`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
CtrlBlock2.KFAp2	19:25 (13:19$_h$)	Acceleration feed forward on speed control	UINT16 0..32767	As*min/rev 0	R/W/ per.

Table 9.9 CtrlBlock2 parameter group

9.2.10 Parameter group`M1`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
M1.filterval	21:40 (15:28$_h$)	Filter value for calculating M1 encoder speed (0: Off) 0: not active >0: active, value corresponds to Tn [ms] (corresponds to the time constant of the PT1 link) resolution: +/- 31 Inc./s In CAM mode the filter must not be disabled!!!	UINT16 0..32767	ms 10	R/W/ per.

Table 9.10 M1 parameter group

9.2.11 Parameter group`Status`

Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.driveStat	28:2 (1C:02_h)	Status word for the operating status HIGH-UINT16: assignment see Bit0..15 in Status.xMode_act LOW-UINT16: status word status machine Bit0..3: number of the current status of the status machine. Bit4: reserved Bit5: fault by internal monitoring Bit6: fault by external monitoring Bit7: warning active Bit8: reserved Bit9: remote control active (only unit types >=CDP2xx) Bit10..11: reserved Bit12::15: axis-operating mode-specific processing status Coding corresponds to the assignment of Bits12..15 in the operating-mode-specific acknowledgement data (e.g. CamGlobal.StateCAM (52:2) in CAM operating mode) Coding status word status machine Bit0..3: 1: Start 2: Not Ready To Switch On 3: Switch On Disabled 4: Ready to Switch On 5: Switched On 6: Operation Enable 7: Quick Stop Active 8: Fault Reaction Active 9: Fault 10..15: not assigned	UINT32	- -	R/-/-
Status.v_refM1	31:43 (1F:$2B_h$)	Speed Input quantity at module on M1 The speed is smoothed by a filter; the filter can be configured with M1.filterval	INT32	Inc/s -	R/-/-
Status.CamMasMod	31:52 (1F:34_h)	CAM: modulo value of master position in Inc Value shows curve of master position over a master cycle valid value only readable if: - CAM operating mode set - Master reference available in all other cases if 0 is returned	INT32 0 ..2147483647	Inc-	R/-/-
Status.CamSlvMod	31:53 (1F:35_h)	CAM: modulo value of slave position in Inc Value shows curve of slave position over a master cycle valid value only readable if: - CAM operating mode set - Slave reference available - Couple signal active in all other if 0 is returned	INT32 0 ..2147483647	Inc-	R/-/-
Status.CamSiPref	31:54 (1F:36_h)	CAM: actual position of master position simulation	INT32	Inc-	R/-/-

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.MsCycAct	31:55 (1F:37$_h$)	CAM: Current or last correctly started master cycle number The number of processed master cycles or detected modulo conditions provides the value. Master cycles are only counted in the following states: - DO_COUPLE_CURVE - DO_NORMAL_CURVE - DO_UNCOUPLE_CURVE In the event of an interruption in processing this counter also contains the number of the cycle in which the interruption occurred When processing the WAIT_FOR_REFERENCE status the counter is reset.	INT32	- 0	R/-/-
Status.MsCycCalc	31:56 (1F:38$_h$)	CAM: theoretical master cycle number corresponding to the current master position The number of processed master cycles or detected modulo conditions provides the value. The value is only updated if the operating mode 'cam' is activated! Master cycles are only counted in the following states: - DO_COUPLE_CURVE - DO_NORMAL_CURVE - DO_UNCOUPLE_CURVE - DO_CAM_DISABLE - IDLE_CAM_DISABLE In the event of an interruption of the process this counter contains the number of the master cycle that would have been set with error-free processing. In the event of interruption a comparison with Status.MsCycAct can show how many cycles the master has moved in the meantime. The counter is reset on processing the WAIT_FOR_REFERENCE state.	INT32	- 0	R/-/-
Status.SlvPosS0	31:57 (1F:39$_h$)	CAM: Slave absolute position with master modulo situation of the currently processed master cycle A valid value is only available after execution of the CAM referencing. The value corresponds to the absolute position of the slave at the first curve point of the profiled curve. In the event of interruption of the profiling the position corresponds to the slave position of the cycle in which the interruption occurred.	INT32	Inc 0	R/-/-
Status.CamSlMdNu	31:59 (1F:3B$_h$)	CAM: current numerator of the slave modulo length The current internally used slave modulo length (slave position of the last curve point) can be calculated. This is derived depending on the setting of CamCtrlx.SlMdMode. The value is required for resetting after an interruption of profiling for calculation of an absolute slave position in a follow interval. A reasonable value is only available after initial activation of operating mode 'cam'.	INT32 0 ..2147483647	Inc 0	R/-/-
Status.CamSlMdDe	31:60 (1F:3C$_h$)	CAM: current denominator of the slave modulo length For description see Status.CamSlMdNu	INT32 1 ..2147483647	Cycles 1	R/-/-

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Group.Name	Idx:Six dec (hex)	Explanation and unit [ ]	Value range	Default value	R/W per.
Status.CamMsMdMu	31:62 (1F:3E$_h$)	CAM: modulo value of master position in MasterUnits See description of read value Status.CamMasMod The read value is however returned in MasterUnits instead of in Inc. The master cycle length from the current active CamCtrlBlock is used, the max. master value from the currently used cam profile description. Read access returns 0 as long as the CamCtrlBlock to be processed is in status 'disable'	INT32 0 ..2147483647	Master Units -	R/-/-
Status.CamSlMdSu	31:63 (1F:3F$_h$)	CAM: modulo value of slave position in SlaveUnits See description of read value Status.CamSlvMod The read value is however returned in SlaveUnits instead of in Inc. The slave cycle length from the current active CamCtrlBlock is used, the max. slave value from the currently used cam profile description. Read access returns 0 as long as the CamCtrlBlock to be processed is in status 'disable'	INT32	Slave Units -	R/-/-

Table 9.11 Status parameter group

10 Service, maintenance and disposal

⚠ DANGER!

Electric shock, fire or explosion

- Only qualified personnel who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (for discharge of DC bus capacitors).
  - Measure voltage between DC+ and DC- and check for <48V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).
- Do not short-circuit DC bus or touch unshielded components or screws of the terminals with voltage present.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to grounding the drive system.
- Do not reach into the drive system (e.g. no pointed objects).

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING!

Unexpected responses may cause injury and damage to the system.

The behaviour of the drive system is governed by numerous saved data. Unsuitable data may cause unexpected motions or responses to signals.

- Do not operate a unit with unknown data.
- Check the saved data.
- When commissioning carefully run tests for all operating states and fault cases.
- Check the functions after replacing a unit and also after changes to the saved data.
- Start the system only if there are no persons or materials in the danger zone and the system can be operated safely.

Failure to follow these instructions can result in death or serious injury.

10.1 Service address

If you have any questions please contact your local dealer. Your dealer will be happy to give you the name of a customer service outlet in your area.

Have any repairs to our drive systems conducted only by a repair service that we have certified. Do not make any mechanical or electrical modifications to the drive components. We will not honour the warranty or accept any liability if unauthorised modifications are made or the system is opened.

Repairs cannot be made with the device installed.

Before all work on the drive system consult the chapters on Installation and Commissioning to see what precautions and processes must be observed.

Maintenance

The controller is maintenance-free

▶ Check the filter in the switch cabinet ventilator regularly. Inspection intervals depend on the ambient conditions on site.

10.2 Shipping, storage, disposal

Removal

▶ Save the parameter settings of the controller:

The commissioning software can be used to back up all values to the PC data medium with "File - Save".

Use the TLHMI hand-held operating unit to import a parameter set to the copy memory of the TLHMI hand-held operating unit with the menu "8.1 Read Param"

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- ▶ Switch off the controller.
- ▶ Disconnect the power supply.
- ▶ Label all connections on the controller.
- ▶ Disconnect the motor cable.
- ▶ Pull out the interface connector.
- ▶ Remove the controller from the switch cabinet.

Shipping The controller must be protected against shocks during transport. Use the original packaging for this purpose.

Storage Store the controller only under the specified, permissible environmental conditions for room temperature and humidity.

Protect the controller against dust and dirt.

Disposal The controller consists of various materials that can be recycled or must be disposed of separately.

Remove the following parts from the controller for recycling

- Housing, screws and terminals for ferrous metal recycling
- Cables for copper recycling
- Connectors, hood for plastics recycling

Circuit boards and electronic components must be disposed of separately in accordance with the applicable environmental protection laws. Send these parts for special waste disposal.

11 Glossaries

This manual only contains the abbreviations, product names and terms for operating mode 'cam'. Corresponding lists for the other operating modes and lists including all operating modes can be found in the TLC61x and TLC63x device manual.

11.1 Terms and Abbreviations

Access channel	Operating interface for user access (e.g. field bus)
AND	logical AND
Cam control block	Parameter setting range for setting the sequence of cam profiling and the curves to be used in the process
Cam profile description file	ASCII file exported from the cam editor that contains the curve data. A cam profile description comprises header and slave values. The file is named *.cam and cam be transferred to the Twin Line controller for processing.
Cam status machine	The different profiling states and the transition conditions between the cam profiling states are shown as a status machine.
Cam signal	Configurable 24V output signal that is switched on or off depending on the master position
CAPTURE input	Hardware input through which a position capture can be triggered in the capture unit
Capture unit	Controller unit for fast capture of position values when events occur
Command variable	Input variable for cam profiling
Couple	Synchronisation of cam profiling in continuing master movement
COUPLE input	Hardware input for triggering a couple request
CoupleReq	Request condition for couple processing
Curve number	This is used for unique identification of a curve shape in the cam profile description file. During parameter setting in the Twin Line controller this number is used as the basis for selection of the required curve.
EQ	equal
Equidistant	Equal distance
Flash	Memory in which curve data can be saved to prevent loss from power failure
Float	Representation of numbers in floating point format
Header	Part of cam profile description file in which curve-specific values are defined
Idx	Index value of a parameter
IEC 61131-3	PLC programming standard
Integer	Whole-number value

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Master	Returns input variable for cam profiling, e.g. via an external incremental encoder
Master increment	Smallest change of the master input variable or master position
Master mark	System signal from the profiling process that is received on the master side (e.g. printing mark)
Master cycle length	Change of the master position within which the defined curve is completely run
MasterUnits	Unit of the master values
Master values	Description of the master variables by the user in the cam editor or the cam profile description file
master cycle	Movement change of the master in which the defined curve is run through once
Modulo condition	Transition from a master cycle to the next or previous cycle
Modulo position	Change of the master or slave position with reference to the corresponding positions of the first curve point
Motion profile	Curve shape generated in cam editor. It can be saved to the PC as a *.bpl file.
NE	not equal
OR	logical OR
per.	Information on whether the value of the parameter is non-volatile, i.e. is retained in memory after switching the unit off. The user must back up the data in the non-volatile memory before switching off the device to ensure that the value is saved in non-volatile memory.
Postprocess	Software component of the cam editor that generates the cam profile description file from the movement profile
PTP mode	Point-to-point controller operating mode
Qualifier	Read value for additional information on error message
RAM	Random Access Memory: volatile memory in Twin Line controllers
Six	Subindex value of a parameter
Slave	Drive that runs a movement resulting from the defined curve shape depending on the master movement.
Slave cycle length	Change of the slave position between the curve point with slave value = 0 and the max. slave value
Slave increment	Smallest change of slave position
Slave mark	System signal from the profiling process that is received on the slave side
Slave modulo length	Change of the slave position between the last and first curve point
SlaveUnits	Unit of slave values
Slave values	Description of the slave variables by the user in the cam editor or the cam profile description file
SPL	software profile generator
Token	Character string for unique identification of individual curve-specific values in the header

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Uncouple	Desynchronisation from cam profiling process
VDI 2143	VDI (association of German engineers) standard that describes laws of movements for cam mechanisms
Wait cycle	Master cycle in which no slave movement shall be done

11.2 Product names

Cam editor	PC software for creating the curve shapes as motion plans by using the laws of motion for cam mechanisms (VDI 2143).
CoDeSys	Programming tool for developing and testing application programs. CoDeSys is compliant with the IEC 61131-3 Standard.
TLC61x	programmable positioning controller for stepping motors
TLC63x	Programmable positioning controller for AC synchronous servomotors
TLCT	Software for commissioning

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