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MAXPOS

Firmware Specification

maxpos.maxongroup.com

MAXPOS Positioning Controllers
Firmware Specification
CCMC | Edition 2019-08 | DocID rel8961

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TABLE OF CONTENTS

READ THIS FIRST

These instructions are intended for qualified technical personnel. Prior commencing with any activities*…*

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

MAXPOS Positioning Controllers *are considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and* ***are intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment****.*

Therefore, you must not put the device into service*,…*

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

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1 ABOUT THIS DOCUMENT

1.1 Intended Purpose

The purpose of the present document is to familiarize you with the described equipment and the tasks on safe and adequate installation and/or commissioning.

Observing the described instructions in this document will help you …

- to avoid dangerous situations,
- to keep installation and/or commissioning time at a minimum and
- to increase reliability and service life of the described equipment.

Use for other and/or additional purposes is not permitted. maxon, the manufacturer of the equipment described, does not assume any liability for loss or damage that may arise from any other and/or additional use than the intended purpose.

1.2 Target Audience

This document is meant for trained and skilled personnel working with the equipment described. It conveys information on how to understand and fulfill the respective work and duties.

This document is a reference book. It does require particular knowledge and expertise specific to the equipment described.

1.3 How to use

Take note of the following notations and codes which will be used throughout the document.

Notation	Explanation
«Abcd»	indicating a title or a name (such as of document, product, mode, etc.)
(n)	referring to an item (such as order number, list item, etc.)
*	referring to an internal value
***	referring to a not yet implemented item
➔	denotes “see”, “see also”, “take note of”, or “go to”

Table 1-1 Notations used in this Document

1.4 Symbols and Signs

Requirement / Note / Remark
Indicates an action you must perform prior continuing or refers to information on a particular item.

Best Practice
Gives advice on the easiest and best way to proceed.

Material Damage
Points out information particular to potential damage of equipment.

1.5 Trademarks and Brand Names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the below list is not necessarily concluding) are protected by copyright and/or other intellectual property rights even if their legal trademarks are omitted in the later course of this document.

Brand Name	Trademark Owner
Adobe® Reader®	© Adobe Systems Incorporated, USA-San Jose, CA
BiSS	© iC-Haus GmbH, DE-Bodenheim
EtherCAT®	© EtherCAT Technology Group, DE-Nuremberg, licensed by Beckhoff Automation GmbH, DE-Verl
TwinCAT®	© Beckhoff Automation GmbH, DE-Verl

Table 1-2 Brand Names and Trademark Owners

1.6 Sources for additional Information

For further details and additional information, please refer to below listed sources:

#	Reference
[1]	ETG.1000: EtherCAT Specification ➔www.ethercat.org
[2]	IEC 61158-x-12: Industrial communication networks – Fieldbus specifications
[3]	IEC 61800-7: Adjustable speed electrical power drives systems
[4]	maxon: MAXPOS Application Notes ➔www.maxongroup.com
[5]	BiSS-C specifications ➔www.ichaus.de

Table 1-3 Sources for additional Information

1.7 Copyright

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2 INTRODUCTION

2.1 Important Notice: Prerequisites for Permission to commence Installation

The MAXPOS Positioning Controllers are considered as partly completed machinery according to EU directive 2006/42/EC, Article 2, Clause (g) and therefore **are intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

WARNING

Risk of Injury
Operating the device without the full compliance of the surrounding system with the EU directive 2006/42/EC may cause serious injuries!

- *Do not operate the device, unless you have made sure that the other machinery fulfills the requirements stated in EU directive!*
- *Do not operate the device, unless the surrounding system fulfills all relevant health and safety aspects!*
- *Do not operate the device, unless all respective interfaces have been established and fulfill the stated requirements!*

2.2 General Information

The present document provides you with the firmware details on the MAXPOS Positioning Controllers. It contains descriptions of the architecture, device states, operation modes, error handling, and object dictionary.

In the later course of the present document, the following abbreviations and acronyms will be used:

Short	Description
CCW	Counterclockwise
CiA	CAN in Automation
CoE	CAN Application Protocol over EtherCAT
CSP	Cyclic Synchronous Position Mode
CST	Cyclic Synchronous Torque Mode
CSV	Cyclic Synchronous Velocity Mode
CW	Clockwise
ESI	EtherCAT Slave Information (EtherCAT Device Description)
ESM	EtherCAT State Machine
ETG	EtherCAT Technology Group
FoE	File Access over EtherCAT
GPIO	General purpose input/output
HMM	Homing Mode
OBD	Object Dictionary
PDO	Process Data Object
PPM	Profile Position Mode

Continued on next page.

Short	Description
PVM	Profile Velocity Mode
SDO	Service Data Object
SII	Slave Information Interface

Table 2-4 Abbreviations & Acronyms

Find the latest edition of the present document, as well as additional documentation and software to the MAXPOS Positioning Controller also on the Internet: ➔http://maxpos.maxongroup.com.

2.3 Documentation Structure

The present document is part of a documentation set. Please find below an overview on the documentation hierarchy and the interrelationship of its individual parts:

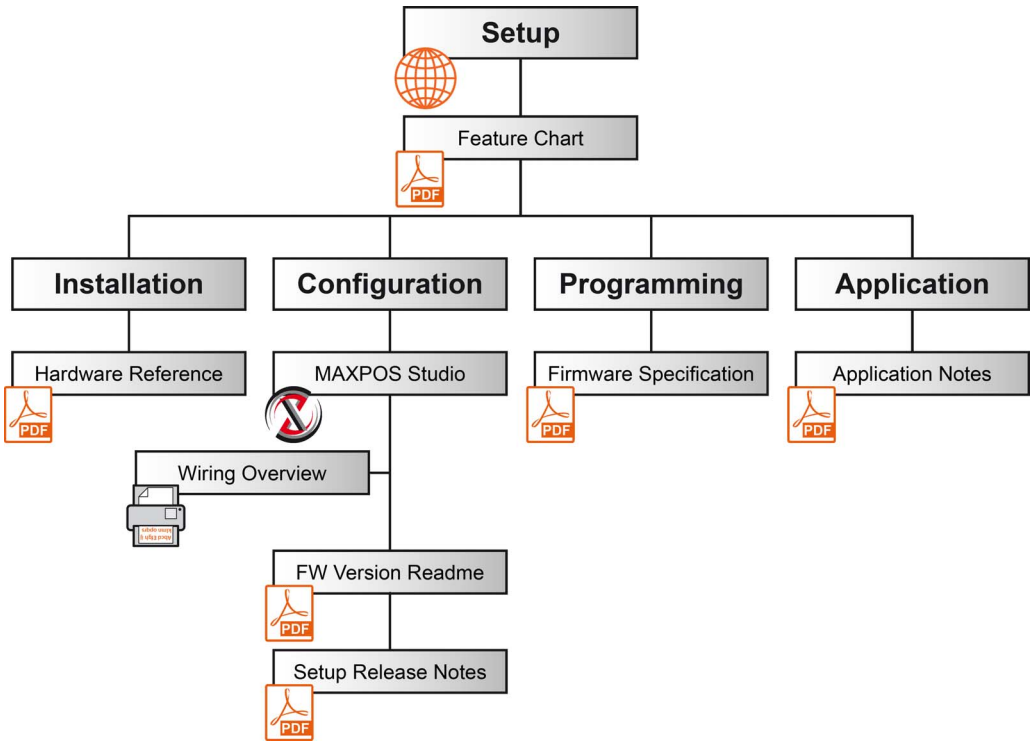


Figure 2-1 Documentation Structure

3 SYSTEM OVERVIEW

3.1 Device Architecture

The MAXPOS's communication interface follows these specifications (numbers in brackets refer to respective items listed on ➔page 1-8):

- EtherCAT Technology Group (ETG): ETG.1000 EtherCAT Specification (➔[1])
- International Electrotechnical Commission (IEC): IEC 61158 Type 12 (➔[2])

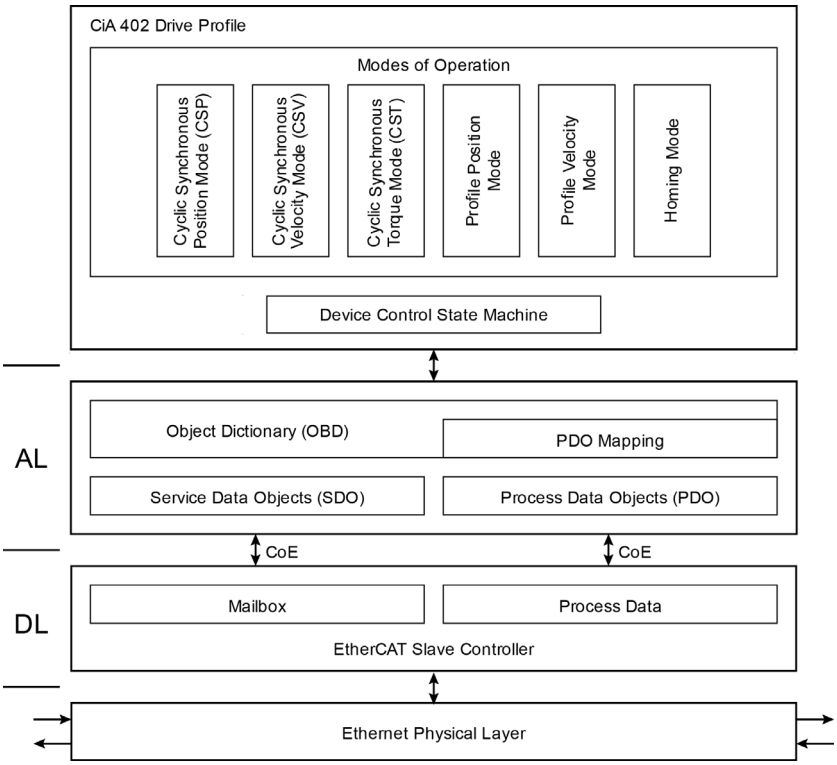


Figure 3-2 Communication Architecture

The physical layer of EtherCAT is based on an IEC 8802-3 (IEEE802.3) 100BASE-TX standard Ethernet physics. The data link layer (DL) is handled by the EtherCAT Slave Controller which splits the specific Ethernet data frames in process data and mailbox data. The application layer (AL) is connected via the CAN application protocol over EtherCAT (CoE) and can handle the service data objects as well as the cyclic process data objects. The drive functionality follows the CiA 402 Drive Profile based on IEC 61800-7-201 and IEC 61800-7-301.

DEVICE CONTROL

Starting and stopping of the drive and several mode-specific commands are executed by the state machine.

MODES OF OPERATION

The operating mode defines the behavior of the drive.

3.2 Device Control

The state machine describes the device state and the possible control sequence of the drive. A single state represents a special internal or external behavior. The state of the drive also determines which commands are accepted.

States may be changed using the ➔Controlword and/or according to internal events. The actual state can be read using the ➔Statusword.

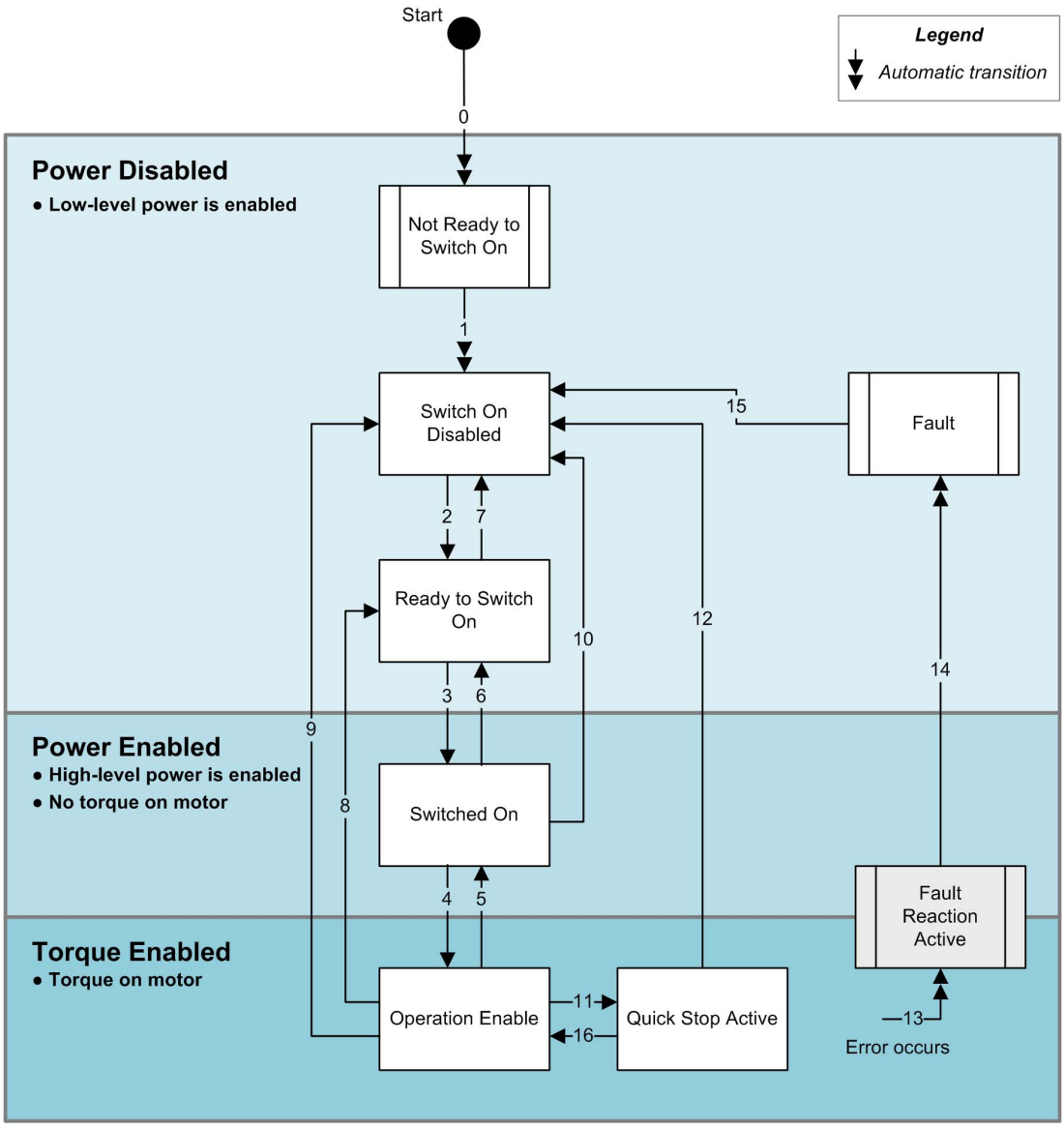


Figure 3-3 Device State Machine

3.2.1 State of the Drive

The following ➔Statusword bits indicate the actual state of the drive.

State	Statusword [binary]	Description
Not Ready to Switch On	xxxx xxxx x000 0000	Drive function is disabled
Switch On Disabled	xxxx xxxx x100 0000	Drive initialization is complete Drive parameters may be changed Drive function is disabled
Ready to Switch On	xxxx xxxx x010 0001	Drive parameters may be changed Drive function is disabled
Switched On	xxxx xxxx x010 0011	Drive function is disabled Actual offset calibration done
Operation Enable	xxxx xxxx x011 0111	No faults have been detected Drive function is enabled and power is applied to the motor
Quick Stop Active	xxxx xxxx x001 0111	Quick Stop function is being executed Drive function is enabled and power is applied to the motor
Fault Reaction Active	xxxx xxxx x001 1111	A fault has occurred in the drive Selected fault reaction is being executed
Fault	xxxx xxxx x000 1000	A fault has occurred in the drive Drive parameters may have changed Drive function is disabled

Table 3-5 Device State Bits

3.2.2 State Transitions

State transitions are caused by internal events in the drive or by commands from the host via the ➔Controlword.

Note:
If a command is received which causes a change of state, this command will be processed completely and the new state attained before the next command can be processed.

Transition	Event	Action
0	Reset	Initialize drive
1	Drive has initialized successfully	Activate communication
2	«Shutdown» command received	
3	«Switch On» command received	
4	«Enable Operation» command received	Refresh power section
5	«Disable Operation» command received	Disable power section; disable drive function
6	«Shutdown» command received	
7	«Quick Stop» or «Disable Voltage» command received	
8	«Shutdown» command received	Disable power section/drive function
9	«Disable Voltage» command received	Disable power section/drive function
10	«Quick Stop» or «Disable Voltage» command received	
11	«Quick Stop» command received	Setup Quick Stop profile
12	«Disable Voltage» command received	Disable power section/drive function

Continued on next page.

Transition	Event	Action
13	A fault has occurred	Disable power section/drive function
14	The fault reaction is completed	
15	«Fault Reset» command received	Reset fault condition if no fault is present
16	«Enable Operation» command received	Enable drive function

Table 3-6 Device State Transitions

3.2.3 Device Control Commands

Device control commands are triggered by the following bit patterns in the ➔Controlword.

Command	LowByte of Controlword [binary]	State Transition
Shutdown	0xxx x110	2, 6, 8
Switch On	0xxx 0111	3
Switch On & Enable Operation	0xxx 1111	3, 4*1)
Disable Voltage	0xxx xx0x	7, 9, 10, 12
Quick Stop	0xxx x01x	7, 10, 11
Disable Operation	0xxx 0111	5
Enable Operation	0xxx 1111	4, 16
Fault Reset	0xxx xxxx → 1xxx xxxx	15

Remark:
*1) Automatic transition to “Enable Operation” after executing “Switched On” functionality.

Table 3-7 Device Control Commands

3.3 System Units

The user-defined units for this device are as follows:

- Position Units (➔“SI Unit Position” on page 7-155; 0x60A8)
- Velocity Units (➔“SI Unit Velocity” on page 7-156; 0x60A9)
- Acceleration Units (➔“Defines the acceleration units. Coding of the user-defined units and prefixes follows èchapter “3.3.1 SI Units” on page 3-15.” on page 7-157; 0x60AA)

The units are used for all objects that support user-defined units. They are specified by the SI unit objects. Objects with factor group-independent values have fixed units specified by the object.

Coding of user-defined units and prefixes takes place as to ➔Table 3-8.

Bit 31…24	Bit 23…16	Bit 15…8	Bit 7…0
Prefix	Numerator	Denominator	reserved (0)

Table 3-8 User-defined Units – Parameter Structure

3.3.1 SI Units

Description	Name	Symbol	Notation Index
Dimensionless	–	–	0x00
Length	Meter	m	0x01
Mass	*Kilogram*	*kg*	*0x02*
Time	Second	s	0x03
Electric current	*Ampere*	*A*	*0x04*
Time	Minute	min	0x47
Square second	*Square second*	s^2	*0x57*

Table 3-9 SI Units – Notation Index

3.3.2 CiA 402 Application Profile-specific Units

Description	Name	Symbol	Notation Index
Revolutions	revolutions	rev	0xB4
Increments	increments	inc	0xB5
Steps	*steps*	*steps*	*0xAC*
Velocity (manufacturer-specific)	revolutions/minute	rpm	0xC0

Table 3-10 CiA 402 Application Profile-specific Units – Notation Index

3.3.3 Unit Prefixes

Prefix	Factor	Symbol	Notation Index
Mega	*10^{6}*	*M*	*0x06*
Kilo	*10^{3}*	*k*	*0x03*
Hecta	*10^{2}*	*h*	*0x02*
Deca	*10^{1}*	*da*	*0x02*
–	10^{0}	–	0x00
Deci	10^{-1}	d	0xFF
Centi	10^{-2}	c	0xFE
Milli	10^{-3}	m	0xFD
Micro	*10^{-6}*	*µ*	*0xFA*

Table 3-11 Unit Prefixes – Notation Index

4 OPERATING MODES

4.1 Operating Mode Selection Guide

The device behavior depends on the currently activated mode of operation.

- Choose desired mode (➔“Overview” on page 4-18).
- Select mode using (➔“Modes of Operation” on page 7-143).
- Read currently active mode from ➔“Modes of Operation Display” on page 7-143.

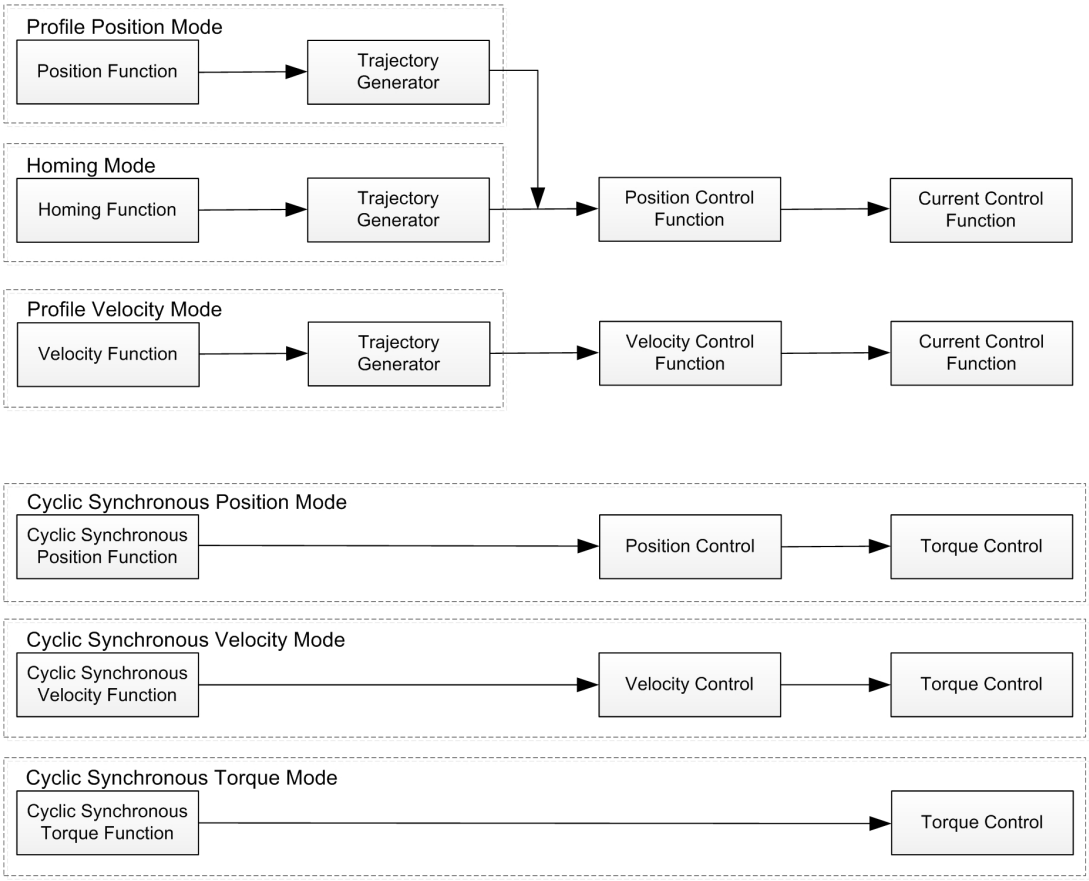


Figure 4-4 Functional Architecture

4.2 Overview

PROFILE POSITION MODE (PPM)

Defines the drive's positioning. Speed, position, and acceleration can be limited, profiled moves can be executed using a Trajectory Generator.
For details ➔page 4-19.

PROFILE VELOCITY MODE (PVM)

Controls the velocity of the drive without particular focus on the position. It supplies limit functions and Trajectory Generation.
For details ➔page 4-22.

HOMING MODE (HMM)

Provides various methods to find a home position (also called reference point or zero point).
For details ➔page 4-25.

CYCLIC SYNCHRONOUS POSITION MODE (CSP)

The trajectory generator is located in the control device (not in the drive device). In cyclic synchronous manner, it provides a target position to the drive device, which then performs position control, velocity control, and torque control.
For details ➔page 4-40.

CYCLIC SYNCHRONOUS VELOCITY MODE (CSV)

The trajectory generator is located in the control device (not in the drive device). In cyclic synchronous manner, it provides a target velocity to the drive device, which then performs velocity control and torque control.
For details ➔page 4-43.

CYCLIC SYNCHRONOUS TORQUE MODE (CST)

The trajectory generator is located in the control device (not in the drive device). In cyclic synchronous manner, it provides a target torque to the drive device, which then performs torque control.
For details ➔page 4-46.

4.3 Profile Position Mode (PPM)

A target position is applied to the trajectory generator. It will generate a position demand value for the position control loop described in ➔“Cyclic Synchronous Position Mode (CSP)” on page 4-40. For the overall architecture of this mode ➔Figure 4-5.

Annotation
Items marked with an asterisk (*) refer to internal values.

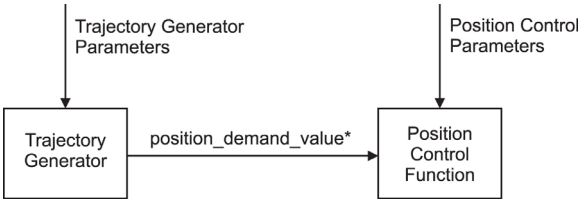


Figure 4-5 Profile Position Mode – Overview

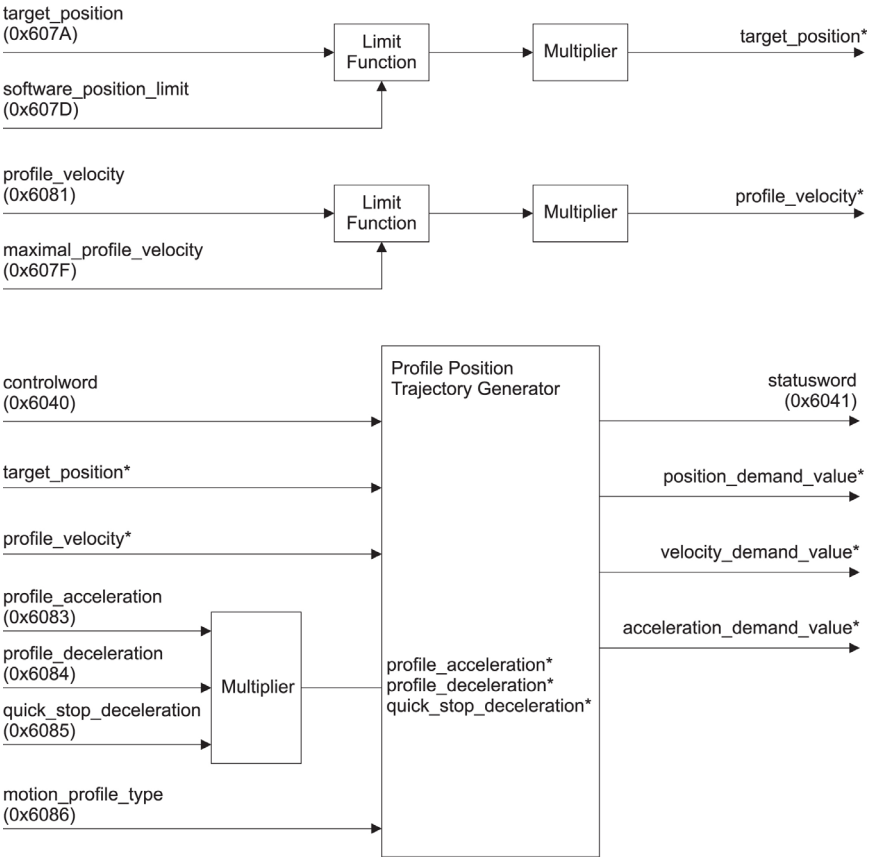


Figure 4-6 Profile Position Mode – Block Diagram

4.3.1 Profile Position Trajectory Generator

The trajectory generator supports the following profile type.

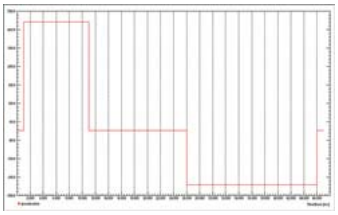
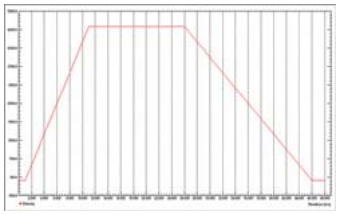
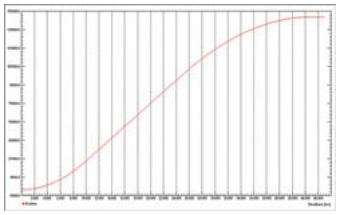
Acceleration	Velocity	Position
		
A_{max} = Profile Acceleration A_{min} = Profile Deceleration	V_{max} = Profile Velocity	Absolute Movement P_{end} = Target Position Relative Movement P_{end} = Position Demand Value + Target Position

Figure 4-7 Profile Position Trajectory

4.3.2 How to use «PPM»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Software Position Limit	0x607D	Contains the sub-parameters “Min Position Limit” and “Max Position Limit” that define the absolute position limits of the position demand value
➔Max Profile Velocity	0x607F	Defines the maximal allowed speed
➔Max Motor Speed	0x6080	Indicates the configured maximal allowed speed for the motor. It is used to protect the motor and is taken from the motor data sheet.
➔Quick Stop Deceleration	0x6085	Defines the deceleration ramp during a Quick Stop
➔Max Acceleration	0x60C5	Defines the maximal allowed acceleration and deceleration

Table 4-12 Profile Position Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Controlword	0x6040	The mode will be controlled by a write access to the controlword's mode-dependent bits
➔Target Position	0x607A	The position, the drive is supposed to move to using the motion control parameters, such as velocity, acceleration, motion profile type, etc. It will be interpreted as absolute or relative depending on the Controlword “abs / rel” flag.
➔Profile Velocity	0x6081	The velocity normally attained at the end of the acceleration ramp during a profiled move
➔Profile Acceleration	0x6083	Defines the acceleration ramp during a movement
➔Profile Deceleration	0x6084	Defines the deceleration ramp during a movement
➔Motion Profile Type	0x6086	Selects the type of motion profile used for the movement: 0 = linear ramp (trapezoidal profile)

Table 4-13 Profile Position Mode – Commanding Parameters

CONTROLWORD (PROFILE POSITION MODE-SPECIFIC BITS)

Bit 15…9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3…0
➔ Table 7-116	Halt	➔ Table 7-116	Abs / rel	Change set immediately	New setpoint	➔ Table 7-116

Table 4-14 Profile Position Mode – Controlword

Name	Value	Description
New setpoint	0	Does not assume ➔Target Position
	0→1	Assume ➔Target Position
Change set immediately	0	Finish actual positioning, than start next positioning. The actual positioning is considered as completed, as soon as the position demand value reaches the target position.
	1	Interrupt actual positioning and start next positioning
Abs / rel	0	➔Target Position is an absolute value
	1	➔Target Position is a relative value
Halt	0	Execute or continue positioning
	1	Stop axis with ➔Halt Option Code

Table 4-15 Profile Position Mode – Controlword Bits

OUTPUT PARAMETERS

Parameter	Index	Description
➔Statusword	0x6041	Mode state can be observed by the Statusword bits.
➔Position Demand Value	0x6062	The output of the trajectory generator. It is used as input for the position control function.

Table 4-16 Profile Position Mode – Output Parameters

STATUSWORD (PROFILE POSITION MODE-SPECIFIC BITS)

Bit 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
➔ Table 7-117	Following error	Setpoint acknowledge	➔ Table 7-117	Target reached	➔ Table 7-117

Table 4-17 Profile Position Mode – Statusword

Name	Value	Description
Target reached	0	Halt = 0: ➔Target Position not reached Halt = 1: Axis decelerates
	1	Halt = 0: ➔Target Position reached Halt = 1: Velocity of axis is “0” (zero)
Setpoint acknowledge	0	Positioning to the previous setpoint is ongoing and a new setpoint may be accepted
	1	The previous setpoint has been assumed and no additional setpoint may be accepted
Following error	0	Not following error
	1	Following error

Table 4-18 Profile Position Mode – Statusword Bits

4.4 Profile Velocity Mode (PVM)

The profile velocity mode includes a velocity trajectory generator and a velocity control function.

Annotation
Items marked with an asterisk (*) refer to internal values.

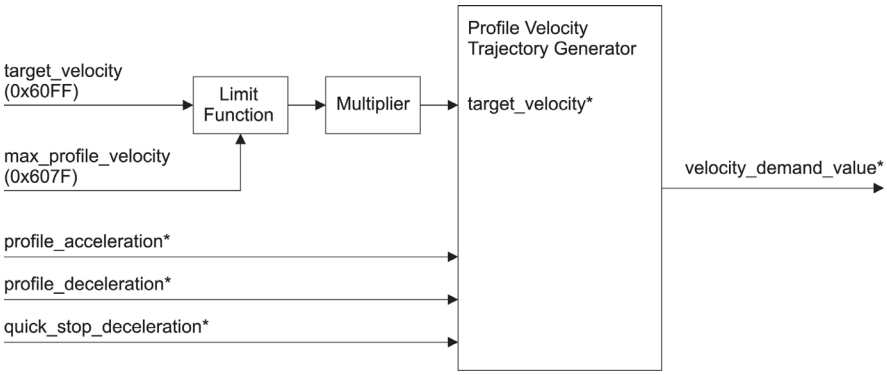


Figure 4-8 Profile Velocity Mode – Block Diagram

4.4.1 Profile Velocity Trajectory Generator

The trajectory generator supports different motion profile types.

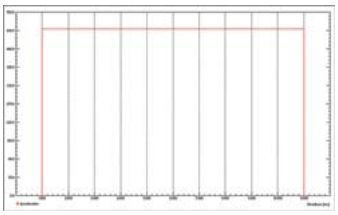
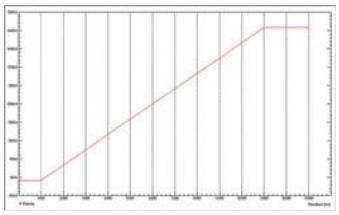
Acceleration	Velocity
	
A_{max} = Profile Acceleration A_{min} = −Profile Deceleration	V_{max} = Target Velocity

Figure 4-9 Profile Velocity Trajectory – Linear Ramp (trapezoidal Profile)

4.4.2 How to use «PVM»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Software Position Limit	0x607D	Contains the sub-parameters “Min Position Limit” and “Max Position Limit” that define the absolute position limits of the position demand value
➔Max Profile Velocity	0x607F	Defines the maximal allowed speed
➔Max Motor Speed	0x6080	Indicates the configured maximal allowed speed for the motor. It is used to protect the motor and is taken from the motor data sheet.
➔Quick Stop Deceleration	0x6085	Defines the deceleration ramp during a Quick Stop
➔Max Acceleration	0x60C5	Defines the maximal allowed acceleration and deceleration

Table 4-19 Profile Velocity Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Controlword	0x6040	The mode will be controlled by a write access to the controlword's mode-dependent bits. A new target velocity is not assumed before the controlword is written.
➔Target Velocity	0x60FF	The speed the drive is supposed to reach
➔Profile Acceleration	0x6083	Defines the acceleration ramp during a movement
➔Profile Deceleration	0x6084	Defines the deceleration ramp during a movement
➔Motion Profile Type	0x6086	Selects the type of motion profile used for the movement: 0 = linear ramp (trapezoidal profile)

Table 4-20 Profile Velocity Mode – Commanding Parameters

CONTROLWORD (PROFILE VELOCITY MODE-SPECIFIC BITS)

Bit 15…9	Bit 8	Bit 7	Bit 6…4	Bit 3…0
➔ Table 7-116	Halt	➔ Table 7-116	reserved	➔ Table 7-116

Table 4-21 Profile Velocity Mode – Controlword

Name	Value	Description
Halt	0	Execute or continue motion
	1	Stop axis

Table 4-22 Profile Velocity Mode – Controlword Bits

OUTPUT PARAMETERS

Parameter	Index	Description
➔Statusword	0x6041	Mode state can be observed by the Statusword bits
➔Velocity Demand Value	0x606B	The output of the trajectory generator. It is used as input for the velocity control function.

Table 4-23 Profile Velocity Mode – Output Parameters

STATUSWORD (PROFILE VELOCITY MODE-SPECIFIC BITS)

Bit 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
➔ Table 7-117	Not used	Speed	➔ Table 7-117	Target reached	➔ Table 7-117

Table 4-24 Profile Velocity Mode – Statusword

Name	Value	Description
Target reached	0	Halt = 0: Target velocity not (yet) reached Halt = 1: Axis decelerates
	1	Halt = 0: Target velocity reached Halt = 1: Axis has velocity “0” (zero)
Speed	0	Speed is not equal “0” (zero)
	1	Speed is equal “0” (zero)

Table 4-25 Profile Velocity Mode – Statusword Bits

4.5 Homing Mode (HMM)

«Homing» describes the procedure according to which the drive seeks the home position (also called reference point or zero point). There are various methods to achieve this using limit switches at both ends of travel. Some of the methods use the index (zero) pulse train of an incremental encoder.

Annotation
Items marked with an asterisk (*) refer to internal values.

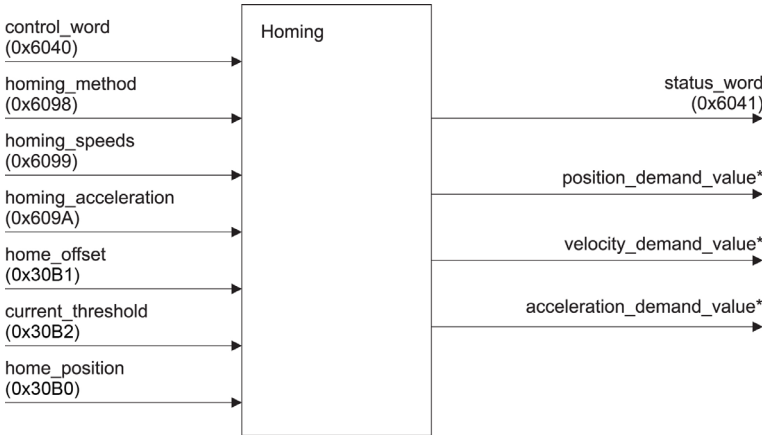


Figure 4-10 Homing Mode – Block Diagram

4.5.1 Homing Trajectory Generator

The trajectory generator supports different motion profile types. The movements are mode-dependant, the end positions will be calculated internally.

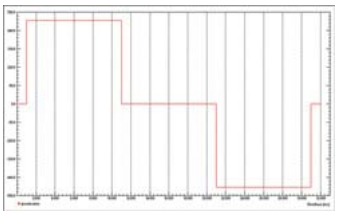
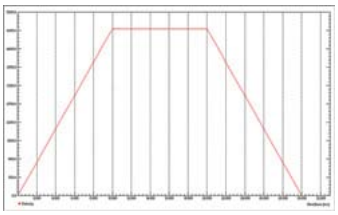
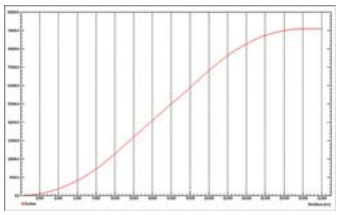
Acceleration	Velocity	Position
		
A_{max} = Homing Acceleration A_{min} = −Homing Acceleration	V_{max} = Speed for Switch Search or Speed for Zero Search	Absolute Movement P_{end} = e.g. reference position + Home Offset Move Distance

Figure 4-11 Homing Trajectory – Linear Ramp (trapezoidal Profile)

4.5.2 How to use «HMM»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Digital Input Properties	0x3141	Input polarity and logic state
➔Configuration of Digital Inputs	0x3142	Permits the configuration of digital inputs to digital input functionalities. Necessary for limit and homing switches used for “Homing”.
➔Digital Inputs	0x3141	Input functionality state (after polarity correction)
➔Motion Profile Type	0x6086	Selects the type of motion profile used for the movement: 0 = linear ramp (trapezoidal profile)

Table 4-26 Homing Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Controlword	0x6040	The mode will be controlled by a write access to the controlword’s mode-dependent bits
➔Homing Method	0x6098	Defines the type of homing procedure
➔Homing Speeds	0x6099	Specifies the two speeds used for Homing: In a typical cycle, the faster speed is used to find the home switch and for the offset move, the slower speed is used to find the index pulse.
➔Homing Acceleration	0x609A	Specifies the acceleration during Homing
➔Home Offset Move Distance	0x30B1	The distance to move away from a detected position upon end of the homing sequence
➔Current Threshold for Homing Mode	0x30B2	The current threshold used for homing methods −1…−4
➔Home Position	0x30B0	Allows to displace zero in the user’s coordinate system

Table 4-27 Homing Mode – Commanding Parameters

CONTROLWORD (HOMING MODE-SPECIFIC BITS)

Bit 15…9	Bit 8	Bit 7	Bit 6, 5	Bit 4	Bit 3…0
➔ Table 7-116	Halt	➔ Table 7-116	reserved	Homing operation start	➔ Table 7-116

Table 4-28 Homing Mode – Controlword

Name	Value	Description
Homing operation start	0	Homing mode inactive
	0→1	Start homing mode
Halt	0	Execute instruction of bit 4
	1	Stop axis with ➔Homing Acceleration

Table 4-29 Homing Mode – Controlword Bits

OUTPUT PARAMETERS

Parameter	Index	Description
➔Statusword	0x6041	Mode state can be observed by the Statusword bits

Table 4-30 Homing Mode – Output Parameters

STATUSWORD (HOMING MODE-SPECIFIC BITS)

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
Position referenced to home position	➔ Table 7-117	Homing error	Homing attained	➔ Table 7-117	Target reached	➔ Table 7-117

Table 4-31 Homing Mode – Statusword

Name	Value	Description
Bit 15 Position referenced to home position	0	The position is not referenced to the home position (e.g. homing not yet attained or position overflow)
	1	Homing was attained and the position is referenced to the home position

Table 4-32 Homing Mode – Statusword Bit 15

Bit 13 Homing error	Bit 12 Homing attained	Bit 10 Target reached	Description
0	0	0	Homing procedure is in progress
0	0	1	Homing procedure is interrupted or not started
0	1	1	Homing procedure is completed successfully
1	0	0	Homing error occurred, velocity is not “0” (zero)
1	0	1	Homing error occurred, velocity is “0” (zero)
1	1	X	reserved

Table 4-33 Homing Mode – Statusword Bits 10, 12, and 13

4.5.3 Homing Methods

4.5.3.1 Homing Method 1 (Negative Limit Switch & Index)

The initial direction of the movement is negative (here to the left) if the negative limit switch is inactive (here shown as low).

a) The axis moves with Speed for Switch Search (➔Homing Speeds) to the positive edge of the limit switch (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) to the negative edge of the limit switch and further to the first encoder index pulse after the negative edge of the limit switch (2).

c) Now, the axis moves the ➔Home Offset Move Distance (3) in positive direction with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

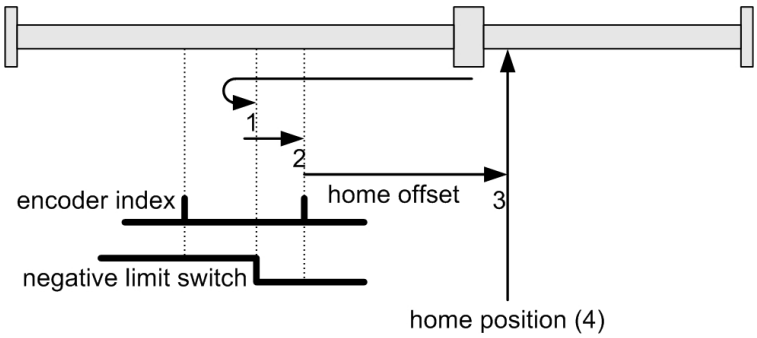


Figure 4-12 Homing Method 1

4.5.3.2 Homing Method 2 (Positive Limit Switch & Index)

The initial direction of the movement is positive (here to the right) if the positive limit switch is inactive (here shown as low).

a) The axis moves with Speed for Switch Search (➔Homing Speeds) to the positive edge of the limit switch (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) to the negative edge of the limit switch and further to the first encoder index pulse after the negative edge of the limit switch (2).

c) Now, the axis moves the ➔Home Offset Move Distance (3) in negative direction with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

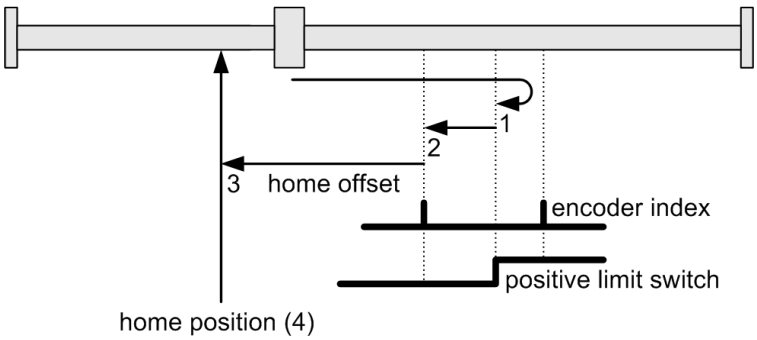


Figure 4-13 Homing Method 2

4.5.3.3 Homing Method 7 (Home Switch Positive Speed & Index)

The method uses a home switch, which is active only over a portion of the travel. In effect, the switch momentarily acts as the axis' position sweeps past the switch.

The initial direction of the movement is to the right (to positive position) except when the home switch is already active upon start of the motion.

a) The axis moves with Speed for Switch Search (➔Homing Speeds) to the positive edge of the limit switch (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) to the encoder index pulse (2).

c) Now, the axis moves the ➔Home Offset Move Distance (3) with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

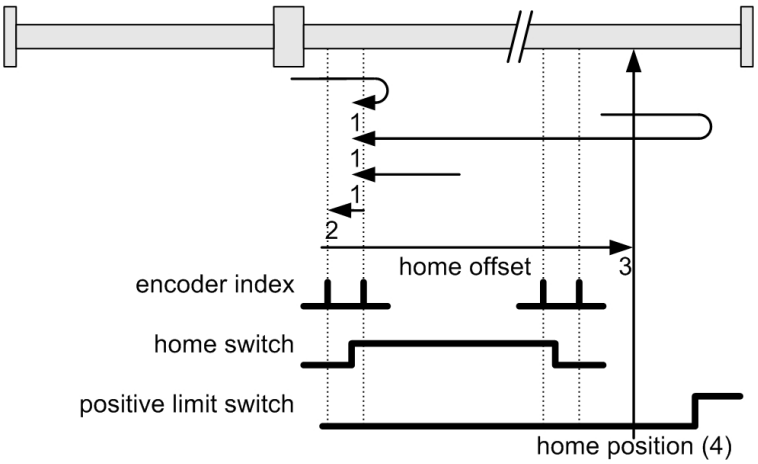


Figure 4-14 Homing Method 7

4.5.3.4 Homing Method 11 (Home Switch Negative Speed & Index)

The method uses a home switch, which is active only over a portion of the travel. In effect, the switch momentarily acts as the axis' position sweeps past the switch.

The initial direction of the movement is to the left (to negative position) except when the home switch is already active upon start of the motion.

a) The axis moves with Speed for Switch Search (➔Homing Speeds) to the positive edge of the limit switch (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) to the encoder index pulse (2).

c) Now, the axis moves the ➔Home Offset Move Distance (3) with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

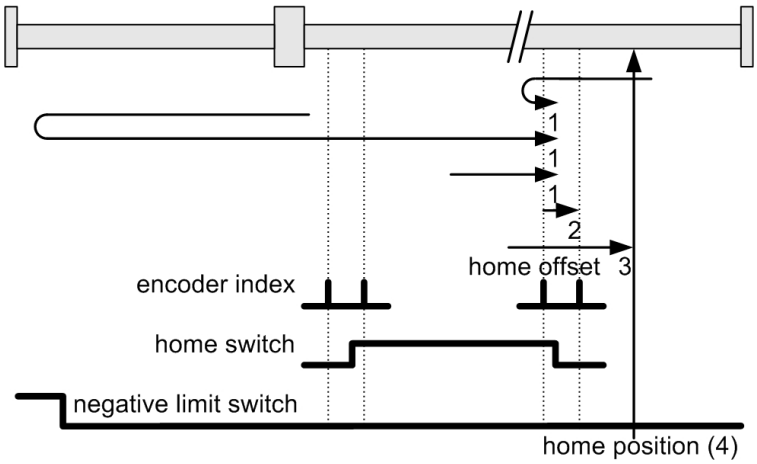


Figure 4-15 Homing Method 11

4.5.3.5 Homing Method 17 (Negative Limit Switch)

Similar to method 1 except that the ➔Home Position is not dependent on the index pulse but only on the negative edge of the negative limit switch.

4.5.3.6 Homing Method 18 (Positive Limit Switch)

Similar to method 2 except that the ➔Home Position is not dependent on the index pulse but only on the negative edge of the positive limit switch.

4.5.3.7 Homing Method 23 (Home Switch Positive Speed)

Similar to method 7 except that the ➔Home Position is not dependent on the index pulse but only on the falling edge of the home switch.

4.5.3.8 Homing Method 27 (Home Switch Negative Speed)

Similar to method 11 except that the ➔Home Position is not dependent on the index pulse but only on the falling edge of the home switch.

4.5.3.9 Homing Method 33 (Index Negative Speed)

The direction for homing is negative.

a) The axis moves with Speed for Zero Search (➔Homing Speeds) to the next encoder index pulse (33).

b) Now, the axis moves the ➔Home Offset Move Distance (2) with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

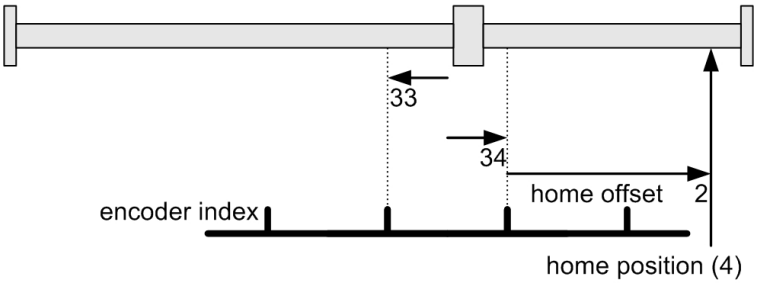


Figure 4-16 Homing Method 33

4.5.3.10 Homing Method 34 (Index Positive Speed)

The direction for homing is positive.

a) The axis moves with Speed for Zero Search (➔Homing Speeds) to the next encoder index pulse (34).

b) Now, the axis moves the ➔Home Offset Move Distance (2) with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

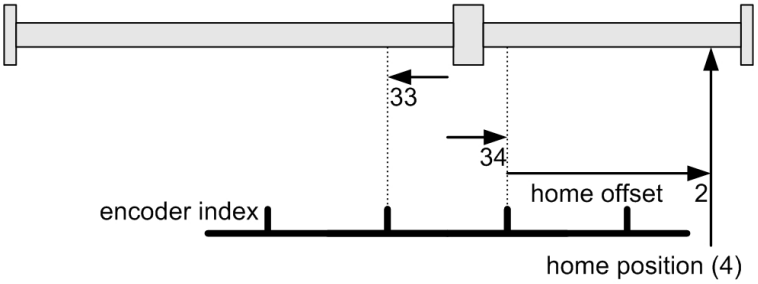


Figure 4-17 Homing Method 34

4.5.3.11 Homing Method 37 (Actual Position)

The axis moves the ➔Home Offset Move Distance in positive direction with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position.

The actual position is changed and considered as the future ➔Home Position.

The method may be used if the axis is disabled. In this case, the offset move (➔Home Offset Move Distance) is omitted.

4.5.3.12 Homing Method −1 (Current Threshold Positive Speed & Index)

Uses a mechanical limit stop in positive direction (here on the right side). This border is detected when the output current rises above ➔Current Threshold for Homing Mode.

a) The axis moves with positive Speed for Switch Search (➔Homing Speeds) to the mechanical end stop (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) back until the output current falls below ➔Current Threshold for Homing Mode and further to the first encoder index pulse.

c) Now, the axis moves the ➔Home Offset Move Distance (3) in negative direction with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

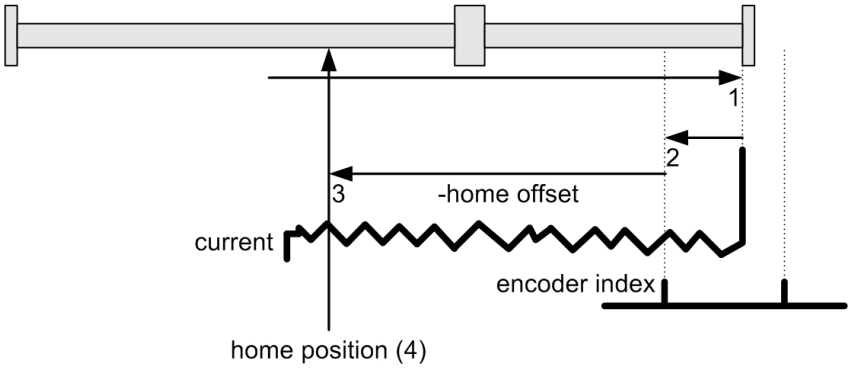


Figure 4-18 Homing Method −1

4.5.3.13 Homing Method −2 (Current Threshold Negative Speed & Index)

Uses a mechanical limit stop in negative direction (here on the left side). This border is detected when the output current rises above ➔Current Threshold for Homing Mode.

a) The axis moves with negative Speed for Switch Search (➔Homing Speeds) to the mechanical end stop (1).

b) The axis moves with Speed for Zero Search (➔Homing Speeds) back until the output current falls below ➔Current Threshold for Homing Mode and further to the first encoder index pulse.

c) Now, the axis moves the ➔Home Offset Move Distance (3) in positive direction with Speed for Switch Search (➔Homing Speeds). This point will be used as reference for all further moves and is set to ➔Home Position (4).

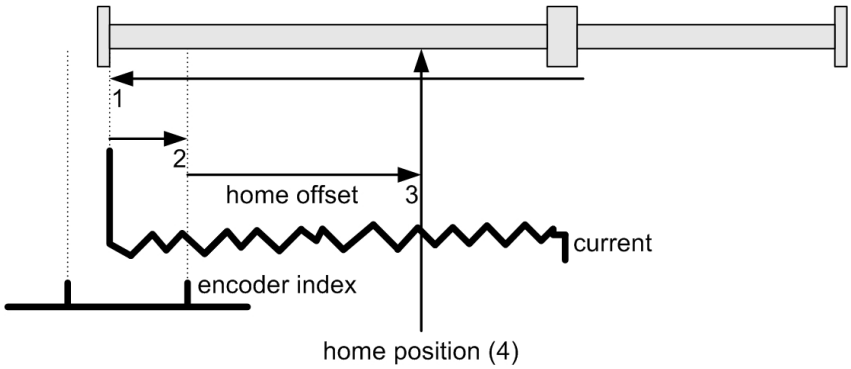


Figure 4-19 Homing Method −2

4.5.3.14 Homing Method −3 (Current Threshold Positive Speed)

Similar to method −1 except that the ➔Home Position is not dependent on the index pulse but only on mechanical limit stop.

4.5.3.15 Homing Method −4 (Current Threshold Negative Speed)

Similar to method −2 except that the ➔Home Position is not dependent on the index pulse but only on mechanical limit stop.

4.6 Position Control Function

Used for position-based modes, such as «Profile Position Mode» and «Homing Mode».

The control loop is fed with the “Position Demand Value” and “Position Actual Value” (the output of the position detection unit) like an encoder as input parameter. The behavior of the control may be influenced by externally applicable control parameters (Position Control Parameter Set). The output of the controller is a current demand value, which serves as input for the current controller.

Annotation
Items marked with an asterisk (*) refer to internal values.

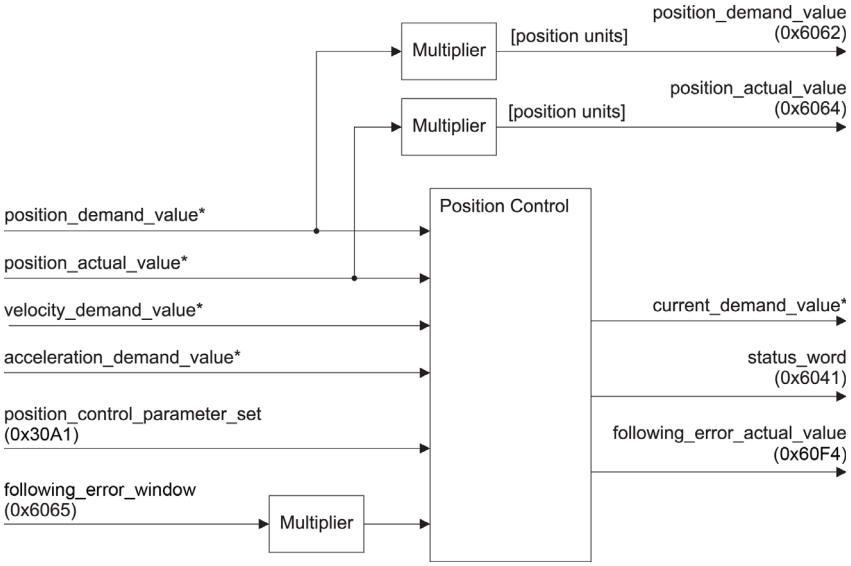


Figure 4-20 Position Control Function – Block Diagram

4.6.1 How to use «Position Control Function»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Following Error Window	0x6065	Defines the following error window. If the difference between Position Actual Value and Position Demand Value is larger than the following error window, a following error will occur.
➔Position Control Parameter Set	0x30A1	Configuration of the position controller. The parameters are defined by the controller properties bandwidth, reset time, and damping factor.

Table 4-34 Position Control Function – Configuration Parameters

COMMANDING PARAMETERS

There are no commanding parameters. The Position Control Function is directly commanded by position-based operating modes (such as Profile Position Mode, Homing Mode).

OUTPUT PARAMETERS

Parameter	Index	Description
➔Position Demand Value	0x6062	The operation mode's output. It is used as input for the position control function. Generally, the value is the trajectory generator output.
➔Position Actual Value	0x6064	The actual position is absolute and referenced to system zero position in position units.

Table 4-35 Position Control Function – Output Parameters

4.7 Velocity Control Function

Used for velocity-based modes, such as «Profile Velocity Mode».

The control loop is fed with the “Velocity Demand Value” and “Position Actual Value” (the output of the position detection unit) like an encoder as input parameter. The behavior of the control may be influenced by externally applicable control parameters. The output of the controller is a current demand value, which serves as input for the current controller.

Annotation
Items marked with an asterisk (*) refer to internal values.

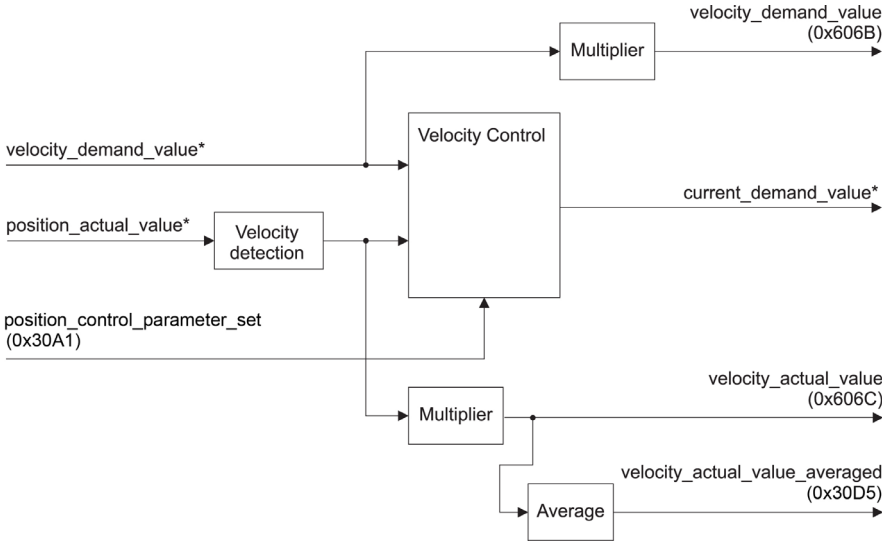


Figure 4-21 Velocity Control Function – Block Diagram

4.7.1 How to use «Velocity Control Function»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Position Control Parameter Set	0x30A1	Configuration of the velocity controller. The parameters are defined by the controller properties bandwidth, reset time, and damping factor.

Table 4-36 Velocity Control Function – Configuration Parameters

COMMANDING PARAMETERS

There are no commanding parameters. The Velocity Control Function is directly commanded by velocity-based operating modes (as Profile Velocity Mode).

OUTPUT PARAMETERS

Parameter	Index	Description
➔Velocity Demand Value	0x606B	The operation mode's output. It is used as input for the velocity control function. Generally, the value is the output of the trajectory generator.
➔Velocity Actual Value	0x606C	The actual velocity value
➔Velocity Actual Value Averaged	0x30D5	The averaged actual velocity value

Table 4-37 Velocity Control Function – Output Parameters

4.8 Current Control Function

All operating modes are based on the current control function. The “Current Demand Value” is received from a superordinate position or the velocity controller.

Annotation
Items marked with an asterisk (*) refer to internal values.

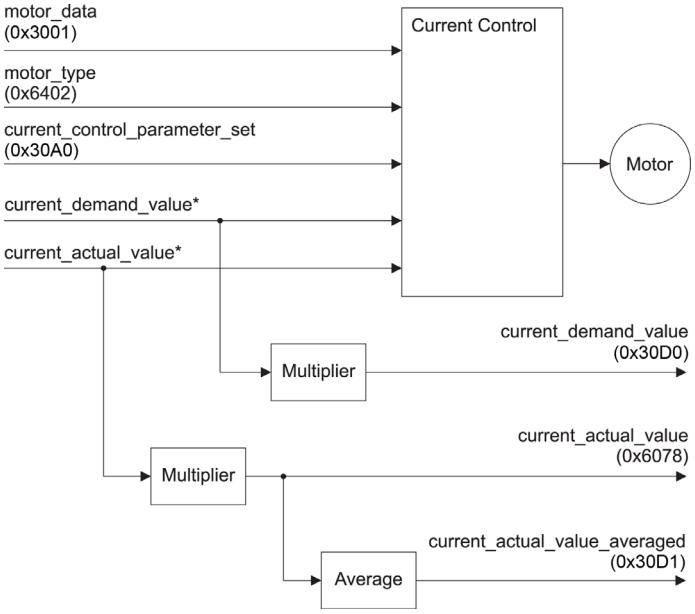


Figure 4-22 Current Control Function – Block Diagram

4.8.1 Output Current Limitation according to I²t Method

With properly setup ➔Motor Data, the device will limit the output current according to I²t method with the parameters “Nominal Current”, “Output Current Limit”, and “Thermal Time Constant Winding”. The I2t method assumes an ambient temperature of 25 °C. If this condition is not fulfilled, the output current must be reduced by adjusting the above mentioned parameters to the actual ambient temperature.

The heating-up of the motor is given as follows

$$\vartheta = P_V \cdot R_{th} \cdot \left(1 - e^{-\frac{t}{\tau_{th}}} \right) + \vartheta_a \cdot e^{-\frac{t}{\tau_{th}}}$$

ϑ calculated actual winding temperature

P_V thermal dissipation loss

R_{th} thermal resistance

ϑ_a temperature at beginning of measuring period

τ_{th} thermal time constant winding

4.8.2 How to use «Current Control Function»

CONFIGURATION PARAMETERS

Parameter	Index	Description
➔Current Control Parameter Set	0x30A0	Configuration of the current controller gains
➔Motor Data	0x3001	Used for configuration of motor-dependent parameters
➔Motor Type	0x6402	Used to define the type of motor

Table 4-38 Current Control Function – Configuration Parameters

COMMANDING PARAMETERS

There are no commanding parameters. The Current Control Function is commanded by the control loops “Position Control Function” or “Velocity Control Function”, or directly by operating mode «Cyclic Synchronous Torque Mode».

OUTPUT PARAMETERS

Parameter	Index	Description
➔Current Demand Value	0x30D0	Set value for current controller
➔Current Actual Value	0x6078	Actual current value
➔Current Actual Value Averaged	0x30D1	Averaged actual current value

Table 4-39 Current Control Function – Output Parameters

4.9 Cyclic Synchronous Position Mode (CSP)

With Cyclic Synchronous Position Mode, the trajectory generator is located in the control device (not in the drive device). It provides a target position to the drive device in cyclic synchronous manner, thus the drive position control and torque control.

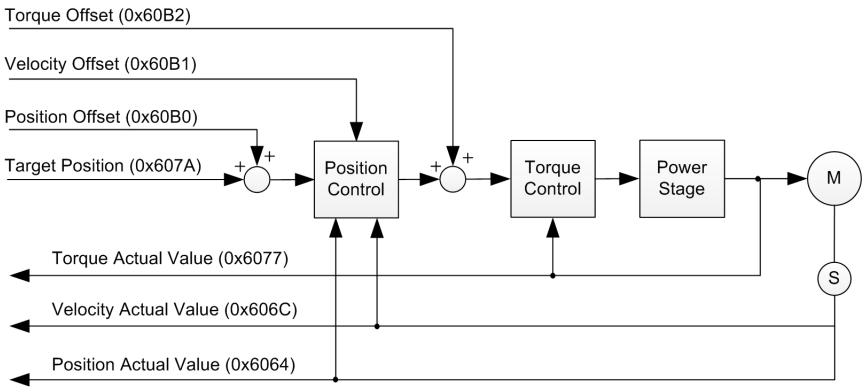


Figure 4-23 Cyclic Synchronous Position Mode – Overview

Cyclic Synchronous Position Mode is based on position control function. The inputs are “Target Position” and (optionally) “Position Offset”. Furthermore, an optional velocity and torque offset are being used for feed forward control. The “Motor Data” input is used to define limitations for current value (torque). Other features specified in this mode are limit functions used to restrict the range of values to avoid unintended positions as well as monitoring of the following error. In this mode, the motor speed is not limited. Actual values for position, velocity, and torque are used as output to the control device.

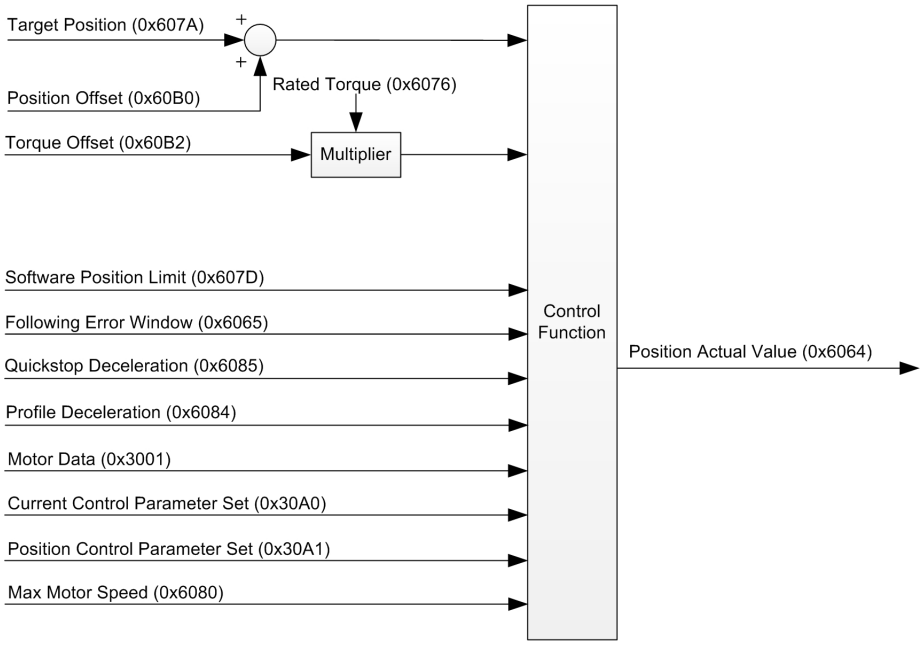


Figure 4-24 Cyclic Synchronous Position Mode – Block Diagram

4.9.1 How to use «CSP»

CONFIGURATION PARAMETERS

Parameter	Index	Description
Nominal Current (➔Motor Data)	0x3001-01	The maximal permissible continuous current of the motor
Motor Torque Constant (➔Motor Data)	0x3001-05	The torque constant of the motor
➔Current Control Parameter Set	0x30A0	Configuration of the current controller gains
➔Position Control Parameter Set	0x30A1	Configuration of the position controller. The parameters are defined by the controller properties bandwidth, reset time and damping factor.
➔Quick Stop Deceleration	0x6085-00	Defines the deceleration for the Quick Stop ramp
➔Profile Deceleration	0x6084-00	Defines the deceleration for the slowdown ramp
➔Following Error Window	0x6065	The maximal allowed difference of position actual value to position demand value. If exceeded, following error is generated.
➔Software Position Limit	0x607D	Used to restrict the absolute position range. If the target position or the actual position exceeds the range, a software position limit error is generated.
➔Motor Rated Torque	0x6076-00	Holds the value to which all torque objects are related to

Table 4-40 Cyclic Synchronous Position Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Target Position	0x607A-00	Position input value for the position controller
➔Position Offset	0x60B0-00	Optional additive position value which is added to the target position
➔Velocity Offset	0x60B1-00	Optional velocity feed forward input
➔Torque Offset	0x60B2-00	Optional torque feed forward input

Table 4-41 Cyclic Synchronous Position Mode – Commanding Parameters

CONTROLWORD

Cyclic Synchronous Position Mode does not use mode-specific controlword bits.

OUTPUT PARAMETERS

Parameter	Index	Description
➔Torque Actual Value	0x6077-00	Actual motor torque value
➔Velocity Actual Value	0x606C-00	Actual velocity value [velocity units]
➔Position Actual Value	0x6064-00	Actual position is absolute and referenced to system zero position
➔Current Actual Value	0x6078-00	Actual motor current value
➔Current Demand Value	0x30D0-00	Holds the actual set value for the current controller
➔Position Demand Value	0x6062-00	Holds the actual set value for the position controller
➔Following Error Actual Value	0x60F4-00	The actual value of the following error

Table 4-42 Cyclic Synchronous Position Mode – Output Parameters

STATUSWORD (CYCLIC SYNCHRONOUS POSITION MODE-SPECIFIC BITS)

Bit 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
➔Table 7-117	following error	drive follows command value	➔Table 7-117	reserved	➔Table 7-117

Table 4-43 Cyclic Synchronous Position Mode – Statusword

Name	Value	Description
drive follows command	0	Drive does not follow the target value
	1	Drive is in state operation enable and follows the target and setpoint values of the control device
following error	0	No following error
	1	Difference of position demand value and position actual value exceeds the defined maximal following error

Table 4-44 Cyclic Synchronous Position Mode – Statusword Bits

4.10 Cyclic Synchronous Velocity Mode (CSV)

With Cyclic Synchronous Velocity Mode, the trajectory generator is located in the control device (not in the drive device). It provides a target velocity to the drive device in cyclic synchronous manner, thus the drive velocity control and torque control.

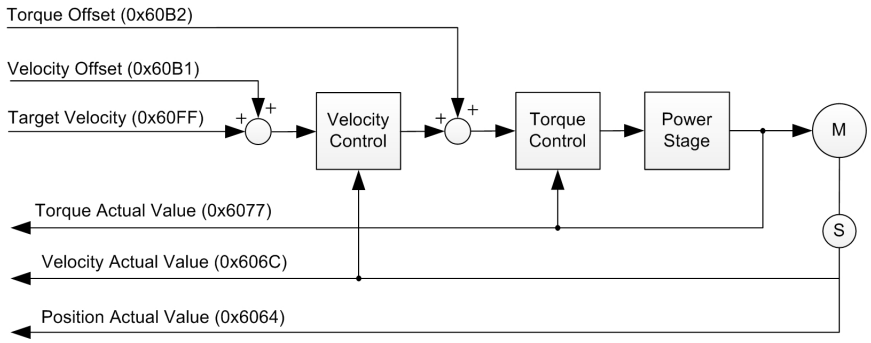


Figure 4-25 Cyclic Synchronous Velocity Mode – Overview

Cyclic Synchronous Velocity Mode is based on velocity control function. The inputs are «Target Velocity». Optionally, additive velocity and torque values may be provided by the control system in order to allow a second source for velocity and/or a torque feed forward control. The «Motor Data» input is used to define limitations for velocity and current values. Actual values for position, velocity, and torque are used as output to the control device.

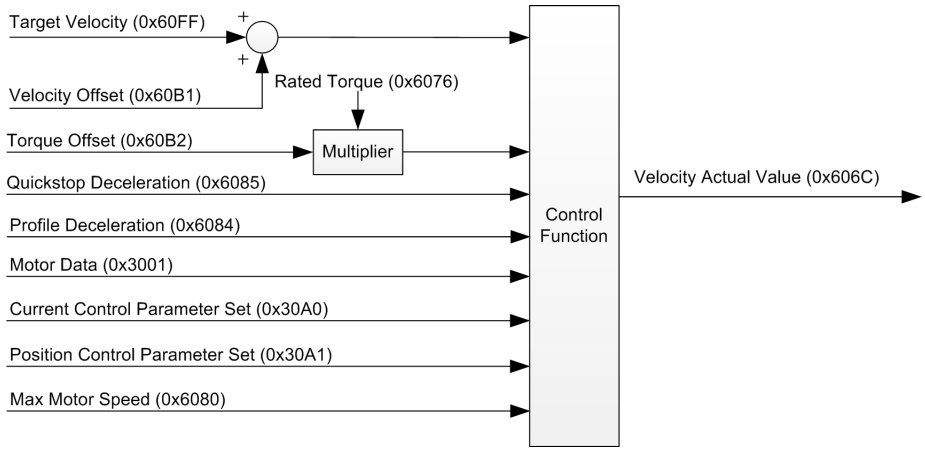


Figure 4-26 Cyclic Synchronous Velocity Mode – Block Diagram

4.10.1 How to use «CSV»

CONFIGURATION PARAMETERS

Parameter	Index	Description
Nominal Current (➔Motor Data)	0x3001-01	The maximal permissible continuous current of the motor
Motor Torque Constant (➔Motor Data)	0x3001-05	The torque constant of the motor
➔Current Control Parameter Set	0x30A0	Configuration of the current controller gains
➔Position Control Parameter Set	0x30A1	The position controller gains
➔Quick Stop Deceleration	0x6085-00	Defines the deceleration for the Quick Stop ramp
➔Profile Deceleration	0x6084-00	Defines the deceleration for the slowdown ramp
➔Software Position Limit	0x607D	Used to restrict the absolute position range. If the target position or the actual position exceeds the range, a software position limit error is generated.
➔Motor Rated Torque	0x6076-00	Holds the value to which all torque objects are related to

Table 4-45 Cyclic Synchronous Velocity Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Target Velocity	0x60FF-00	Velocity input value for the velocity controller
➔Velocity Offset	0x60B1-00	Optional velocity feed forward input
➔Torque Offset	0x60B2-00	Optional torque feed forward input

Table 4-46 Cyclic Synchronous Velocity Mode – Commanding Parameters

CONTROLWORD

Cyclic Synchronous Velocity Mode does not use mode-specific controlword bits.

OUTPUT PARAMETERS

Parameter	Index	Description
➔Torque Actual Value	0x6077-00	Actual motor torque value
➔Velocity Actual Value	0x606C-00	Actual velocity value [velocity units]
➔Position Actual Value	0x6064-00	Actual position is absolute and referenced to system zero position
➔Current Actual Value	0x6078-00	Actual motor current value
➔Velocity Demand Value	0x606B-00	Holds the actual set value for the velocity controller
➔Current Demand Value	0x30D0-00	Holds the actual set value for the current controller

Table 4-47 Cyclic Synchronous Velocity Mode – Output Parameters

STATUSWORD (CYCLIC SYNCHRONOUS VELOCITY MODE-SPECIFIC BITS)

Bit 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
➔Table 7-117	reserved	drive follows command value	➔Table 7-117	reserved	➔Table 7-117

Table 4-48 Cyclic Synchronous Velocity Mode – Statusword

Name	Value	Description
drive follows command	0	Drive does not follow the target value
	1	Drive is in state operation enable and follows the target and setpoint values of the control device

Table 4-49 Cyclic Synchronous Velocity Mode – Statusword Bits

4.11 Cyclic Synchronous Torque Mode (CST)

With Cyclic Synchronous Torque Mode, the trajectory generator is located in the control device (not in the drive device). It provides a target torque to the drive device in cyclic synchronous manner, thus the drive performing torque control.

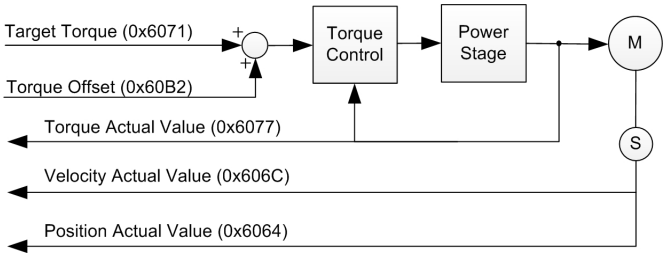


Figure 4-27 Cyclic Synchronous Torque Mode – Overview

Cyclic Synchronous Torque Mode is based on the current control function. The inputs are “Target Torque” and (optionally) “Torque Offset”. The “Motor Data” input is used to define limitations for velocity and current values. Actual values for position, velocity, and torque are used as output to the control device.

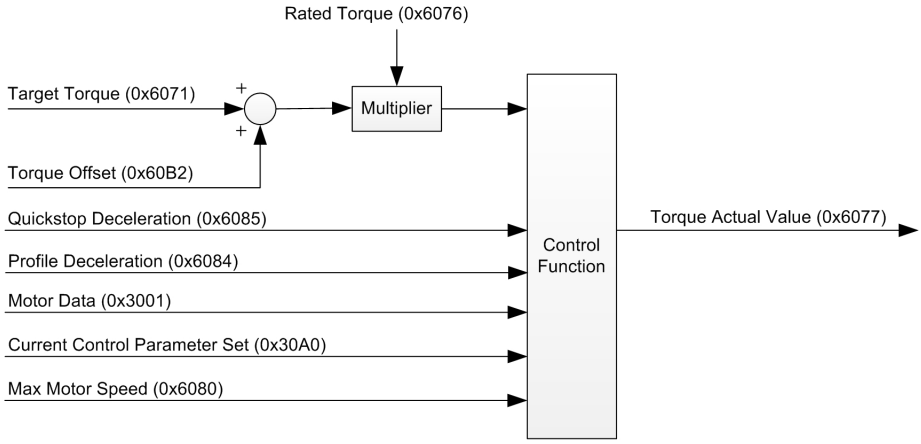


Figure 4-28 Cyclic Synchronous Torque Mode – Block Diagram

4.11.1 How to use «CST»

CONFIGURATION PARAMETERS

Parameter	Index	Description
Nominal Current (➔Motor Data)	0x3001-01	The maximal permissible continuous current of the motor
Motor Torque Constant (➔Motor Data)	0x3001-05	The torque constant of the motor
Maximal Motor Speed	0x6080-00	Indicates the configured maximal allowed speed for the motor
➔Current Control Parameter Set	0x30A0	Configuration of the current controller gains
➔Quick Stop Deceleration	0x6085-00	Defines the deceleration for the Quick Stop ramp
➔Profile Deceleration	0x6084-00	Defines the deceleration for the slowdown ramp
➔Motor Rated Torque	0x6076-00	Holds the value to which all torque objects are related to
➔Software Position Limit	0x607D	Limits used to restrict the absolute position range. If the actual position exceeds the defined range, a software position limit error will be generated.

Table 4-50 Cyclic Synchronous Torque Mode – Configuration Parameters

COMMANDING PARAMETERS

Parameter	Index	Description
➔Target Torque	0x6071-00	Torque input value for the torque controller
➔Torque Offset	0x60B2-00	Optional additive torque which is added to the target torque value

Table 4-51 Cyclic Synchronous Torque Mode – Commanding Parameters

CONTROLWORD

Cyclic Synchronous Torque Mode does not use mode-specific controlword bits.

OUTPUT PARAMETERS

Parameter	Index	Description
➔Torque Actual Value	0x6077-00	Actual motor torque value
➔Velocity Actual Value	0x606C-00	Actual velocity value [velocity units]
➔Position Actual Value	0x6064-00	Actual position is absolute and referenced to system zero position
➔Current Actual Value	0x6078-00	Actual motor current value
➔Additional Velocity Actual Values	0x60E5	Actual velocity value [inc/s]
➔Current Demand Value	0x30D0-00	Holds the set value for the current controller
➔Current Actual Value Averaged	0x30D1-00	The filtered average torque value

Table 4-52 Cyclic Synchronous Torque Mode – Output Parameters

STATUSWORD (CYCLIC SYNCHRONOUS TORQUE MODE-SPECIFIC BITS)

Bit 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9…0
➔Table 7-117	reserved	drive follows command value	➔Table 7-117	reserved	➔Table 7-117

Table 4-53 Cyclic Synchronous Torque Mode – Statusword

Name	Value	Description
drive follows command	0	Drive does not follow the target value
	1	Drive is in state operation enables and follows the target and setpoint values of the control device

Table 4-54 Cyclic Synchronous Torque Mode – Statusword Bits

5 INPUTS AND OUTPUTS

5.1 Digital Inputs

Available are predefined functions and general purpose inputs for process control.

Configuration of the digital input functions is done with ➔Configuration of Digital Inputs, the polarity is set with ➔Digital Input Properties.

The input logic state is read with ➔Digital Input Properties while the functionality state is read with ➔Digital Inputs.

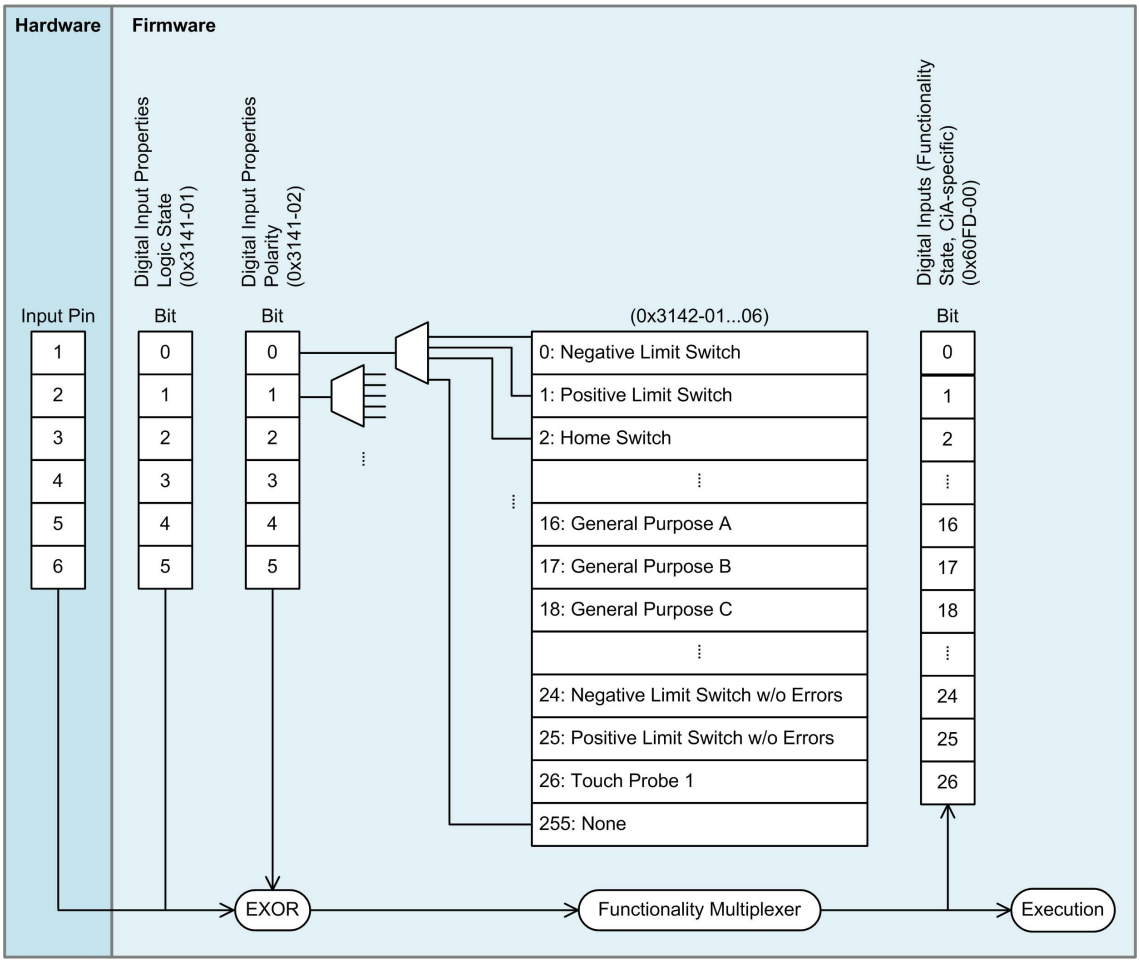


Figure 5-29 Digital Input Functionality – Overview (MAXPOS 50/5)

DIGITAL INPUT TIMING BEHAVIOR

- **Hardware**
  For details on voltage levels and switching delays ➔separate document «Hardware Reference» of respective controller.
- **Software filter**
  Digital inputs are filtered to suppress spikes. The filter has a length of 500 µs. Therefore, to detect a a state change (edge), the input level must be stable for more than 500 µs.
- **Update rates**
  The digital input functionality states (➔Digital Inputs) are updated with 1 kHz. The logic states (➔Digital Input Properties) are updated when the object is read, no update rate applies. The reference positions evaluated with touch probe or homing mode are immediately latched upon the expected signal edge (within ~100 ns).

5.2 Digital Outputs

Available are predefined functions and general purpose outputs for process control.

Configuration of the digital output functions is done with ➔Configuration of Digital Outputs, the polarity is set with ➔Digital Output Properties.

The functionality state can be set with ➔Digital Outputs, the logic state of the corresponding pin can be read with ➔Digital Output Properties.

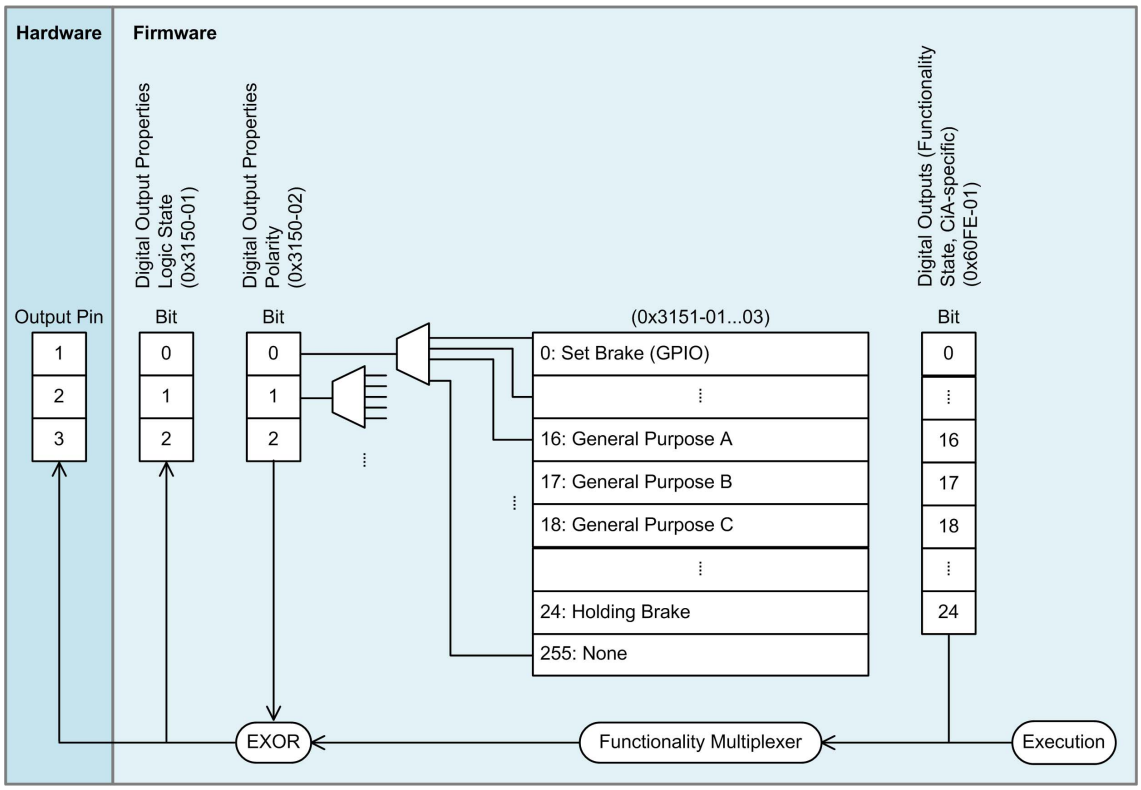


Figure 5-30 Digital Output Functionality – Overview (MAXPOS 50/5)

DIGITAL OUTPUT TIMING BEHAVIOR

- **Hardware**
  For details on voltage levels and switching delays ➔separate document «Hardware Reference» of respective controller.
- **Update rates**
  Digital outputs (➔Digital Outputs) are updated when the object is written, no update rate applies. The same applies for the logic state (➔Digital Output Properties).

6 COMMUNICATION

The MAXPOS EtherCAT supports communication over EtherCAT and USB interface. For detailed information ➔separate document «MAXPOS Application Notes» (for sources ➔chapter “1.6 Sources for additional Information” on page 1-8).

6.1 EtherCAT State Machine (ESM)

The EtherCAT State Machine coordinates both Master and Slave during startup and operation. Their interaction (Master ↔ Slave) results in changes of states being related to writes to the Application Layer Control-word: AL Ctrl (0x0120).

Upon initialization of Data Layer and Application Layer, the ESM enters “Init” state which defines the Application Layer's root of the communication relationship between Master and Slave. In the Application Layer, no direct communication between Master and Slave is possible. The Master uses “Init” state…

- to initialize a configuration register set and
- to configure the Sync Manager.

Operation of the connected MAXPOS (the Slave) requires its prior initialization by the Master via the ESM. Within the ESM, transitions between certain states must follow a given scheme and will be initiated by the Master. The Slave itself must not execute any transition.

For an overview of the EtherCAT State Machine ➔Figure 6-31, for further descriptions ➔as from Table 6-55.

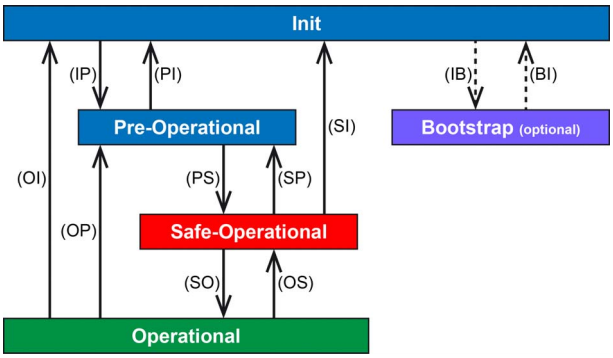


Figure 6-31 EtherCAT State Machine – Scheme

Condition	Description
Power ON	• MAXPOS is ON • MAXPOS autonomously initializes and switches to state “Init”
Init	• Master will synchronize the EtherCAT field bus • Asynchronous communication between Master and Slave (Mailbox) will be established. At this time, no direct communication (Master n Slave) will yet take place. • When all devices have been connected to the field bus and have successfully passed configuration, state will be changed to “Pre-Operational”
Pre-Operational	• Asynchronous communication between Master and Slave (Mailbox) will be active. • Master will setup cyclic communication via PDOs and necessary parameterization via acyclic communication. • Upon successful completion, the Master will change to state “Safe-Operational”.
Safe-Operational	• Used to establish a safe operation condition of all devices connected to the EtherCAT field bus. Thereby, the Slave sends actual values to the Master while ignoring new setpoint values of the Master and using save default values instead. • Upon successful completion, the Master will change to state “Operational”

Continued on next page.

Condition	Description
Operational	• Acyclic as well as cyclic communication is active • Master and Slave exchange setpoint and actual values • MAXPOS be enabled and operated via the CoE protocol
Bootstrap	• Only FoE is possible (Mailbox) • Firmware download via FoE

Table 6-55 EtherCAT State Machine – Conditions

Status Transition	Status
IP	Start of acyclic communication (Mailbox)
PI	Stop of acyclic communication (Mailbox)
PS	Start of cyclic communication (Process Data) Slave sends actual values to Master Slave ignores setpoint values by the Master and uses default values
SP	Stop of cyclic communication (Process Data) Slave ceases to send actual values to the Master
SO	Slave evaluates actual setpoint values of the Master
OS	Slave ignores setpoint values from Master and uses internal default values
OP	Stop of cyclic communication (Process Data) Slave ceases to send actual values to the Master Master ceases to send actual values to the Slave
SI	Stop of cyclic communication (Process Data) Stop of acyclic communication (Mailbox) Slave ceases to send actual values to the Master Master ceases to send actual values to the Slave
OI	Stop of cyclic communication (Process Data) Stop of acyclic communication (Mailbox) Slave ceases to send actual values to the Master Master ceases to send actual values to the Slave
IB	Start Bootstrap Mode Firmware download via FoE (Mailbox)
BI	Reset device after successful firmware download

Table 6-56 EtherCAT State Machine – Transitions

Parameter	Address	Bit	Description
Control	0x120	3…0	0x01: Init Request 0x02: Pre-Operational Request 0x03: Bootstrap Mode Request 0x04: Safe-Operational Request 0x08: Operational Request
Error Acknowledge	0x120	4	0x00: No error acknowledgment 0x01: Error acknowledgment at rising edge
reserved	0x120	7…5	–
Application-specific	0x120	15…8	–

Table 6-57 EtherCAT State Machine – Control Register

7 OBJECT DICTIONARY

7.1 Overview

7.1.1 Object Data Types

Index	Name	Base Type	Description	Size [Bits]	Range
0x0001	BOOLEAN	BOOL	False/True	1	0.1
0x0002	INTEGER8	SINT	Short Integer	8	$-2^{7}\ldots2^{7}-1$
0x0003	INTEGER16	INT	Integer	16	$-2^{15}\ldots2^{15}-1$
0x0004	INTEGER32	DINT	Double Integer	32	$-2^{31}\ldots2^{31}-1$
0x0015	INTEGER64	LINT	Long Integer	64	$-2^{63}\ldots2^{63}-1$
0x0005	UNSIGNED8	USINT	Unsigned Short Integer	8	$0\ldots2^{8}-1$
0x0006	UNSIGNED16	UINT	Unsigned Integer	16	$0\ldots2^{16}-1$
0x0007	UNSIGNED32	UDINT	Unsigned Double Integer	32	$0\ldots2^{32}-1$
0x001B	UNSIGNED64	ULINT	Unsigned Long Integer	64	$0\ldots2^{64}-1$
0x0009	VISIBLE_STRING	STRING(n)	Visible String (1 octet per character)	8*n	–
0x000A	OCTET_STRING	ARRAY[0… n] of USINT	Sequence of octets (data type USINT)	8*(n+1)	–
0x0021	PDO_MAPPING	–	PDO Mapping Parameter Record	–	–
0x0023	IDENTITY	–	Identity Parameter Record	–	–

Table 7-58 Object Data Types

7.1.2 Object Codes

Object Code	Object Name
0x0007	VAR
0x0008	ARRAY
0x0009	RECORD

Table 7-59 Object Codes

7.1.3 Object Access Types

Access Type	Description
RW	read and write access
RO	read only access
WO	write only access

Table 7-60 Object Access Types

7.1.4 Object Flags

Flag	Code	Description
PDO Mapping	TXPDO, RXPDO, TRXPDO	Entry can be mapped as TxPdo, RxPdo, or both
Backup	YES/NO	Entry can be stored/not stored in non-volatile memory

Table 7-61 Object Flags

7.1.5 Entries Overview

Index	Name	Object Code
0x1000	➔Device Type	VAR
0x1001	➔Error Register	VAR
0x1008	➔Manufacturer Device Name	VAR
0x1018	➔Identity Object	RECORD
0x10F3	➔Diagnosis History	RECORD
0x1600	➔Receive PDO 1 Mapping	RECORD
0x1601	➔Receive PDO 2 Mapping	RECORD
0x1602	➔Receive PDO 3 Mapping	RECORD
0x1603	➔Receive PDO 4 Mapping	RECORD
0x1A00	➔Transmit PDO 1 Mapping	RECORD
0x1A01	➔Transmit PDO 2 Mapping	RECORD
0x1A02	➔Transmit PDO 3 Mapping	RECORD
0x1A03	➔Transmit PDO 4 Mapping	RECORD
0x1C00	➔Sync Manager Communication Type	ARRAY
0x1C12	➔Sync Manager 2 PDO Assignment	ARRAY
0x1C13	➔Sync Manager 3 PDO Assignment	ARRAY
0x1C32	➔Sync Manager Output Parameter	RECORD
0x1C33	➔Sync Manager Input Parameter	RECORD
0x2100	➔Serial Number Complete	VAR
0x2110	➔Store Parameters	ARRAY
0x2111	➔Restore Default Parameters	ARRAY
0x3000	➔Axis Configuration	ARRAY
0x3001	➔Motor Data	RECORD
0x3010	➔Digital Incremental Encoder 1	RECORD
0x3011	➔Analog Incremental Encoder (sin/cos)	RECORD
0x3012	➔SSI Absolute Encoder	RECORD
0x3014	➔BiSS Absolute Encoder	RECORD
0x301A	➔Digital Hall Sensor	RECORD
0x3020	➔Digital Incremental Encoder 2	RECORD
0x30A0	➔Current Control Parameter Set	ARRAY
0x30A1	➔Position Control Parameter Set	ARRAY
0x30B0	➔Home Position	VAR
0x30B1	➔Home Offset Move Distance	VAR
0x30B2	➔Current Threshold for Homing Mode	VAR

Continued on next page.

Index	Name	Object Code
0x30D0	➔Current Demand Value	VAR
0x30D1	➔Current Actual Value Averaged	VAR
0x30D5	➔Velocity Actual Value Averaged	VAR
0x30E0	➔Standstill Window Configuration	RECORD
0x3141	➔Digital Input Properties	ARRAY
0x3142	➔Configuration of Digital Inputs	ARRAY
0x3150	➔Digital Output Properties	ARRAY
0x3151	➔Configuration of Digital Outputs	ARRAY
0x3158	➔Holding Brake Configuration	ARRAY
0x6007	➔Abort Connection Option Code	VAR
0x603F	➔Error Code	VAR
0x6040	➔Controlword	VAR
0x6041	➔Statusword	VAR
0x605A	➔Quick Stop Option Code	VAR
0x605B	➔Shutdown Option Code	VAR
0x605C	➔Disable Operation Option Code	VAR
0x605D	➔Halt Option Code	VAR
0x605E	➔Fault Reaction Option Code	VAR
0x6060	➔Modes of Operation	VAR
0x6061	➔Modes of Operation Display	VAR
0x6062	➔Position Demand Value	VAR
0x6064	➔Position Actual Value	VAR
0x6065	➔Following Error Window	VAR
0x6066	➔Following Error Timeout	VAR
0x606B	➔Velocity Demand Value	VAR
0x606C	➔Velocity Actual Value	VAR
0x6071	➔Target Torque	VAR
0x6076	➔Motor Rated Torque	VAR
0x6077	➔Torque Actual Value	VAR
0x6078	➔Current Actual Value	VAR
0x607A	➔Target Position	VAR
0x607B	➔Position Range Limit	ARRAY
0x607D	➔Software Position Limit	ARRAY
0x607F	➔Max Profile Velocity	VAR
0x6080	➔Max Motor Speed	VAR
0x6081	➔Profile Velocity	VAR
0x6083	➔Profile Acceleration	VAR
0x6084	➔Profile Deceleration	VAR
0x6085	➔Quick Stop Deceleration	VAR
0x6086	➔Motion Profile Type	VAR
0x6098	➔Homing Method	VAR
0x6099	➔Homing Speeds	ARRAY

Continued on next page.

Index	Name	Object Code
0x609A	➔Homing Acceleration	VAR
0x60A8	➔SI Unit Position	VAR
0x60A9	➔SI Unit Velocity	VAR
0x60AA	➔SI Unit Acceleration	VAR
0x60B0	➔Position Offset	VAR
0x60B1	➔Velocity Offset	VAR
0x60B2	➔Torque Offset	VAR
0x60B8	➔Touch Probe Function	VAR
0x60B9	➔Touch Probe Status	VAR
0x60BA	➔Touch Probe Position 1 Positive Value	VAR
0x60BB	➔Touch Probe Position 1 Negative Value	VAR
0x60C2	➔Interpolation Time Period	RECORD
0x60C5	➔Max Acceleration	VAR
0x60D0	➔Touch Probe Source	ARRAY
0x60D5	➔Touch Probe 1 Positive Edge Counter	VAR
0x60D6	➔Touch Probe 1 Negative Edge Counter	VAR
0x60E3	➔Supported Homing Methods	ARRAY
0x60E4	➔Additional Position Actual Values	ARRAY
0x60E5	➔Additional Velocity Actual Values	ARRAY
0x60F4	➔Following Error Actual Value	VAR
0x60FD	➔Digital Inputs	VAR
0x60FE	➔Digital Outputs	ARRAY
0x60FF	➔Target Velocity	VAR
0x6402	➔Motor Type	VAR
0x6502	➔Supported Drive Modes	VAR
0xF000	➔Modular Device Profile	RECORD
0xF010	➔Module Profile List	ARRAY
0xF050	➔Detected Module List	ARRAY

Table 7-62 Object Dictionary Overview

7.2 Objects

Annotation
Items marked with an asterisk (*) refer to internal values.
Items marked with three trailing asterisks (***) are not yet implemented.

7.2.1 Device Type

Describes the device type. The lower word stands for the supported device profile number. The value 0x0192 (402) means that the device follows CiA 402 Device Profile Drives and Motion Control. The higher word holds information on the drive type. The value 0x0002 means that the drive is a servo drive.

Name	Device Type	
Index	0x1000	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	0x00020192	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.2 Error Register

An error register for the device. The device maps internal errors in this byte.

Name	Error Register	
Index	0x1001	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	0	
Value Range	–	–
PDO Mapping	YES	
Backup	NO	

Bit	Description
7	Motion error
6	reserved (always 0)
5	Device profile-specific
4	Communication error
3	Temperature error
2	Voltage error
1	Current error
0	Generic error

Table 7-63 Error Register Bits

7.2.3 Manufacturer Device Name

Holds the manufacturer device name.

Name	Manufacturer Device Name	
Index	0x1008	
Subindex	0x00	
Data Type	VISIBLE_STRING	
Access Type	RO	
Default Value	“MAXPOS”	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.4 Identity Object

Provides general identification information on the device.

Name	Identity Object
Index	0x1018
Object Code	RECORD
Data Type	IDENTITY

7.2.4.1 Highest Subindex supported

Number of entries supported by the Identity Object.

Name	Highest Subindex supported	
Index	0x1018	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	4	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.4.2 Vendor ID

Unique “maxon motor ag” vendor identification defined by CiA.

Name	Vendor ID	
Index	0x1018	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	0x000000FB	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.4.3 Product Code

The high word contains the hardware version. The low word contains the application number.

Name	Product Code	
Index	0x1018	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Hardware Version	Description
0x30xx	MAXPOS 50/5

Table 7-64 Definition of Hardware Version

7.2.4.4 Revision Number

The high word contains the software version. The low word contains the application version.

Name	Revision Number	
Index	0x1018	
Subindex	0x03	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.4.5 Serial Number

Contains the last 8 digits of the device serial number.

Related Objects: ➔“Serial Number Complete” on page 7-86

Name	Serial Number	
Index	0x1018	
Subindex	0x04	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.5 Diagnosis History

Allows the EtherCAT master to access the latest diagnosis messages. Up to maximal 10 diagnosis messages can be accessed.

In case of an error, the corresponding message will be displayed in «TwinCAT» (tab “Diag History”) and in «MAXPOS Studio».

The error may be cleared by writing the value 0x80 to the ➔“Controlword” on page 7-138.

Name	Diagnosis History
Index	0x10F3
Object Code	RECORD
Max Subindex	6…15

7.2.5.1 Maximum Messages

Number of diagnosis messages that can be stored in the diagnosis history (subindex 6 onwards).

Name	Maximum Messages	
Index	0x10F3	
Subindex	0x01	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.5.2 Newest Message

Subindex of the latest diagnosis message (6…255).

Name	Newest Message	
Index	0x10F3	
Subindex	0x02	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	0	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.5.3 Newest Acknowledged Message

Name	Newest Acknowledged Message	
Index	0x10F3	
Subindex	0x03	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	0	
Value Range	0	255
PDO Mapping	NO	
Backup	NO	

Bit	RW	Description
255…7	W	SDO abort with codes 0x06090030 (value range of parameter exceeded) or 0x06090031 (value of parameter too high)
6	W	SI3 = written value without checking
5…1	W	The Slave shall return SDO abort with codes 0x06090030 (value range of parameter exceeded) or 0x06090032 (value of parameter too low)
0	R	When the message queue will be overwritten, the Slave shall set SI3 to “0” (zero)
	W	The Slave will clear all messages

Table 7-65 Read/Write Bits

7.2.5.4 New Messages Available

Name	New Messages Available	
Index	0x10F3	
Subindex	0x04	
Data Type	BOOLEAN	
Access Type	RO	
Default Value	0	
Value Range	0 (newest message was read)	1 (newest message was not read)
PDO Mapping	YES	
Backup	NO	

7.2.5.5 Flags

Flags the diagnosis messages for sending/storing. The ESI/SII describes the functionality supported by the Slave. If the Master writes an unsupported value, the Slave shall return 0x06090030 (value range of parameter exceeded).

Name	Flags	
Index	0x10F3	
Subindex	0x05	
Data Type	UNSIGNED16	
Access Type	R(W)	
Default Value	0	
Value Range	0	15
PDO Mapping	NO	
Backup	NO	

Bit		RW	Description
15…6	–	–	reserved
5	1	RO	• In Overwrite Mode: Unacknowledged messages have been overwritten; SI3 is set to “0” (zero) • In Acknowledge Mode: Buffer is full with unacknowledged messages, new messages are discarded
4	0	(W)	Overwrite Mode – old messages are overwritten if buffer is full
	1		Acknowledge Mode – new messages only overwrites older ones if before acknowledged
3	0	(W)	Error messages are stored in the diagnosis message queue
	1		Error messages will not be stored in the diagnosis message queue
2	0	W	Warning messages are stored in the diagnosis message queue
	1		Warning messages will not be stored in the diagnosis message queue
1	0	W	Info messages are stored in the diagnosis message queue
	1		Info messages will not be stored in the diagnosis message queue
0	0	(W)	Default if device does not support Emergency Sending
	1		New diagnosis messages shall be sent as Emergency Message

Table 7-66 Read/Write Bits

7.2.5.6 Diagnosis Message

The buffer can store up to 250 diagnosis messages. The first message is stored in subindex 6, the next in subindex 7, and so on. Once the diagnosis message queue is full, the Slave shall overwrite subindex 6, then subindex 7, and so on, thus enabling the Master to access the most recent messages.

Name	Diagnosis Message	
Index	0x10F3	
Subindex	0x06…0xFF	
Data Type	OCTET_STRING	
Access Type	R	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.6 Receive PDO 1 Mapping

Contains the process data mapping parameters of RxPDO1. Changes in mapping are only possible in ESM state “Pre-Operational”. Mapping of objects is required to enable PDO processing. Subindex 0 represents the number of mapped objects. Subindex 0x01…0x0A represent the mapped objects whereby the value describes the corresponding index, subindex, and length. The value for the length (in bits) and is used to calculate the total mapping length.

Write access is only permitted in ESM state “Pre-Operational”.

The structure for the mapped object in subindex 0x01…0x0A is as follows:

MSB		LSB
Index (16 bits)	Subindex (8 bits)	Object length (8 bits)

To be able to change the PDO mapping, the following procedure must be performed:

a) Write the value “0” (zero) to subindex 0x00 (disable PDO).
b) Modify the desired objects in subindex 0x01…0x0n.
c) Write the desired number of mapped objects to subindex 0x00.

Name	Receive PDO 1 Mapping
Index	0x1600
Object Code	RECORD
Data Type	PDO Mapping

7.2.6.1 Number of mapped Objects in RxPDO 1

Name	Number of mapped Objects in RxPDO 1	
Index	0x1600	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	8	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.6.2 1st mapped Object in RxPDO 1

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in RxPDO 1	
Index	0x1600	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60400010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Continued on next page.

DEFAULT VALUES FOR MAPPED OBJECTS IN RXPDO1

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60400010	➔Controlword
2nd	0x02	INTEGER32	RW	0x607A0020	➔Target Position
3rd	0x03	INTEGER32	RW	0x60B00020	➔Position Offset
4th	0x04	INTEGER32	RW	0x60B10020	➔Velocity Offset
5th	0x05	INTEGER16	RW	0x60B20010	➔Torque Offset
6th	0x06	INTEGER8	RW	0x60600008	➔Modes of Operation
7th	0x07	UNSIGNED32	RW	0x60FE0120	➔Digital Outputs
8th	0x08	UNSIGNED16	RW	0x60B80010	➔Touch Probe Function

Table 7-67 Receive PDO 1 Mapping – CSP (mapped Objects)

7.2.7 Receive PDO 2 Mapping

Contains the process data mapping parameters of RxPDO2. For a detailed description applicable by analogy ➔“Receive PDO 1 Mapping” on page 7-63.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Receive PDO 2 Mapping
Index	0x1601
Object Code	RECORD
Data Type	PDO Mapping

7.2.7.1 Number of mapped Objects in RxPDO 2

Name	Number of mapped Objects in RxPDO 2	
Index	0x1601	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	7	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.7.2 1st mapped Object in RxPDO 2

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in RxPDO 2	
Index	0x1601	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60400010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

DEFAULT VALUES FOR MAPPED OBJECTS IN RXPDO2

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60400010	➔Controlword
2nd	0x02	INTEGER32	RW	0x60FF0020	➔Target Velocity
3rd	0x03	INTEGER32	RW	0x60B10020	➔Velocity Offset
4th	0x04	INTEGER16	RW	0x60B20010	➔Torque Offset
5th	0x05	INTEGER8	RW	0x60600008	➔Modes of Operation
6th	0x06	UNSIGNED32	RW	0x60FE0120	➔Digital Outputs
7th	0x07	UNSIGNED16	RW	0x60B80010	➔Touch Probe Function

Table 7-68 Receive PDO 2 Mapping – CSV (mapped Objects)

7.2.8 Receive PDO 3 Mapping

Contains the process data mapping parameters of RxPDO3. For a detailed description applicable by analogy ➔“Receive PDO 1 Mapping” on page 7-63.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Receive PDO 3 Mapping
Index	0x1602
Object Code	RECORD
Data Type	PDO Mapping

7.2.8.1 Number of mapped Objects in RxPDO 3

Name	Number of mapped Objects in RxPDO 3	
Index	0x1602	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	6	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.8.2 1st mapped Object in RxPDO 3

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in RxPDO 3	
Index	0x1602	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60400010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

DEFAULT VALUES FOR MAPPED OBJECTS IN RXPDO3

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60400010	➔Controlword
2nd	0x02	INTEGER16	RW	0x60710010	➔Target Torque
3rd	0x03	INTEGER16	RW	0x60B20010	➔Torque Offset
4th	0x04	INTEGER8	RW	0x60600008	➔Modes of Operation
5th	0x05	UNSIGNED32	RW	0x60FE0120	➔Digital Outputs
6th	0x06	UNSIGNED16	RW	0x60B80010	➔Touch Probe Function

Table 7-69 Receive PDO 3 Mapping – CST (mapped Objects)

7.2.9 Receive PDO 4 Mapping

Contains the process data mapping parameters of RxPDO4. For a detailed description applicable by analogy ➔“Receive PDO 1 Mapping” on page 7-63.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Receive PDO 4 Mapping
Index	0x1603
Object Code	RECORD
Data Type	PDO Mapping

7.2.9.1 Number of mapped Objects in RxPDO 4

Name	Number of mapped Objects in RxPDO 4	
Index	0x1603	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	8	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.9.2 1st mapped Object in RxPDO 4

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in RxPDO 4	
Index	0x1603	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60400010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

DEFAULT VALUES FOR MAPPED OBJECTS IN RXPDO4

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60400010	➔Controlword
2nd	0x02	INTEGER32	RW	0x607A0020	➔Target Position
3rd	0x03	INTEGER32	RW	0x60FF0020	➔Target Velocity
4th	0x04	UNSIGNED32	RW	0x60830020	➔Profile Acceleration
5th	0x05	UNSIGNED32	RW	0x60840020	➔Profile Deceleration
6th	0x06	UNSIGNED32	RW	0x60810020	➔Profile Velocity
7th	0x07	INTEFGER8	RW	0x60600008	➔Modes of Operation
8th	0x08	UNSIGNED32	RW	0x60FE0120	➔Digital Outputs

Table 7-70 Receive PDO 4 Mapping – PPM/PVM (mapped Objects)

7.2.10 Transmit PDO 1 Mapping

Contains the process data mapping parameters of TxPDO1. Changes in mapping are only possible in ESM state “Pre-Operational”. Mapping of objects is required to enable PDO processing. Subindex 0 represents the number of mapped objects. Subindex 0x01…0x0A represent the mapped objects whereby the value describes the corresponding index, subindex, and length. The value for the length (in bits) and is used to calculate the total mapping length.

Write access is only permitted in ESM state “Pre-Operational”.

The structure for the mapped object in subindex 0x01…0x0A is as follows:

MSB		**LSB**
Index (16 bits)	Subindex (8 bits)	Object length (8 bits)

To be able to change the PDO mapping, the following procedure must be performed:

a) Write the value “0” (zero) to subindex 0x00 (disable PDO).
b) Modify the desired objects in subindex 0x01…0x0n.
c) Write the desired number of mapped objects to subindex 0x00.

Name	Transmit PDO 1 Mapping
Index	0x1A00
Object Code	RECORD
Data Type	PDO Mapping

7.2.10.1 Number of mapped Objects in TxPDO 1

Name	Number of mapped Objects in TxPDO 1	
Index	0x1A00	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	9	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.10.2 1st mapped Object in TxPDO 1

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in TxPDO 1	
Index	0x1A00	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60410010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Continued on next page.

DEFAULT VALUES FOR MAPPED OBJECTS IN TXPDO1

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60410010	➔Statusword
2nd	0x02	INTEGER32	RW	0x60640020	➔Position Actual Value
3rd	0x03	INTEGER32	RW	0x606C0020	➔Velocity Actual Value
4th	0x04	INTEGER16	RW	0x60770010	➔Torque Actual Value
5th	0x05	INTEGER8	RW	0x60610008	➔Modes of Operation Display
6th	0x06	UNSIGNED32	RW	0x60FD0020	➔Digital Inputs
7th	0x07	UNSIGNED16	RW	0x60B90010	➔Touch Probe Status
8th	0x08	INTEGER32	RW	0x60BA0020	➔Touch Probe Position 1 Positive Value
9th	0x09	INTEGER32	RW	0x60BB0020	➔Touch Probe Position 1 Negative Value

Table 7-71 Transmit PDO 1 Mapping – CSP (mapped Objects)

7.2.11 Transmit PDO 2 Mapping

Contains the process data mapping parameters of TxPDO2. For a detailed description applicable by analogy ➔“Transmit PDO 1 Mapping” on page 7-68.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Transmit PDO 2 Mapping
Index	0x1A01
Object Code	RECORD
Data Type	PDO Mapping

7.2.11.1 Number of mapped Objects in TxPDO 2

Name	Number of mapped Objects in TxPDO 2	
Index	0x1A01	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	9	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.11.2 1st mapped Object in TxPDO 2

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in TxPDO 2	
Index	0x1A01	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60410010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Continued on next page.

DEFAULT VALUES FOR MAPPED OBJECTS IN TXPDO2

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60410010	➔Statusword
2nd	0x02	INTEGER32	RW	0x60640020	➔Position Actual Value
3rd	0x03	INTEGER32	RW	0x606C0020	➔Velocity Actual Value
4th	0x04	INTEGER16	RW	0x60770010	➔Torque Actual Value
5th	0x05	INTEGER8	RW	0x60610008	➔Modes of Operation Display
6th	0x06	UNSIGNED32	RW	0x60FD0020	➔Digital Inputs
7th	0x07	UNSIGNED16	RW	0x60B90010	➔Touch Probe Status
8th	0x08	INTEGER32	RW	0x60BA0020	➔Touch Probe Position 1 Positive Value
9th	0x09	INTEGER32	RW	0x60BB0020	➔Touch Probe Position 1 Negative Value

Table 7-72 Transmit PDO 2 Mapping – CSV (mapped Objects)

7.2.12 Transmit PDO 3 Mapping

Contains the process data mapping parameters of TxPDO3. For a detailed description applicable by analogy ➔“Transmit PDO 1 Mapping” on page 7-68.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Transmit PDO 3 Mapping
Index	0x1A02
Object Code	RECORD
Data Type	PDO Mapping

7.2.12.1 Number of mapped Objects in TxPDO 3

Name	Number of mapped Objects in TxPDO 3	
Index	0x1A02	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	9	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.12.2 1st mapped Object in TxPDO 3

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in TxPDO 3	
Index	0x1A02	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60410010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Continued on next page.

DEFAULT VALUES FOR MAPPED OBJECTS IN TXPDO3

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60410010	➔Statusword
2nd	0x02	INTEGER32	RW	0x60640020	➔Position Actual Value
3rd	0x03	INTEGER32	RW	0x606C0020	➔Velocity Actual Value
4th	0x04	INTEGER16	RW	0x60770010	➔Torque Actual Value
5th	0x05	INTEGER8	RW	0x60610008	➔Modes of Operation Display
6th	0x06	UNSIGNED32	RW	0x60FD0020	➔Digital Inputs
7th	0x07	UNSIGNED16	RW	0x60B90010	➔Touch Probe Status
8th	0x08	INTEGER32	RW	0x60BA0020	➔Touch Probe Position 1 Positive Value
9th	0x09	INTEGER32	RW	0x60BB0020	➔Touch Probe Position 1 Negative Value

Table 7-73 Transmit PDO 3 Mapping – CST (mapped Objects)

7.2.13 Transmit PDO 4 Mapping

Contains the process data mapping parameters of TxPDO4. For a detailed description applicable by analogy ➔“Transmit PDO 1 Mapping” on page 7-68.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Transmit PDO 4 Mapping
Index	0x1A03
Object Code	RECORD
Data Type	PDO Mapping

7.2.13.1 Number of mapped Objects in TxPDO 4

Name	Number of mapped Objects in TxPDO 4	
Index	0x1A03	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	7	
Value Range	0 (PDO disabled)	1…10 (1…10 objects are mapped)
PDO Mapping	NO	
Backup	YES	

7.2.13.2 1st mapped Object in TxPDO 4

Objects with subindex 0x02…0x0A follow the same description as the object with subindex 1.

Name	1st mapped Object in TxPDO 4	
Index	0x1A03	
Subindex	0x01	
Data Type	UNSINED32	
Access Type	RW	
Default Value	0x60410010	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

DEFAULT VALUES FOR MAPPED OBJECTS IN TXPDO4

Mapped Object	Sub-index	Type	Access	Default Value	
1st	0x01	UNSIGNED16	RW	0x60410010	➔Statusword
2nd	0x02	INTEGER32	RW	0x60640020	➔Position Actual Value
3rd	0x03	INTEGER32	RW	0x606C0020	➔Velocity Actual Value
4th	0x04	INTEGER16	RW	0x60780010	➔Current Actual Value
5th	0x05	INTEGER32	RW	0x60F40020	➔Following Error Actual Value
6th	0x06	INTEGER8	RW	0x60610008	➔Modes of Operation Display
7th	0x07	UNSIGNED32	RW	0x60FD0020	➔Digital Inputs

Table 7-74 Transmit PDO 4 Mapping – PPM/PVM (mapped Objects)

7.2.14 Sync Manager Communication Type

The preconfigured read only object is used to read out the transfer mode of the EtherCAT Sync Manager's channels.

Write access is only permitted in ESM state "Pre-Operational".

Name	Sync Manager Communication Type
Index	0x1C00
Object Code	ARRAY
Data Type	UNSIGNED8

7.2.14.1 Number of used Sync Manager Channels

Name	Number of used Sync Manager Channels	
Index	0x1C00	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	4	
Value Range	4	4
PDO Mapping	NO	
Backup	NO	

7.2.14.2 Communication Type Sync Channel 0

Name	Communication Type Sync Channel 0	
Index	0x1C00	
Subindex	0x01	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	1: Mailbox Receive (Master → Slave)	
Value Range	1	1
PDO Mapping	NO	
Backup	NO	

7.2.14.3 Communication Type Sync Channel 1

Name	Communication Type Sync Channel 1	
Index	0x1C00	
Subindex	0x02	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	2: Mailbox Transmit (Master ← Slave)	
Value Range	2	2
PDO Mapping	NO	
Backup	NO	

7.2.14.4 Communication Type Sync Channel 2

Name	Communication Type Sync Channel 2	
Index	0x1C00	
Subindex	0x03	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	3: Process Data Output (Master → Slave)	
Value Range	3	3
PDO Mapping	NO	
Backup	NO	

7.2.14.5 Communication Type Sync Channel 3

Name	Communication Type Sync Channel 3	
Index	0x1C00	
Subindex	0x04	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	4: Process Data Input (Master ← Slave)	
Value Range	4	4
PDO Mapping	NO	
Backup	NO	

7.2.15 Sync Manager 2 PDO Assignment

Used to configure a PDO assignment for Sync channel 2 (Master → Slave). Subindex 0 defines the number of PDO mappings assigned to the Sync channel. Subindex 1…4 carry the PDO mapping objects.

Up to four PDO can be defined, whereby only objects within the defined value range will be accepted. The EtherCAT Master must set the desired PDO mapping.

In order to change a value in the objects “1st to 4th assigned RxPDO”, the object “Number of assigned PDOs” (0x00) must be set to “0” (zero) first.

Write access is only permitted in ESM state “Pre-Operational”.

Related Objects: ➔“Receive PDO 1 Mapping” on page 7-63 up to ➔“Receive PDO 4 Mapping” on page 7-67.

Name	Sync Manager 2 PDO Assignment
Index	0x1C12
Object Code	ARRAY
Data Type	UNSIGNED8

7.2.15.1 Number of assigned RxPDOs

Name	Number of assigned RxPDOs	
Index	0x1C12	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	1	
Value Range	0 (PDO is disabled)	4
PDO Mapping	NO	
Backup	YES	

7.2.15.2 1st assigned RxPDO

Name	1st assigned RxPDO	
Index	0x1C12	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1600	
Value Range	0x1600	0x1603
PDO Mapping	NO	
Backup	YES	

7.2.15.3 2nd assigned RxPDO

Name	2nd assigned RxPDO	
Index	0x1C12	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1601	
Value Range	0x1600	0x1603
PDO Mapping	NO	
Backup	YES	

7.2.15.4 3rd assigned RxPDO

Name	3rd assigned RxPDO	
Index	0x1C12	
Subindex	0x03	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1602	
Value Range	0x1600	0x1603
PDO Mapping	NO	
Backup	YES	

7.2.15.5 4th assigned RxPDO

Name	4th assigned RxPDO	
Index	0x1C12	
Subindex	0x04	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1603	
Value Range	0x1600	0x1603
PDO Mapping	NO	
Backup	YES	

7.2.16 Sync Manager 3 PDO Assignment

Used to configure a PDO assignment for Sync channel 3 (Master ← Slave). Subindex 0 defines the number of PDO mappings assigned to the Sync channel. Subindex 1…4 carry the PDO mapping objects.

Up to four PDO can be defined, whereby only objects within the defined value range will be accepted. The EtherCAT Master must set the desired PDO mapping.

In order to change a value in the objects “1st to 4th assigned TxPDO”, the object “Number of assigned PDOs” (0x00) must be set to “0” (zero) first.

Write access is only permitted in ESM state “Pre-Operational”.

Related Objects: ➔“Transmit PDO 1 Mapping” on page 7-68 up to ➔“Transmit PDO 4 Mapping” on page 7-74

Name	Sync Manager 3 PDO Assignment
Index	0x1C13
Object Code	ARRAY
Data Type	UNSIGNED8

7.2.16.1 Number of assigned TxPDOs

Name	Number of assigned TxPDOs	
Index	0x1C13	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	1	
Value Range	0 (PDO is disabled)	4
PDO Mapping	NO	
Backup	YES	

7.2.16.2 1st assigned TxPDO

Name	1st assigned TxPDO	
Index	0x1C13	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1A00	
Value Range	0x1A00	0x1A03
PDO Mapping	NO	
Backup	YES	

7.2.16.3 2nd assigned TxPDO

Name	2nd assigned TxPDO	
Index	0x1C13	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1A01	
Value Range	0x1A00	0x1A03
PDO Mapping	NO	
Backup	YES	

7.2.16.4 3rd assigned TxPDO

Name	3rd assigned TxPDO	
Index	0x1C13	
Subindex	0x03	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1A02	
Value Range	0x1A00	0x1A03
PDO Mapping	NO	
Backup	YES	

7.2.16.5 4th assigned TxPDO

Name	4th assigned TxPDO	
Index	0x1C13	
Subindex	0x04	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x1A03	
Value Range	0x1A00	0x1A03
PDO Mapping	NO	
Backup	YES	

7.2.17 Sync Manager Output Parameter

Used to display the synchronization of output parameters. To achieve the intended behavior, the values must be defined using extra care. For an overview ➔Table 7-75.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Sync Manager Output Parameter	
Index	0x1C32	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	5	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Index	Description	Data Type	RW	Default Value
0x1C32:0	Number of subindexes	UINT8	RO	5
0x1C32:1	Sync mode	UINT16	RO	2
0x1C32:2	Cycle Time	UINT32	RO	1'000'000 [ns]
0x1C32:3	Shift time	UINT32	RO	0 [ns]
0x1C32:4	Sync modes supported	UINT16	RO	0x0006
0x1C32:5	Min cycle time	UINT32	RO	100'000 [ns]

Table 7-75 Sync Manager Output Parameter – Subindexes

7.2.17.1 Sync Mode

Displays the synchronization mode of the output parameters.

Name	Sync Mode
Index	0x1C32
Subindex	0x01
Data Type	UNSIGNED16
Access Type	RO
Default Value	2
Value Range	➔Table 7-76
PDO Mapping	NO
Backup	NO

Value	Description
0	FreeRun (not supported)
1	SM-Synchron: Synchronous with SM2 event
2	DC-Synchron: Synchronous with SYN0 event

Table 7-76 Sync Mode Output Parameters

7.2.17.2 Cycle Time

Displays the cycle time of the output parameters. Value is given in [ns].

Name	Cycle Time	
Index	0x1C32	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	1'000'000	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.17.3 Shift Time

Displays the shift time of the output parameters. Value is given in [ns].

Name	Shift Time	
Index	0x1C32	
Subindex	0x03	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	0 (not used)	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.17.4 Sync Modes Supported

Displays the supported synchronization modes of the output parameters.

Name	Sync Modes Supported
Index	0x1C32
Subindex	0x04
Data Type	UNSIGNED16
Access Type	RO
Default Value	0x0006
Value Range	➔Table 7-77
PDO Mapping	NO
Backup	NO

Bit	Description
2	DC mode supported
1	SM mode supported
0	FreeRun (not supported)

Table 7-77 Sync Modes Supported – Output Parameters

7.2.17.5 Min Cycle Time

Displays the minimum cycle time of the output parameters. Value is given in [ns].

Name	Min Cycle Time	
Index	0x1C32	
Subindex	0x05	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	100'000	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.18 Sync Manager Input Parameter

Used to display the synchronization of output parameters. To achieve the intended behavior, the values must be defined using extra care. For an overview ➔Table 7-78.

Write access is only permitted in ESM state “Pre-Operational”.

Name	Sync Manager Input Parameter	
Index	0x1C33	
Subindex	0x00	
Data Type	UNSIGNED8	
Access Type	RO	
Default Value	5	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Index	Description	Data Type	RW	Default Value
0x1C33:0	Number of subindexes	UINT8	RO	5
0x1C33:1	Sync mode	UINT16	RO	2
0x1C33:2	Cycle Time	UINT32	RO	1'000'000 [ns]
0x1C33:3	Shift time	UINT32	RO	50'000 [ns]
0x1C33:4	Sync modes supported	UINT16	RO	0x0006
0x1C33:5	Min cycle time	UINT32	RO	100'000 [ns]

Table 7-78 Sync Manager Input Parameter – Subindexes

7.2.18.1 Sync Mode

Displays the synchronization mode of the input parameters.

Name	Sync Mode
Index	0x1C33
Subindex	0x01
Data Type	UNSIGNED16
Access Type	RO
Default Value	2
Value Range	➔Table 7-79
PDO Mapping	NO
Backup	NO

Value	Description
0	FreeRun (not supported)
34	SM-Synchron: Synchronous with SM2 event
2	DC-Synchron: Synchronous with SYN0 event

Table 7-79 Sync Mode Input Parameters

7.2.18.2 Cycle Time

Displays the cycle time of the input parameters. Value is given in [ns].

Name	Cycle Time	
Index	0x1C33	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	1'000'000	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.18.3 Shift Time

Displays the shift time of the input parameters. Value is given in [ns].

Name	Shift Time	
Index	0x1C33	
Subindex	0x03	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	50'000	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.18.4 Sync Modes Supported

Displays the supported synchronization modes of the input parameters.

Name	Sync Modes Supported
Index	0x1C33
Subindex	0x04
Data Type	UNSIGNED16
Access Type	RO
Default Value	0x0006
Value Range	➔Table 7-80
PDO Mapping	NO
Backup	NO

Bit	Description
2	DC mode supported
1	SM mode supported
0	FreeRun (not supported)

Table 7-80 Sync Modes Supported – Input Parameters

7.2.18.5 Min Cycle Time

Displays the minimum cycle time of the input parameters. Value is given in [ns].

Name	Min Cycle Time	
Index	0x1C33	
Subindex	0x05	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	100'000	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.19 Serial Number Complete

Holds the serial number of the device.

Name	Serial Number Complete	
Index	0x2100	
Subindex	0x00	
Data Type	UNSIGNED64	
Access Type	CONST	
Default Value	RO	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.20 Store Parameters

Controls saving of configuration parameters in a non-volatile memory.

Related Objects: ➔“Restore Default Parameters” on page 7-89

Name	Store Parameters	
Index	0x2110	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	3	
Value Range	–	–

In order to avoid storage of parameters by mistake, storage shall only be executed when a specific signature is written to the respective subindex.

BYTE	MSB			LSB
Character	‘e’	‘v’	‘a’	‘s’
Hex value	0x65	0x76	0x61	0x73

Table 7-81 Store Parameters Signature

Upon read access, the object indicates the actual state of “Store Parameters” procedure for the respective subindex.

Bit	Description
15…3	reserved
2	1 = Store parameter process running
1	1 = Error during Store Parameter procedure
0	1 = Store parameter done

Table 7-82 Store Parameters State

7.2.20.1 Store All Parameters

All parameters of the controller will be stored in a non-volatile memory, if the code “save” is written to the object. By read access, the object indicates the actual state of the “Store All Parameters” procedure.

Name	Store All Parameters
Index	0x2110
Subindex	0x01
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-81) read access (➔Table 7-82)
PDO Mapping	NO
Backup	NO

7.2.20.2 Store Communication Parameters

All communication-specific parameters of the controller will be stored in a non-volatile memory, if the code “save” is written to the object. By read access, the object indicates the actual state of the “Store Communication Parameters” procedure.

Name	Store Communication Parameters
Index	0x2110
Subindex	0x02
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-81) read access (➔Table 7-82)
PDO Mapping	NO
Backup	NO

7.2.20.3 Store Axis Parameters

All axis-specific parameters will be stored in a non-volatile memory, if the code “save” is written to the object. By read access, the object indicates the actual state of the “Store Axis Parameters” procedure.

Name	Store Axis Parameters
Index	0x2110
Subindex	0x06
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-81) read access (➔Table 7-82)
PDO Mapping	NO
Backup	NO

7.2.21 Restore Default Parameters

Configuration parameters are restored to the default.

Restoring the default parameters is permitted in ESM state “Pre-Operational” only.

Related Objects: ➔“Store Parameters” on page 7-87

Name	Restore Default Parameters	
Index	0x2111	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	3	
Value Range	–	–

In order to avoid restoring of default parameters by mistake, restoring shall only be executed when a specific signature is written to the respective subindex.

BYTE	MSB			LSB
Character	‘d’	‘a’	‘o’	‘l’
Hex value	0x64	0x61	0x6F	0x6C

Table 7-83 Restore Default Parameters Signature

Upon read access, the object indicates the actual state of “Restore Default Parameters” procedure for the respective subindex.

Bit	Description
15…3	reserved
2	1 = Restore default parameter process running
1	1 = Error during Restore Default Parameter procedure
0	1 = Restore default parameter done

Table 7-84 Restore Default Parameters State

7.2.21.1 Restore All Default Parameters

All parameters of the controller will be stored in a non-volatile memory, if the code “load” is written to the object. By read access, the object indicates the actual state of the “Restore All Default Parameters” procedure.

Only permitted if all axes of the controller are in “Power Disable” state.

Name	Restore All Default Parameters
Index	0x2111
Subindex	0x01
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-83) read access (➔Table 7-84)
PDO Mapping	NO
Backup	NO

7.2.21.2 Restore Communication Default Parameters

All parameters of the controller will be stored in a non-volatile memory, if the code “load” is written to the object. By read access, the object indicates the actual state of the “Restore Communication Default Parameters” procedure.

Only permitted if all axes of the controller are in “Power Disable” state.

Name	Restore Communication Default Parameters
Index	0x2111
Subindex	0x02
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-83) read access (➔Table 7-84)
PDO Mapping	NO
Backup	NO

7.2.21.3 Restore Axis Default Parameters

All axis-specific parameters will be stored in a non-volatile memory, if the code “load” is written to the object. By read access, the object indicates the actual state of the “Restore Axis Default Parameters” procedure.

Only permitted if all axes of the controller are in “Power Disable” state.

Name	Restore Axis Default Parameters
Index	0x2111
Subindex	0x06
Data Type	UNSIGNED32
Access Type	RW
Default Value	–
Value Range	write access (➔Table 7-83) read access (➔Table 7-84)
PDO Mapping	NO
Backup	NO

7.2.22 Axis Configuration

Used to setup the main components of the axis by configuring the sensors and the control structure.

Write access is only permitted if the corresponding axis is in “Power Disable” state.

Related Objects: ➔“Motor Type” on page 7-173

Name	Axis Configuration	
Index	0x3000	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	5	
Value Range	–	–

7.2.22.1 Sensors Configuration

Used to define the sensor types used for the axis.

- If object ➔“Motor Type” on page 7-173 is set to “brushed DC motor”, the field “Digital Hall Sensor” is set to “none”.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the “Position referenced to home position” bit (➔“Statusword” on page 7-139), the ➔“Position Actual Value” on page 7-144, and the ➔“Additional Position Actual Values” on page 7-166 will be cleared.

Related Objects: ➔“Analog Incremental Encoder (sin/cos)” on page 7-101 / ➔“Digital Incremental Encoder 1” on page 7-99 / ➔“Digital Incremental Encoder 2” on page 7-120 / ➔“SSI Absolute Encoder” on page 7-103

Name	Sensors Configuration
Index	0x3000
Subindex	0x01
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00100001
Value Range	➔Table 7-85 and Table 7-86
PDO Mapping	NO
Backup	YES

Bit 31…24	Bit 23…16	Bit 15…8	Bit 7…0
reserved (0)	Sensor 3 Type	Sensor 2 Type	Sensor 1 Type

Table 7-85 Sensor Configuration – Bits

Continued on next page.

Name	Value	Description	Socket
Sensor 1 Type	0x00	None	X5
	0x01	Digital Incremental Encoder 1	
Sensor 2 Type	0x00	None	X6
	0x01	Digital Incremental Encoder 2	
	0x02	Analog Incremental Encoder (sin/cos)	
	0x03	SSI Encoder	
	0x05	BiSS Encoder	
Sensor 3 Type	0x0x	None	X4
	0x10	Digital Hall Sensor	

Table 7-86 Supported Sensor Types (MAXPOS 50/5)

Details on Socket and Pin Assignment
For detailed information ➔separate document «Hardware Reference» of respective controller.

7.2.22.2 Control Structure

Defines the control structure of the axis depended on the available sensors.

- The main sensor can only be selected if the corresponding value of object ➔"Axis Configuration" on page 7-91 (Sensors Configuration) has been configured (not "none").
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the ➔"Position referenced to home position" bit (➔"Statusword" on page 7-139, the ➔"Position Actual Value" on page 7-144, and the ➔"Additional Position Actual Values" on page 7-166 will be cleared.
- Take into account that the position control quality depends, among other influences, on the resolution of the main sensor. For some sensor types (such as BiSS and SSI), the "Position Refresh Rate" additionally effects the position control quality.
  Therefore, increase the sensor's data rate (➔BiSS Encoder Data Rate, ➔SSI Data Rate) to improve the position control quality.

Name	Control Structure
Index	0x3000
Subindex	0x02
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00000011
Value Range	➔Table 7-87 and Table 7-88
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
31…8	reserved	0	–
7…4	Main Sensor	0	None (only current control, no max speed supervision)
		1	Sensor 1
		2	Sensor 2
		3	Sensor 3
3…0	Controller Type	1	PID Controller with Feed Forward (standard)

Table 7-87 Control Structure – Bits

Value	Description	Controller Structure
0x00000001	PID Controller with Feed Forward, no main sensor	Control Structure #1 (➔Figure 7-32)
0x00000011	PID Controller with Feed Forward, main Sensor 1	Control Structure #2 (➔Figure 7-33)
0x00000021	PID Controller with Feed Forward, main Sensor 2	Control Structure #3 (➔Figure 7-34)
0x00000031	PID Controller with Feed Forward, main Sensor 3	Control Structure #4 (➔Figure 7-35)

Table 7-88 Control Structure – Value Range

Continued on next page.

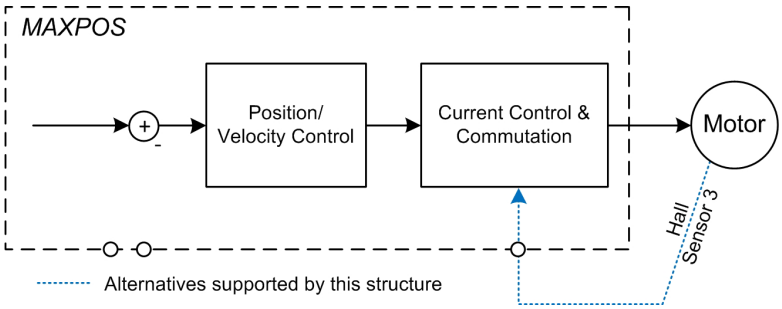


Figure 7-32 Control Structure #1

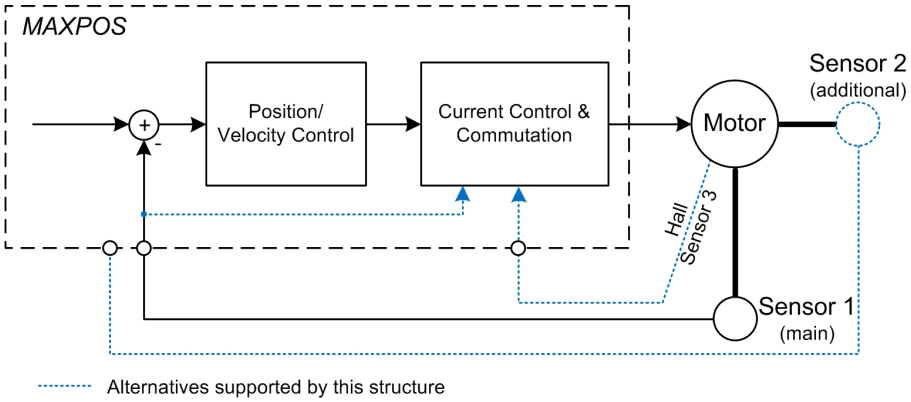


Figure 7-33 Control Structure #2

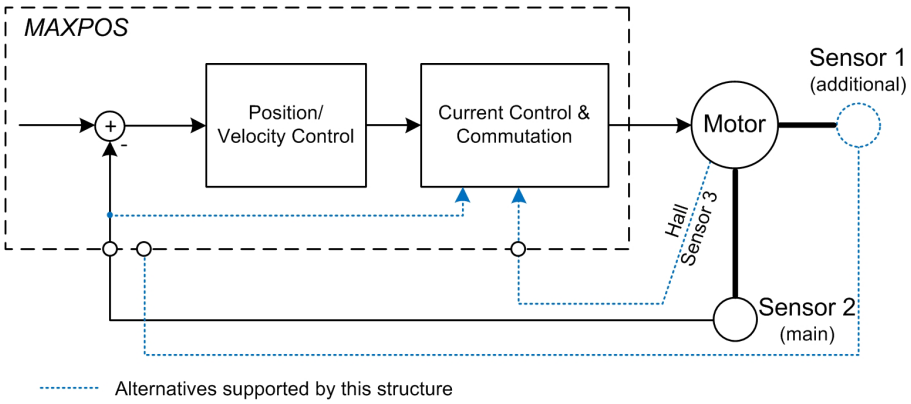


Figure 7-34 Control Structure #3

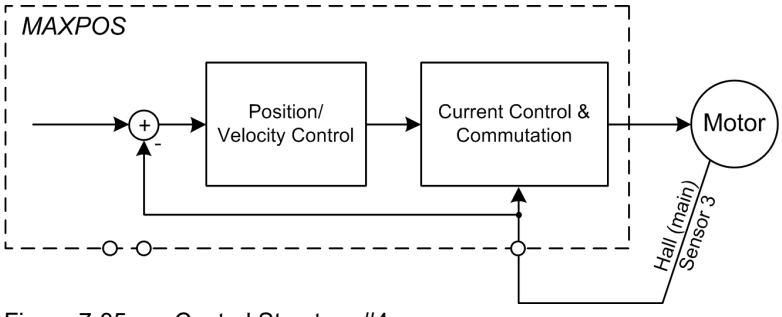


Figure 7-35 Control Structure #4

7.2.22.3 Commutation Sensors

Defines the control structure of the axis depended on the available sensors and their disposition.

Defines the commutation sensors for the axis motor. For “brushed DC motor” without meaning. For “brushless DC motor”, the entry may not be set to 0x0000 (no commutation sensor defined).

“Sensor absolute” is used for sensors that do not require additional alignment to perform commutation (e.g. digital Hall sensors). In contrast, “Sensor relative” is used if additional algorithms are required to use the sensor as commutation sensor (e.g. digital incremental encoder). Combinations of both relative and absolute commutation sensor are possible.

- The commutation sensor absolute, as well as the commutation sensor relative can only be selected if the corresponding value of “Sensor Configuration” is configured (not none).
- If a sensor is used as commutation sensor, it must be mounted on the motor shaft. The configuration is done by the object “Control Structure”.
- For some sensor types (such as BiSS and SSI), the “Position Refresh Rate” effects the commutation quality.
  Therefore, increase the sensor’s data rate (➔BiSS Encoder Data Rate, ➔SSI Data Rate) to improve the commutation quality or use other types of sensors for commutation.

Name	Commutation Sensors
Index	0x3000
Subindex	0x03
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00000031
Value Range	➔Table 7-89 and Table 7-90
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
31…8	reserved	0	–
7…4	Commutation Sensor Absolute	0	None
		1	Sensor 1
		2	Sensor 2
		3	Sensor 3
3…0	Commutation Sensor Relative	0	None
		1	Sensor 1
		2	Sensor 2
		3	Sensor 3

Table 7-89 Commutation Sensors – Bits

Value	Description
0x00000000	No commutation sensor defined (only DC motor supported in this case)
0x00000030	Sensor 3 used for commutation (e.g. digital Hall sensor)
0x00000031	Sensor 3 & Sensor 1 used for commutation
0x00000032	Sensor 3 & Sensor 2 used for commutation

Table 7-90 Commutation Sensors – Value Range

7.2.22.4 Axis Configuration Miscellaneous

Used to define various options regarding the axis configuration.

Name	Axis Configuration Miscellaneous
Index	0x3000
Subindex	0x04
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00000000
Value Range	➔Table 7-91
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
31…1	reserved	0	–
0	Axis Polarity	1	Inverse polarity – rotational direction of the axis is CW when positive demanded values are attached.
		0	Normal polarity – rotational direction of the axis is CCW when positive demanded values are attached.

Table 7-91 Axis Configuration Miscellaneous – Bits

7.2.22.5 Main Sensor Resolution

Displays the resolution of the main sensor given in [increments/revolution].

Name	Main Sensor Resolution	
Index	0x3000	
Subindex	0x05	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.23 Motor Data

Used to configure the parameters of the uses motor.

Some parameters are used to limit the output current according to the I2t method.

For detailed motor specifications ➔maxon catalog.

Related Objects: ➔Motor Type

Name	Motor Data	
Index	0x3001	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	5	
Value Range	–	–

7.2.23.1 Nominal Current

Represents the nominal current of the motor [mA]. Continuous operation of the motor at this current level and at 25 °C ambient will cause the winding to ultimately reach the specified maximal winding temperature. This assumes no heat sinking. The value can be substantially increased if the motor mount is made of heat-dissipating materials.

Related Objects: ➔Motor Rated Torque

Name	Nominal Current	
Index	0x3001	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	5000 (MAXPOS 50/5)	
Value Range	0	5000 (MAXPOS 50/5)
PDO Mapping	NO	
Backup	YES	

7.2.23.2 Output Current Limit

Represents the maximal permissible current of the motor [mA]. We recommend to set the value to double of ➔Nominal Current.

Name	Output Current Limit	
Index	0x3001	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	15'000 (MAXPOS 50/5)	
Value Range	0	15'000 (MAXPOS 50/5)
PDO Mapping	NO	
Backup	YES	

7.2.23.3 Number of Pole Pairs

Number of magnetic pole pairs (number of poles divided by 2) of the rotor of a brushless DC motor (maxon EC motor/BLDC motor).

Write access is only permitted if the axis is in “Power Disable” state.

Related Objects: ➔Max Motor Speed

Name	Number of Pole Pairs	
Index	0x3001	
Subindex	0x03	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	1	
Value Range	1	31
PDO Mapping	NO	
Backup	YES	

7.2.23.4 Thermal Time Constant Winding

Represents the thermal time constant of motor winding. The value is used to calculate the length of time the ➔Output Current Limit (subindex 0x02) is permitted to be connected to the motor. Value is given in [100 ms].

Example: For a time constant of 4 seconds, set the value 40.

Name	Thermal Time Constant Winding	
Index	0x3001	
Subindex	0x04	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	40	
Value Range	1	10'000
PDO Mapping	NO	
Backup	YES	

7.2.23.5 Torque Constant

Represents the motor’s torque constant. Value is given in [µNm/A].

Related Objects: ➔Motor Rated Torque

Name	Torque Constant	
Index	0x3001	
Subindex	0x05	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	0	
Value Range	0	10'000'000
PDO Mapping	NO	
Backup	YES	

7.2.24 Digital Incremental Encoder 1

Defines the configuration of the digital incremental encoder 1. Make sure to activate the encoder for the respective axis using ➔"Axis Configuration" on page 7-91.

- Write access is only permitted if the corresponding axis is in "Power Disable" state.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the "Position referenced to home position" bit (➔"Statusword" on page 7-139), the ➔"Position Actual Value" on page 7-144, and the ➔"Additional Position Actual Values" on page 7-166 will be cleared.

Related Objects: ➔"Axis Configuration" on page 7-91

Name	Digital Incremental Encoder 1	
Index	0x3010	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	4	
Value Range	–	–

7.2.24.1 Digital Incremental Encoder 1 Number of Pulses

Defines the resolution of the digital incremental encoder 1. Value is given in [pulses/revolution]. Unit conversion is as follows:

$$4 \times \frac{pulses}{revolutions} = \frac{increments[inc]}{revolutions[rev]} = \frac{quadcounts[qc]}{revolutions[rev]}$$

Name	Digital Incremental Encoder 1 Number of Pulses	
Index	0x3010	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	500	
Value Range	16	2'500'000
PDO Mapping	NO	
Backup	YES	

7.2.24.2 Digital Incremental Encoder 1 Type

Defines the configuration of the digital incremental encoder 1.

Name	Digital Incremental Encoder 1 Type
Index	0x3010
Subindex	0x02
Data Type	UNSIGNED16
Access Type	RW
Default Value	0x0001
Value Range	➔Table 7-92
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
15…5	reserved	0	–
4	Direction	0	maxon (CCW counts positive)
		1	Inverted (or encoder mounted on motor shaft)
3…1	reserved	0	–
0	Index	0	Encoder without index (2-channel)
		1	Encoder with index (3-channel)

Table 7-92 Digital Incremental Encoder 1 Type – Bits

7.2.24.3 Digital Incremental Encoder 1 Index Position

Holds the digital incremental encoder 1 position reached upon last detected encoder index pulse. Value is given in [increments].

Name	Digital Incremental Encoder 1 Index Position	
Index	0x3010	
Subindex	0x04	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.25 Analog Incremental Encoder (sin/cos)

Defines the configuration of the analog incremental encoder. Make sure to activate the encoder for the respective axis using ➔“Axis Configuration” on page 7-91.

- Write access is only permitted if the corresponding axis is in “Power Disable” state.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the “Position referenced to home position” bit (➔“Statusword” on page 7-139), the ➔“Position Actual Value” on page 7-144, and the ➔“Additional Position Actual Values” on page 7-166 will be cleared.

Related Objects: ➔“Axis Configuration” on page 7-91

Name	Analog Incremental Encoder	
Index	0x3011	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	3	
Value Range	–	–

7.2.25.1 Analog Incremental Encoder Type

Defines the configuration of the analog incremental encoder.

Name	Analog Incremental Encoder Type
Index	0x3011
Subindex	0x01
Data Type	UNSIGNED16
Access Type	RW
Default Value	0x0001
Value Range	➔Table 7-93
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
15…5	reserved	0	–
4	Direction	0	maxon (CCW counts positive)
		1	Inverted (or encoder mounted on motor shaft)
3…1	reserved	0	–
0	Index	0	Encoder without index (2-channel)
		1	Encoder with index (3-channel)

Table 7-93 Analog Incremental Encoder Type – Bits

7.2.25.2 Analog Incremental Encoder Resolution

Defines the resolution of the analog incremental encoder. Use “Number of Periods” (bits 31…8) to set the sin/cos encoder’s number of periods per turn. Use “Interpolation Bits” (bits 7…0) to define the desired interpolation within a period. Hence, the resolution yields as follows:

$$Resolution = 2^{InterpolationBits} \cdot PeriodsPerTurn \text{ [inc/rev]}$$

Thereby, the following boundaries apply:

$$MaxResolution = 2^{InterpolationBits} \cdot PeriodsPerTurn \leq 10'000'000 \text{ [inc/rev]}$$

$$MinResolution = 2^{InterpolationBits} \cdot PeriodsPerTurn \geq 64 \text{ [inc/rev]}$$

Name	Analog Incremental Encoder Resolution
Index	0x3011
Subindex	0x02
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00080004
Value Range	➔Table 7-94
PDO Mapping	NO
Backup	YES

Bit	Name	Value		
		Min	Max	Default
31…8	Number of Periods	1	2'500'000	2048
7…0	Interpolation Bits	2	10	4

Table 7-94 Analog Incremental Encoder Resolution

7.2.25.3 Analog Incremental Encoder Index Position

Holds the analog incremental encoder’s position reached upon last detected encoder index pulse. Value is given in [increments].

Name	Analog Incremental Encoder Index Position	
Index	0x3011	
Subindex	0x03	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.26 SSI Absolute Encoder

Defines the configuration of the SSI encoder. Make sure to activate the encoder for the respective axis using ➔“Axis Configuration” on page 7-91.

- Write access is only permitted if the corresponding axis is in “Power Disable” state.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the “Position referenced to home position” bit (➔“Statusword” on page 7-139), the ➔“Position Actual Value” on page 7-144, and the ➔“Additional Position Actual Values” on page 7-166 will be cleared.

Related Objects: ➔“Axis Configuration” on page 7-91

Name	SSI Absolute Encoder	
Index	0x3012	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	7	
Value Range	–	–

7.2.26.1 SSI Data Rate

Represents the SSI encoder data rate (SSI clock frequency). Value is given in [kbit/s].

The maximal data rate depends on the actual cable length and the configuration of the encoder. Typically, 400 kbit/s go together with cable lengths <50 m. For the correlation between cable length and data rate ➔Table 7-95. Use shielded cables with twisted pairs.

Cable Length [m]	Data Rate [kbit/s]
1000	50
500	100
200	300
100	500
50	1000
10	2000

Table 7-95 SSI Encoder – Cable Length vs. Data Rate

Name	SSI Data Rate	
Index	0x3012	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	500	
Value Range	80	3000
PDO Mapping	NO	
Backup	YES	

7.2.26.2 SSI Number of Data Bits

Defines the number of multi-turn or single-turn bits.The maximum value combined is 30 (including special bits ➔Figure 7-36). The resolution for rotary encoders is as follows:

$$Resolution = 2^{NumberOfBitsSingleTurn} \text{ [inc/rev]}$$

Name	SSI Number of Data Bits
Index	0x3012
Subindex	0x02
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x000C0D00
Value Range	➔Table 7-96
PDO Mapping	NO
Backup	YES

Bit	Name	Value		
		Min	Max	Default
31…24	reserved	–	–	–
23…16	Multi-turn Bits	0	24	12
15…8	Single-turn Bits	6	23	13
7…0	Special Bits	0	8	0

Table 7-96 SSI Encoder Number of Data Bits

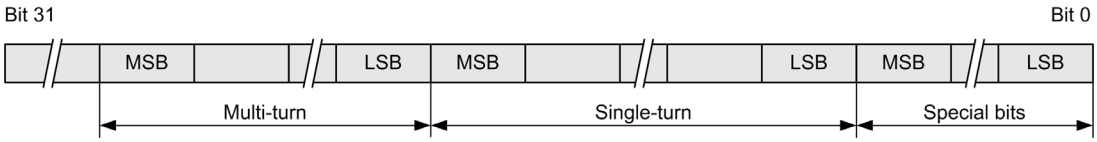


Figure 7-36 SSS Encoder Data Frame

7.2.26.3 SSI Encoding Type

Defines the type of SSI encoding.

Name	SSI Encoding Type	
Index	0x3012	
Subindex	0x03	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x0000	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Bit	Name	Value	Default	Description
15…5	reserved	0	0	–
4	Direction	0	0	maxon (CCW counts positive)
		1		Inverted (or encoder mounted on motor shaft)
3…0	Encoding Type	0	0	SSI Encoder Binary Type
		1		SSI Encoder Gray Type
		–		reserved

Table 7-97 SSI Encoder Protocol

7.2.26.4 SSI Transmit Wait Time

An addition between the first falling edge and the first rising edge (➔Figure 7-37). The total sampling frequency is composed of Transmit Wait Time, Data Transmit Time, and Timeout Time. By default, Transmit Wait Time is “0” (zero). Value is given in [0.1 µs].

Name	SSI Transmit Wait Time	
Index	0x3012	
Subindex	0x04	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0	
Value Range	0	500
PDO Mapping	NO	
Backup	YES	

Continued on next page.

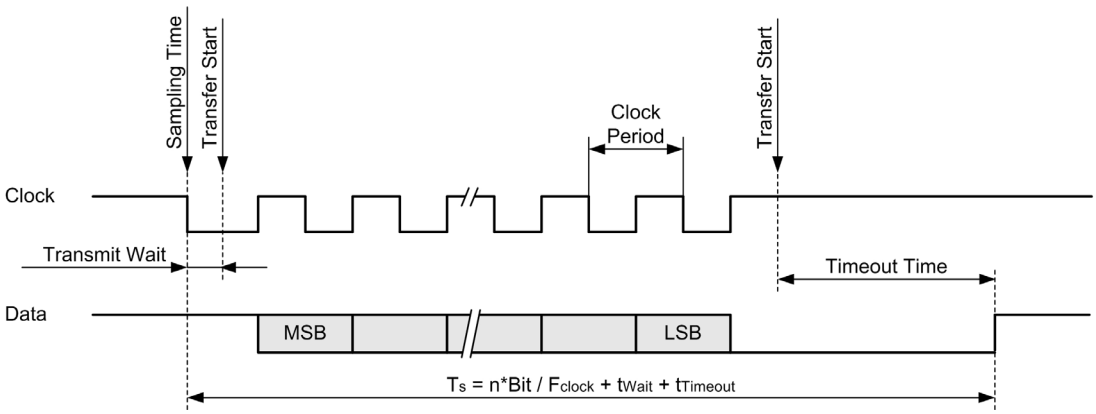


Figure 7-37 SSS Encoder – Timing

7.2.26.5 SSI Timeout Time

Represents the duration after the last clock edge of a sequence until the first clock edge of the next sequence (➔Figure 7-37). The total sampling frequency is composed of Transmit Wait Time, Data Transmit Time, and Timeout Time. Value is given in [0.1 µs].

Name	SSI Timeout Time	
Index	0x3012	
Subindex	0x05	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	300	
Value Range	0	500
PDO Mapping	NO	
Backup	YES	

7.2.26.6 SSI Special Bits

Only visible if “Special Bits” >0 (➔0x02; Table 7-96). Subsequent processing must be handled by the superior application.

Name	SSI Special Bits	
Index	0x3012	
Subindex	0x06	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	YES	
Backup	NO	

7.2.26.7 SSI Refresh Rate

Displays the refresh rate 1/Ts (➔Figure 7-37). Value is given in [Hz].

Related Objects: ➔“SSI Data Rate” on page 7-103 / ➔“SSI Number of Data Bits” on page 7-104 / ➔“SSI Transmit Wait Time” on page 7-105 / ➔“SSI Timeout Time” on page 7-106

Name	SSI Refresh Rate	
Index	0x3012	
Subindex	0x07	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.26.8 SSI Power-up Time

Defines the duration from power up until the SSI encoder is initialized and ready to use. The value is given in [ms].

Name	SSI Power-up Time	
Index	0x3012	
Subindex	0x08	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	200	
Value Range	0	10'000
PDO Mapping	NO	
Backup	YES	

7.2.27 BiSS Absolute Encoder

Defines the configuration of the BiSS encoder. Make sure to activate the encoder for the respective axis using ➔“Axis Configuration” on page 7-91.

BiSS encoder with bidirectional Communication Capability is mandatory
The MAXPOS checks on the used type of encoder by polling certain information on the bidirectional data exchange. With a BiSS encoder featuring just unidirectional communication, a respective BiSS error state will be the result due to a timed-out data exchange.
Take note that it is not possible to operate the MAXPOS with a BiSS encoder that offers only unidirectional communication. Therefore, check the BiSS encoder's communication type by consulting the data sheet or other suitable information made available by the supplier of the encoder.

- Write access is only permitted if the corresponding axis is in “Power Disable” state.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the “Position referenced to home position” bit (➔“Statusword” on page 7-139), the ➔“Position Actual Value” on page 7-144, and the ➔“Additional Position Actual Values” on page 7-166 will be cleared.

Related Objects: ➔“Axis Configuration” on page 7-91

Name	BiSS Absolute Encoder	
Index	0x3014	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	14	
Value Range	–	–

7.2.27.1 BiSS Encoder Controlword

Used to set up the encoder which can only be parameterized manually. Use the command “reinitialize” to finalize the encoder communication setup. The ➔BiSS Encoder Statusword displays the setup information.

Name	BiSS Encoder Controlword
Index	0x3014
Subindex	0x01
Data Type	UNSIGNED8
Access Type	RW
Default Value	0
Value Range	➔Table 7-98
PDO Mapping	NO
Backup	NO

Bit	Name	Value	Command	Description
7…4	Command	0x00	None	No command
		0x01	reserved	
		0x02	Reinitialize	Configures the BiSS interface out of BiSS object parameters and starts the communication. A parameter consistency check is performed only if an EDS is available.
3…0	reserved			

Table 7-98 BiSS Encoder – Controlword

7.2.27.2 BiSS Encoder Statusword

Describes the BISS encoder status during configuration.

Name	BiSS Encoder Statusword
Index	0x3014
Subindex	0x02
Data Type	UNSIGNED16
Access Type	RO
Default Value	0
Value Range	➔Table 7-99
PDO Mapping	NO
Backup	NO

Bit	Name	Value	Description
15…8	Status	0x00	BiSS idle
		0x01	BiSS busy (e.g. Boot up)
		0x02	reserved
		0x03	BiSS reinitialization busy
		0xFF	BiSS Error
7…0	Error	0x00	No error
		0x01	No EDS found
		0x02	Encoder parameter inconsistent
		0x03	EDS parameter out of range
		0x04	Protocol Type Error
		0x05	Profile Type Error
		0x06	Encoder Type Error
		0x07	Position invalid
		0x08	Communication Error
		0x09	No encoder detected
		0x0F	Internal error

Table 7-99 BiSS Encoder – Statusword

7.2.27.3 BiSS Encoder Data Rate

Represents the BiSS Encoder Master Data Rate in [kbit/s].

The maximal data rate depends on the actual cable length and the configuration of the encoder. Typically, 9.4 MHz go together with cable lengths <10 m. For the correlation between cable length and data rate ➔Table 7-100. Use shielded cables with twisted pairs.

A reduction of the data rate will influence the sampling rate (➔BiSS Encoder Refresh Rate). A lower sampling rate might possibly reduce motor dynamics (stiffness) due to delay time. EC motors/BLDC motors can also show losses in maximal speed due to commutation delay.

Cable Length [m]	Data Rate [kbit/s]
60	2343
25	4687
10	9375

Table 7-100 BiSS Encoder – Cable Length vs. Data Rate

The data rate is internally rounded to the next possible data rate value and displayed again. Supported data rates are as follows:

Data Rate [kbit/s]
2343
2500
2678
2884
3125
3409
3750
4166
4687
5357
6250
7500
9375

Table 7-101 BiSS Encoder – configurable Data Rates

Name	BiSS Encoder Data Rate	
Index	0x3014	
Subindex	0x03	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	4687	
Value Range	2000	10000
PDO Mapping	NO	
Backup	YES	

7.2.27.4 BiSS Encoder Timeout Time

Represents the duration after the last data bit until the next transmission [0.01 µs].

The timeout time will influence the sampling rate (➔BiSS Encoder Refresh Rate). A lower sampling rate might possibly reduce motor dynamics (stiffness) due to delay time. EC motors/BLDC motors can also show losses in maximal speed due to commutation delay.

Name	BiSS Encoder Timeout Time	
Index	0x3014	
Subindex	0x04	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	500	
Value Range	0	4000
PDO Mapping	NO	
Backup	YES	

7.2.27.5 BiSS Encoder Busy Time

Represents the additional conversion time of the encoder [0.01 µs].

The busy time will influence the sampling rate (➔BiSS Encoder Refresh Rate). A lower sampling rate might possibly reduce motor dynamics (stiffness) due to delay time. EC motors/BLDC motors can also show losses in maximal speed due to commutation delay.

Name	BiSS Encoder Busy Time	
Index	0x3014	
Subindex	0x05	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0	
Value Range	0	4000
PDO Mapping	NO	
Backup	YES	

7.2.27.6 BiSS Encoder Data Bits

Defines the actual number of transferred multi-turn or single-turn bits [bits]. The maximum value combined is 55 (including zero bits). The feedback bits (F1, F0) can be selected for position error detection.

The data format describes the alignment of the individual data segments of multi-turn, single-turn, and zero bits data. Due to the encoder data format, zero bits to complete a data frame of 12 bit patterns might be applicable (compare with BiSS Profile BP1).

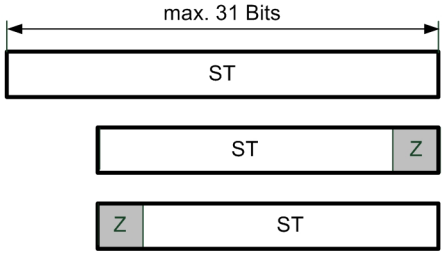
Single-turn data with zero bits can be right aligned or left (compare with BiSS Profile BP3). Multi-turn encoders with zero bits must be left aligned for single-turn data and right aligned for multi-turn data. Alignment and number of zero bits are internally computed in relation to data format configuration.

Remark

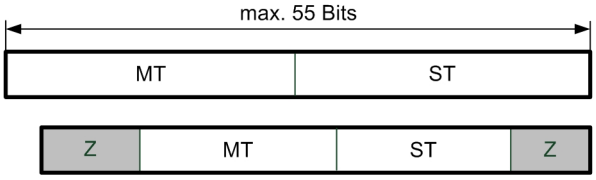
Additional data (such as life counter, warnings, errors, etc.) within the position data frame are not supported. For further information on BiSS-C specifications or profile definitions ➔www.ichaus.de.

Related Objects: ➔“BiSS Encoder Position Bits” on page 7-114

Single-turn Data Format



Multi-turn Data Format



Data Frame

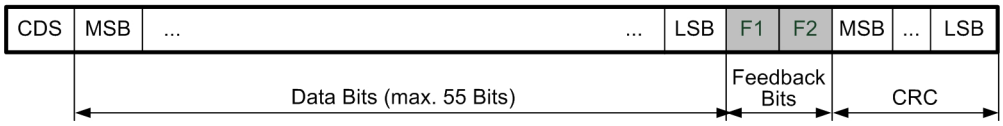


Figure 7-38 BiSS Encoder – Data Bits

Name	BiSS Encoder Data Bits
Index	0x3014
Subindex	0x06
Data Type	UNSIGNED32
Access Type	RW
Default Value	67108876 (0x0400000C)
Value Range	➔Table 7-102
PDO Mapping	NO
Backup	YES

Continued on next page.

Bit	Name	Value			Description
		Min	Max	Default	
31…28	reserved				
27, 26	F1	0		1	None
		1			Error
25, 24	F0	0		0	None
		1			Error
23…16	Data Format	0x00		0x00	Single-turn data only
		0x01			Single-turn | Zero: Single-turn data left aligned, completed with zero bits if required.
		0x02			Zero | Single-turn: Single-turn data right aligned, completed with zero bits if required.
		0x10			Multi-turn | Single-turn: Multi-turn and single-turn data (both right aligned)
		0x11			Zero | Multi-turn | Single-turn | Zero: Multi-turn (right aligned) and single-turn (left aligned), data completed with zero bits if required.
15…8	Number of Bits Multi-turn	0	24	12	Multi-turn size of encoder data
7…0	Number of Bits Single-turn	6	31	12	Single-turn size of encoder data

Table 7-102 BiSS Encoder – Data Bits

7.2.27.7 BiSS Encoder Position Bits

Unlike the BiSS encoder's maximal data length of 55 bits (➔BiSS Encoder Data Bits), the position format of the MAXPOS has a maximal length of 32 bits. Hence, the number of data bits used by the BiSS encoder must be reduced, if the sum exceeds 32 multi-turn/single-turn bits (➔Figure 7-39). Among other instances, the number of single-turn bits is also used for calculation of the actual speed.

The number of single-turn bits is used for calculation of the actual speed. The resolution for rotary encoders:

$$Resolution = 2^{NumberOfSingleturnBits}$$

Related Objects: ➔"BiSS Encoder Data Bits" on page 7-112

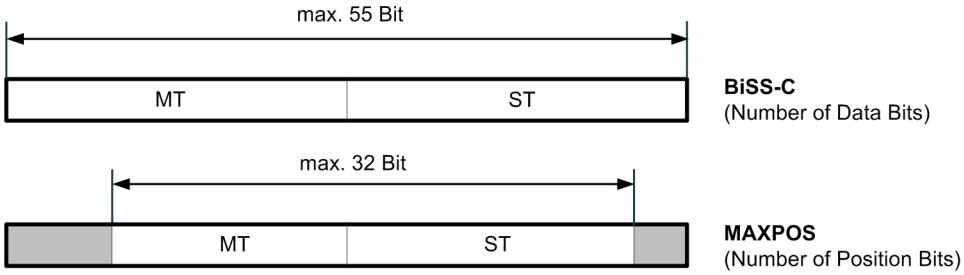


Figure 7-39 BiSS Encoder – Number of Position Bits vs. Number of Data Bits

Name	BiSS Encoder Position Bits
Index	0x3014
Subindex	0x07
Data Type	UNSIGNED32
Access Type	RW
Default Value	12 (0x0000 000C)
Value Range	➔Table 7-103
PDO Mapping	NO
Backup	YES

Bit	Name	Value			Description
		Min	Max	Default	
31…16	reserved				
15…8	Number of Bits Multi-turn	0	24	0	Multi-turn size for position
7…0	Number of Bits Single-turn	6	31	12	Single-turn size for position

Table 7-103 BiSS Encoder – Position Bits

7.2.27.8 BiSS Encoder Type

Defines the BISS encoder type.

Name	BiSS Encoder Type
Index	0x3014
Subindex	0x08
Data Type	UNSIGNED16
Access Type	RW
Default Value	0
Value Range	➔Table 7-104
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Default	Description
15…5	reserved			
4	Direction	0	0	Normal BISS encoder polarity (CCW positive)
		1		Inverted BISS encoder polarity (CW positive)
3…0	reserved			

Table 7-104 BiSS Encoder – Encoder Type

7.2.27.9 BiSS Encoder Protocol

Defines the CRC value and the CRC polarity.

The CRC polynomial value contains the polynomial in its full size (no LSB skipping).

Name	BiSS Encoder Protocol
Index	0x3014
Subindex	0x09
Data Type	UNSIGNED32
Access Type	RW
Default Value	3407888 (0x0043 0010)
Value Range	➔Table 7-105
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Min	Max	Default	Description
31…16	CRC Polynomial		0x0000	0x00FF	0x0043	CRC polynomial value (0x0000 = disable)
15…5	reserved					
4	CRC Polarity	0			1	CRC value normal
		1				CRC value inverse
3…0	reserved					

Table 7-105 BiSS Encoder – Protocol

7.2.27.10 BiSS Encoder Refresh Rate

Displays the sampling frequency of the position data derived from the clock frequency (➔BiSS Encoder Data Rate), ➔BiSS Encoder Timeout Time, and ➔BiSS Encoder Busy Time. Value is given in [Hz].

Name	BiSS Encoder Refresh Rate
Index	0x3014
Subindex	0x0A
Data Type	UNSIGNED16
Access Type	RO
Default Value	0
Value Range	–
PDO Mapping	NO
Backup	NO

7.2.27.11 BiSS Encoder Profile ID

Displays the encoder profile ID.

Low Byte: address 0x42 of encoder register assignment
High Byte: address 0x43 of encoder register assignment

Name	BiSS Encoder Profile ID
Index	0x3014
Subindex	0x0B
Data Type	UNSIGNED16
Access Type	RO
Default Value	0
Value Range	–
PDO Mapping	NO
Backup	NO

7.2.27.12 BiSS Encoder Serial Number

Displays the encoder serial number.

Low Byte: address 0x42 of encoder register assignment
High Byte: address 0x43 of encoder register assignment

Name	BiSS Encoder Serial Number
Index	0x3014
Subindex	0x0C
Data Type	UNSIGNED32
Access Type	RO
Default Value	0
Value Range	–
PDO Mapping	NO
Backup	NO

7.2.27.13 BiSS Encoder Device ID

Displays the encoder device ID.

Byte 1:6: address 0x78 to 0x7D of encoder register assignment
Byte 7:8: not used

Name	BiSS Encoder Device ID
Index	0x3014
Subindex	0x0D
Data Type	UNSIGNED64
Access Type	RO
Default Value	0
Value Range	–
PDO Mapping	NO
Backup	NO

7.2.27.14 BiSS Encoder Manufacturer ID

Displays the encoder manufacturer ID.

Low Byte: address 0x7E of encoder register assignment
High Byte: address 0x7F of encoder register assignment

Name	BiSS Encoder Manufacturer ID
Index	0x3014
Subindex	0x0E
Data Type	UNSIGNED16
Access Type	RO
Default Value	0
Value Range	–
PDO Mapping	NO
Backup	NO

7.2.28 Digital Hall Sensor

Defines the configuration of the digital Hall sensor. Make sure to activate the digital Hall sensor for the respective axis using ➔“Axis Configuration” on page 7-91.

Name	Digital Hall Sensor	
Index	0x301A	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	2	
Value Range	–	–

7.2.28.1 Digital Hall Sensor Type

Defines the configuration of the digital hall sensor.

Name	Digital Hall Sensor Type
Index	0x301A
Subindex	0x01
Data Type	UNSIGNED16
Access Type	RW
Default Value	0
Value Range	➔Table 7-106
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
15…1	reserved		
0	Polarity	0	maxon
		1	Inverted

Table 7-106 Digital Hall Sensor Bits

7.2.28.2 Digital Hall Sensor Pattern

Displays the actual state of the three digital Hall sensors as a pattern.

Name	Digital Hall Sensor Pattern	
Index	0x301A	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Bit	Hardware Signal
2	Digital Hall sensor 3
1	Digital Hall sensor 2
0	Digital Hall sensor 1

Table 7-107 Digital Hall Sensor Pattern

7.2.29 Digital Incremental Encoder 2

Defines the configuration of the digital incremental encoder 2. Make sure to activate the encoder for the respective axis using ➔“Axis Configuration” on page 7-91.

- Write access is only permitted if the corresponding axis is in “Power Disable” state.
- Upon changing this parameter, the absolute position may be corrupted. Therefore, the “Position referenced to home position” bit (➔“Statusword” on page 7-139), the ➔“Position Actual Value” on page 7-144, and the ➔“Additional Position Actual Values” on page 7-166 will be cleared.

Related Objects: ➔“Axis Configuration” on page 7-91

Name	Digital Incremental Encoder 2	
Index	0x3020	
Subindex	0x00	
Object Code	RECORD	
Access Type	RO	
Number of Entries	4	
Value Range	–	–

7.2.29.1 Digital Incremental Encoder 2 Number of Pulses

Defines the resolution of the digital incremental encoder 2. Value is given in [pulses/revolution]. Unit conversion is as follows:

$$4 \times \frac{pulses}{revolutions} = \frac{increments[inc]}{revolutions[rev]} = \frac{quadcounts[qc]}{revolutions[rev]}$$

Name	Digital Incremental Encoder 2 Number of Pulses	
Index	0x3020	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	500	
Value Range	16	2'500'000
PDO Mapping	NO	
Backup	YES	

7.2.29.2 Digital Incremental Encoder 2 Type

Defines the configuration of the digital incremental encoder 2.

Name	Digital Incremental Encoder 2 Type
Index	0x3020
Subindex	0x02
Data Type	UNSIGNED16
Access Type	RW
Default Value	0x0001
Value Range	➔Table 7-108
PDO Mapping	NO
Backup	YES

Bit	Name	Value	Description
15…5	reserved	0	–
4	Direction	0	maxon (CCW counts positive)
		1	Inverted (or encoder mounted on motor shaft)
3…1	reserved	0	–
0	Index	0	Encoder without index (2-channel)
		1	Encoder with index (3-channel)

Table 7-108 Digital Incremental Encoder 2 Type – Bits

7.2.29.3 Digital Incremental Encoder 2 Index Position

Holds the digital incremental encoder 2 position reached upon last detected encoder index pulse. Value is given in [increments].

Name	Digital Incremental Encoder 2 Index Position	
Index	0x3020	
Subindex	0x04	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.30 Current Control Parameter Set

The current controller of the MAXPOS is realized with a digital PI controller.

Name	Current Control Parameter Set
Index	0x30A0
Number of Entries	0x03

7.2.30.1 Current Regulator P Gain

Represents the proportional gain of the current controller. Value is given in $[2^{-16}\frac{V}{A}]$.

Name	Current Regulator P Gain	
Index	0x30A0	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	32'768	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.30.2 Current Regulator I Gain

Represents the integral gain of the current controller. Value is given in $[2^{-16}\frac{V}{A}]$.

Name	Current Regulator I Gain	
Index	0x30A0	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	4096	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.30.3 Current Regulator FF Gain

Represents the feedforward gain of the current controller. Value is given in $[2^{-16}\frac{V}{A}]$.

Name	Current Regulator FF Gain	
Index	0x30A0	
Subindex	0x03	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	0	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.31 Position Control Parameter Set

Position regulation is implemented with a PID feedback controller and a feedforward controller that compensates inertia and viscous friction. The PID parameters are defined by the controller properties bandwidth, reset time, and damping factor. These properties and the feedforward controller parameters are represented by this object.

Name	Position Control Parameter Set
Index	0x30A1
Number of Entries	5

7.2.31.1 Position Regulator Bandwidth

Contains the bandwidth of the PID feedback controller. Value is given in [0.001 Hz].

Name	Position Regulator Bandwidth	
Index	0x30A1	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	4000	
Value Range	10	1'000'000
PDO Mapping	TRXPDO	
Backup	YES	

7.2.31.2 Position Regulator Damping

Contains the damping factor of the PID feedback controller. Value is given in [‰] of the critical damping. A value >1000 means that system damping is overcritical, a value <1000 means that system damping is undercritical.

Name	Position Regulator Damping	
Index	0x30A1	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	1000	
Value Range	0	10'000
PDO Mapping	TRXPDO	
Backup	YES	

7.2.31.3 Position Regulator Reset Time

Contains the reset time of the PID feedback controller. Value is given in [µs].

Name	Position Regulator Reset Time	
Index	0x30A1	
Subindex	0x03	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	1'000'000	
Value Range	100	3'600'000'000
PDO Mapping	TRXPDO	
Backup	YES	

7.2.31.4 Inertia

Contains the inertia of the drive system. Value is given in [mg cm^2].

Name	Inertia	
Index	0x30A1	
Subindex	0x04	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	100'000	
Value Range	10	1'000'000'000
PDO Mapping	TRXPDO	
Backup	YES	

7.2.31.5 Friction

Contains the viscous friction of the drive system. Value is given in [nNm/rpm].

Name	Friction	
Index	0x30A1	
Subindex	0x05	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	0	
Value Range	0	1'000'000'000
PDO Mapping	TRXPDO	
Backup	YES	

maxon

7.2.32 Home Position

Defines the position that will be set as zero position of the absolute position counter. Value is given in [position units] (➔page 3-15).

Related Objects: ➔“Home Offset Move Distance” on page 7-126

Name	Home Position	
Index	0x30B0	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	0	
Value Range	−2'147'483'648	2'147'483'647
PDO Mapping	TRXPDO	
Backup	YES	

7.2.33 Home Offset Move Distance

Represents a moving distance in a homing procedure. It is useful to move away from a detected position (e.g. mechanical limit stop or limit switch) at the end of the homing sequence, thus preventing the axis from a border damage respectively limit switch error.

Name	Home Offset Move Distance	
Index	0x30B1	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	0	
Value Range	−2'147'483'648	2'147'483'647
PDO Mapping	NO	
Backup	YES	

7.2.34 Current Threshold for Homing Mode

Used for homing modes −1, −2, −3, and −4. A measured motor current above this threshold will be interpreted as mechanical limit stop. Value is given in [mA].

Name	Current Threshold for Homing Mode	
Index	0x30B2	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	500	
Value Range	0	depending on system setup
PDO Mapping	NO	
Backup	YES	

7.2.35 Current Demand Value

The set value for the current controller. Value is given in [mA]

Name	Current Demand Value	
Index	0x30D0	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.36 Current Actual Value Averaged

Represents the current actual value filtered by 1st order digital low-pass filter with a cut-off frequency of 50 Hz. Value is given in [mA].

Name	Current Actual Value Averaged	
Index	0x30D1	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.37 Velocity Actual Value Averaged

Provides the actual averaged velocity value of the axis, derived by the main sensor defined in ➔“Axis Configuration” on page 7-91. If no main sensor is configured, the velocity actual value is “0” (zero). Value is given in [velocity units] (➔page 3-15).

Related Objects: ➔“Velocity Actual Value” on page 7-145 / ➔“Additional Velocity Actual Values” on page 7-168

Name	Velocity Actual Value Averaged	
Index	0x30D5	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.38 Standstill Window Configuration

Configures the conditions to detect when the drive has come to standstill. The functionality specifies the behavior of some device state machine transitions (➔chapter “3.2 Device Control” on page 3-12).

Following transitions are not performed until standstill condition is reached:

- Operation Enable → Switch On Disable
- Operation Enable → Ready to Switch On
- Operation Enable → Switched On
- Quick Stop Active → Switch On Disable
- Fault Reaction Active → Fault

The slowdown behavior can be configured using the related objects.

Related Objects: ➔“Shutdown Option Code” on page 7-140 / ➔“Disable Operation Option Code” on page 7-141 / ➔“Fault Reaction Option Code” on page 7-142 / ➔“Abort Connection Option Code” on page 7-137

Name	Standstill Window Configuration	
Index	0x30E0	
Subindex	0x00	
Data Type	RECORD	
Access Type	RO	
Default Value	3	
Value Range	–	–

7.2.38.1 Standstill Window

Defines a symmetric range of accepted velocity values relatively to zero.

Standstill is reached, if the ➔“Velocity Actual Value Averaged” on page 7-127 is within the “Standstill Window” for the ➔“Standstill Window Time” on page 7-129. Value is given in [velocity units] (➔page 3-15).

The value “$2^{32} - 1$” switches off the standstill detection and standstill is deemed to be reached at the end of the trajectory.

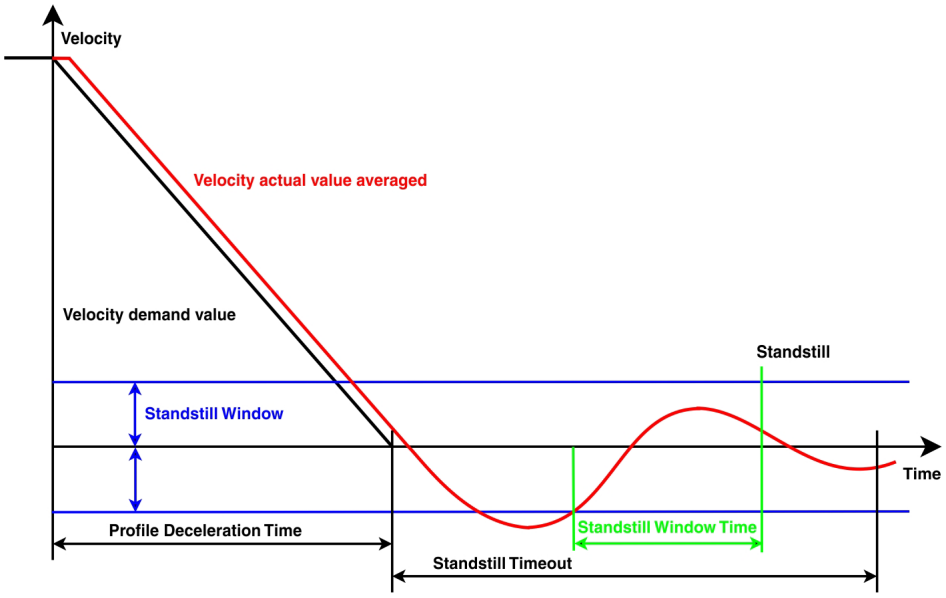


Figure 7-40 Standstill Window

Continued on next page.

Name	Standstill Window	
Index	0x30E0	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	30	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.38.2 Standstill Window Time

Standstill is reached, if the ➔“Velocity Actual Value Averaged” on page 7-127 is within the “Standstill Window” for the ➔“Standstill Window Time” on page 7-129. Value is given in [ms].

Name	Standstill Window Time	
Index	0x30E0	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	2	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.38.3 Standstill Window Timeout

Defines the point of time standstill is supposed to be reached, even if the standstill conditions are not yet fulfilled.

This timeout may be used to prevent “hangs” in the device state machine in case the standstill window configuration or the velocity controller parameters are set inauspicious. The value is given in [ms].

The value “$2^{16} - 1$” will disable the timeout.

Name	Standstill Window Timeout	
Index	0x30E0	
Subindex	0x03	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	1000	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.39 Digital Input Properties

Related Objects: ➔“Configuration of Digital Inputs” on page 7-131 / ➔“Digital Inputs” on page 7-171

Name	Digital Input Properties	
Index	0x3141	
Number of Entries	2	

7.2.39.1 Digital Input Properties Logic State

Displays the state of the digital input logic signal (before polarity correction). A bit is read as one, if the signal at the corresponding pin is high.

Related Objects: ➔“Digital Input Timing Behavior” on page 5-49

Name	Digital Input Properties Logic State	
Index	0x3141	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	0	0x3F
PDO Mapping	TXPDO	
Backup	NO	

Bit	Default Value
5	DigIN6 / STO-IN2
4	DigIN5 / STO-IN1
3	DigIN4
2	DigIN3
1	DigIN2
0	DigIN1

Table 7-109 Digital Input Bits

7.2.39.2 Digital Input Properties Polarity

Used to set the polarity of the digital input functionalities. If a bit is set to “0” (zero), the associated pin is high active. For bit description ➔Table 7-109.

Name	Digital Input Properties Polarity	
Index	0x3141	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x0000	
Value Range	0x0000	0x003F
PDO Mapping	NO	
Backup	YES	

7.2.40 Configuration of Digital Inputs

Configures the functionality that will be assigned to digital inputs 1 to 6.

Related Objects: ➔“Digital Input Timing Behavior” on page 5-49 / ➔“Digital Input Properties” on page 7-130 / ➔“Digital Inputs” on page 7-171

Name	Configuration of Digital Inputs	
Index	0x3142	
Number of Entries	6	

Names	Configuration of Digital Input 1 Configuration of Digital Input 2 Configuration of Digital Input 3	Configuration of Digital Input 4 Configuration of Digital Input 5 Configuration of Digital Input 6
Index	0x3142	
Subindex	0x01…0x06	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	➔Table 7-110	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Digital Input	Default Value
1	0: Negative limit switch
2	1: Positive limit switch
3	2: Home switch
4	19: General purpose D
5	20: General purpose E
6	21: General purpose F

Table 7-110 Digital Inputs – Default Values

Continued on next page.

Value	Functionality	Description
255	None	No functionality assigned
254…27	reserved	–
26	Touch probe 1	Samples actual position
25	Positive limit switch without errors	Used in some homing modes / does not generate limit errors
24	Negative limit switch without errors	Used in some homing modes / does not generate limit errors
23…22	reserved	–
21	General purpose F	State can be read
20	General purpose E	State can be read
19	General purpose D	State can be read
18	General purpose C	State can be read
17	General purpose B	State can be read
16	General purpose A	State can be read
15…3	reserved	–
2	Home switch	Used in some homing modes
1	Positive limit switch	Used in some homing modes / generates limit error
0	Negative limit switch	Used in some homing modes / generates limit error

Table 7-111 Digital Inputs – Configuration

7.2.41 Digital Output Properties

Related Objects: ➔“Configuration of Digital Outputs” on page 7-134 / ➔“Digital Outputs” on page 7-172

Name	Digital Output Properties
Index	0x3150
Number of Entries	2

7.2.41.1 Digital Output Properties Logic State

Displays the digital output logic state (after polarity correction). A bit is read as one if the signal at the corresponding pin is high.

Related Objects: ➔“Digital Output Timing Behavior” on page 5-50

Name	Digital Output Properties Logic State	
Index	0x3150	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

Bit	Description
2	DigOUT3
1	DigOUT2
0	DigOUT1

Table 7-112 Digital Output Bits

7.2.41.2 Digital Output Properties Polarity

Used to set the polarity of the digital outputs. If a bit is set to “1”, the associated output will be inverted, thus “1” in the “Digital Outputs” will set the output pin low.

For bit description ➔Table 7-112.

Name	Digital Output Properties Polarity	
Index	0x3150	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0x0000	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.42 Configuration of Digital Outputs

Configures the functionality that will be assigned to digital outputs 1 to 3.

Related Objects: ➔"Digital Output Timing Behavior" on page 5-50 / ➔"Digital Output Properties" on page 7-133 / ➔"Digital Outputs" on page 7-172

Name	Configuration of Digital Outputs
Index	0x3151
Number of Entries	3

7.2.42.1 Configuration of Digital Output 1…3

Names	Configuration of Digital Output 1 Configuration of Digital Output 2	Configuration of Digital Output 3
Index	0x3151	
Subindex	0x01…0x03	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	➔Table 7-113	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

Digital Output	Default Value
1	16: General purpose OutA
2	17: General purpose OutB
3	18: General purpose OutC

Table 7-113 Digital Outputs – Default Values

Value	Functionality	Description
255	None	No functionality assigned
254…25	reserved	–
24	Holding Brake	Output functionality to drive a holding brake (for details ➔"Holding Brake Configuration" on page 7-135)
23…19	reserved	–
18	General purpose C	State can be read / written by the host
17	General purpose B	State can be read / written by the host
16	General purpose A	State can be read / written by the host
15…1	reserved	–
0	Set Brake (GPIO)	To drive a brake operated by the host conforming to CiA 402 specification

Table 7-114 Digital Outputs – Configuration

7.2.43 Holding Brake Configuration

Holding brakes are designed to provide protection against unintentional drifting at standstill. They are activated when no torque is applied to the motor. If the controller applies torque to the motor, the holding break is deactivated. (➔chapter “3.2 Device Control” on page 3-12).

The functionality can be mapped to any digital output (➔“Configuration of Digital Outputs” on page 7-134). Thereby, take output current limit into account (for details ➔separate document «Hardware Reference» of respective controller).

Design Characteristics of Holding Brake

- *The holding brake is not designed to brake loads. This is done by the controller.*
- *The holding brake or the motor may be damaged if the holding brake will activate before the motor has reached full standstill. Thus, it is of vital importance to configure the standstill conditions (➔“Standstill Window Configuration” on page 7-128)!*
- *The holding brake function will only work properly if a main sensor is configured. Otherwise, there is no available information on the motor speed and, as a consequence thereof, there is no possibility to detect standstill (➔“Standstill Window Configuration” on page 7-128 and ➔“Control Structure” on page 7-93).*

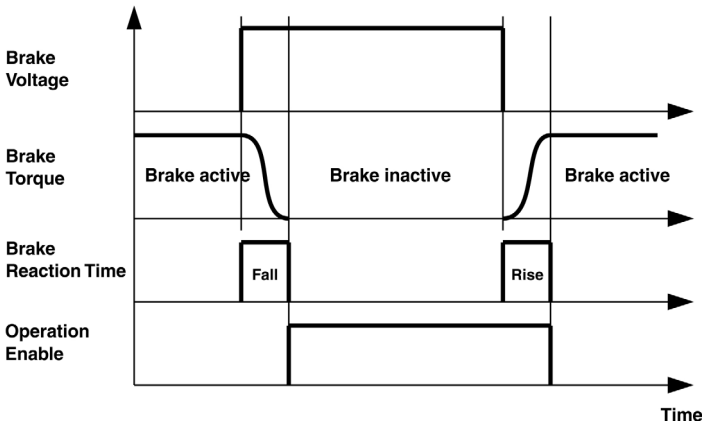


Figure 7-41 Holding Brake Activation Timing (Digital Output Polarity “High Active”)

Name	Holding Brake Configuration	
Index	0x3158	
Subindex	0x00	
Data Type	ARRAY	
Access Type	RO	
Default Value	2	
Value Range	–	–

7.2.43.1 Holding Brake Rise Time

Indicates the time required from power-off until reaching the holding brake's torque (➔Figure 7-41). Value is given in [ms].

Name	Holding Brake Rise Time	
Index	0x3158	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	10	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.43.2 Holding Brake Fall Time

Indicates the time required from power-on until releasing the holding brake's torque (➔Figure 7-41). Value is given in [ms].

Name	Holding Brake Fall Time	
Index	0x3158	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	10	
Value Range	–	–
PDO Mapping	NO	
Backup	YES	

7.2.44 Abort Connection Option Code

Specifies the action that will be performed when one of the errors labeled “a” (➔“Device Errors” on page 8-177) will be detected. It contains all communication errors.

With value set to “1” (Fault signal only), the ➔Statusword; bit 7 (Warning) is set to “1” if an error occurs.

Some critical errors (labeled “d” (➔“Device Errors” on page 8-177) always lead to a disable command even if the fault reaction was not configured to do so.

Related Objects: ➔“Error Register” on page 7-57 / ➔“Fault Reaction Option Code” on page 7-142

Name	Abort Connection Option Code	
Index	0x6007	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	3	
Value Range	1	3
PDO Mapping	NO	
Backup	YES	

Value	Description
1	Fault signal only
2	Disable voltage command
3	Quick stop command

Table 7-115 Abort Connection Option Codes

7.2.45 Error Code

Provides the error code of the last error that occurred in the device. This value differs from the value in object ➔Error Register (0x1001). Yet, it is the value that will also appear in object ➔Diagnosis Message (0x10F3).

Name	Error Code	
Index	0x603F	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	0	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

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7.2.46 Controlword

The controlword consist of bits for…

- the ➔“Device Control Commands” on page 3-14 (bits 0…3, 7),
- supervision of operating modes (bits 4…6, 8):
  ➔“Controlword (Profile Position Mode-specific Bits)” on page 4-21
  ➔“Controlword (Profile Velocity Mode-specific Bits)” on page 4-23
  ➔“Controlword (Homing Mode-specific Bits)” on page 4-26

For bit patterns of triggered commands ➔chapter “3.2.3 Device Control Commands” on page 3-14.

Related Objects: ➔“Statusword” on page 7-139

Name	Controlword	
Index	0x6040	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	–	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

Bit	Description	PPM	PVM	HMM	CSP	CST	CSV
15…11	reserved						
10, 9	reserved						
8	Operating mode-specific	Halt	Halt	Halt			
7	Fault reset						
6	Operating mode-specific	Abs / rel	reserved	reserved			
5	Operating mode-specific	Change set immediately	reserved	reserved			
4	Operating mode-specific	New setpoint	reserved	Homing operation start			
3	Enable operation						
2	Quick Stop						
1	Enable voltage						
0	Switch on						

Table 7-116 Controlword Bits

7.2.47 Statusword

The statusword consist of bits for…

- Actual ➔“State of the Drive” on page 3-13 (bits 0…6, 8 and 14)
- Operating state of the mode (bits 10, 12 and 13):
  ➔“Statusword (Profile Position Mode-specific Bits)” on page 4-21
  ➔“Statusword (Profile Velocity Mode-specific Bits)” on page 4-24
  ➔“Statusword (Homing Mode-specific Bits)” on page 4-27
  ➔“Statusword (Cyclic Synchronous Position Mode-specific Bits)” on page 4-42
  ➔“Statusword (Cyclic Synchronous Torque Mode-specific Bits)” on page 4-48
- Position referenced to home position (bit 15: will be set on homing attained and will be cleared on a position counter overflow or a position sensor error)
- Internal limit active (bit 11: signals the Output Current Limitation according I2t Method)

For bit patterns of triggered commands ➔chapter “3.2.1 State of the Drive” on page 3-13.

Related Objects: ➔“Controlword” on page 7-138

Name	Statusword	
Index	0x6041	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

Bit	Description	PPM	PVM	HMM	CSP	CST	CSV
15	Position referenced to home position						
14	reserved (0)						
13	Operating mode-specific	Following error	Not used	Homing error	Following error		
12	Operating mode-specific	Setpoint ack	Speed	Homing attained	Drive follows command value	Drive follows command value	Drive follows command value
11	Internal limit active						
10	Operating mode-specific	Target reached	Target reached	Target reached			
9	Remote						
8	reserved (1)						
7	Warning						
6	Switch on disable						
5	Quick Stop						
4	Voltage enabled (power stage on)						
3	Fault						

Continued on next page.

Bit	Description	PPM	PVM	HMM	CSP	CST	CSV
2	Operation enable						
1	Switched on						
0	Ready to switch on						

Table 7-117 Statusword Bits

7.2.48 Quick Stop Option Code

Indicates the action that will be performed as Quick Stop is executed.

Name	Quick Stop Option Code	
Index	0x605A	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	6	
Value Range	6	6
PDO Mapping	NO	
Backup	YES	

Value	Description
6	Slow down with quick stop ramp and stay in Quick Stop active, enabled

Table 7-118 Quick Stop Option Codes

7.2.49 Shutdown Option Code

Indicates the action that will be performed during transition from “Operation Enabled” state to “Ready To Switch On” or “Switch On Disable” state.

Name	Shutdown Option Code	
Index	0x605B	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	0	
Value Range	0	1
PDO Mapping	NO	
Backup	YES	

Value	Description
1	Decelerate with slowdown ramp; disabling of the drive function
0	Disable drive function (switch-off the power stage)

Table 7-119 Shutdown Option Codes

7.2.50 Disable Operation Option Code

Indicates the action that will be performed during transition from “Operation Enabled” state to “Switched On” state.

Name	Disable Operation Option Code	
Index	0x605C	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	1	
Value Range	0	1
PDO Mapping	NO	
Backup	YES	

Value	Description
1	Decelerate with slowdown ramp; disabling of the drive function
0	Disable drive function (switch-off the power stage)

Table 7-120 Disable Operation Option Codes

7.2.51 Halt Option Code

Indicates the action that will be performed when the halt function is executed.

Name	Halt Option Code	
Index	0x605D	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	2	
Value Range	2	2
PDO Mapping	NO	
Backup	YES	

Value	Description
2	Slow down with quick stop ramp and stay in operation enabled

Table 7-121 Halt Option Codes

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7.2.52 Fault Reaction Option Code

Specifies the action to be performed if one of the errors labeled “f” in the ➔“Device Errors” on page 8-177 will be detected. It contains most errors except communication errors (handled according to ➔“Abort Connection Option Code” on page 7-137).

With value set to “−1” (Fault signal only), the ➔Statusword; bit 7 (Warning) is set to “1” if an error occurs.

Some critical errors (labeled “d” (➔“Device Errors” on page 8-177) always lead to a disable command even if the fault reaction was not configured to do so.

Related Objects: ➔“Error Register” on page 7-57 / ➔“Abort Connection Option Code” on page 7-137

Name	Fault Reaction Option Code	
Index	0x605E	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	2	
Value Range	−1	2
PDO Mapping	NO	
Backup	YES	

Value	Description
2	Slow down with quick stop ramp
1	Slow down with slowdown ramp
0	Disable drive function
−1	Fault signal only

Table 7-122 Fault Reaction Option Code

7.2.53 Modes of Operation

Switches the actually chosen operating mode.

We recommend to use “Modes of Operational Display” after changing the operation mode.

Related Objects: ➔“Modes of Operation Display” on page 7-143

Name	Modes of Operation
Index	0x6060
Subindex	0x00
Data Type	INTEGER8
Access Type	RW
Default Value	8
Value Range	➔Table 7-123
PDO Mapping	TRXPDO
Backup	NO

Operation Mode	Description
1	➔Profile Position Mode (PPM)
3	➔Profile Velocity Mode (PVM)
6	➔Homing Mode (HMM)
8	➔Cyclic Synchronous Position Mode (CSP)
9	➔Cyclic Synchronous Velocity Mode (CSV)
10	➔Cyclic Synchronous Torque Mode (CST)

Table 7-123 Modes of Operation

7.2.54 Modes of Operation Display

Displays the actual mode of operation. The meaning of the returned value corresponds to the code in ➔Table 7-123.

Related Objects: ➔“Modes of Operation” on page 7-143

Name	Modes of Operation Display
Index	0x6061
Subindex	0x00
Data Type	INTEGER8
Access Type	RO
Default Value	1
Value Range	➔Table 7-123
PDO Mapping	TRXPDO
Backup	NO

7.2.55 Position Demand Value

Used as input for the position controller. For profiled motions, the value is generated by the profile generator. Value is given in [position units] (➔page 3-15).

Name	Position Demand Value	
Index	0x6062	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.56 Position Actual Value

Provides the actual position value of the axis, derived by the main sensor defined in ➔“Axis Configuration” on page 7-91. Value is given in [position units] (➔page 3-15).

- As soon as a homing procedure is successfully performed, the value is absolute and referenced. This is indicated by the “Position referenced to home position” bit ➔“Statusword” on page 7-139
- If no main sensor is configured, the position actual value is always “0” (zero).

Related Objects: ➔“Additional Position Actual Values” on page 7-166

Name	Position Actual Value	
Index	0x6064	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.57 Following Error Window

Maximal permitted difference between ➔“Position Actual Value” on page 7-144 and ➔“Position Demand Value” on page 7-144. If exceeded, a following error will occur. Value is given in [position units] (➔page 3-15).

Name	Following Error Window	
Index	0x6065	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	2000	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.58 Following Error Timeout

Indicates the configured time for a following error condition after the statusword bit 13 is set to “1” (➔“Statusword” on page 7-139). Value is given in milliseconds [ms].

Name	Following Error Timeout	
Index	0x6066	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RW	
Default Value	0	
Value Range	0	0
PDO Mapping	TRXPDO	
Backup	YES	

7.2.59 Velocity Demand Value

Used as input for the position controller. For profiled moves, the value is generated by the profile generator. Value is given in [velocity units] (➔page 3-15).

Name	Velocity Demand Value	
Index	0x606B	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.60 Velocity Actual Value

Provides the actual velocity value of the axis, derived by the main sensor defined in ➔“Axis Configuration” on page 7-91. If no main sensor is configured, the value is “0” (zero). Value is given in [velocity units] (➔page 3-15).

Related Objects: ➔“Velocity Actual Value Averaged” on page 7-127 / ➔“Additional Velocity Actual Values” on page 7-168

Name	Velocity Actual Value	
Index	0x606C	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.61 Target Torque

Indicates the configured input value for the torque controller in Cyclic Synchronous Torque Mode. Given per thousand of Motor Rated Torque (0x6076-00).

Related Objects: ➔“Motor Rated Torque” on page 7-146

Name	Target Torque	
Index	0x6071	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	0	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

7.2.62 Motor Rated Torque

Holds the value to which all torque objects are related to. The value is defined as 'Nominal Current multiplied by the 'Torque Constant. Value is given in [µNm].

Changing the value by write access is not permitted.

Related Objects: ➔“Motor Data” on page 7-97

Name	Motor Rated Torque	
Index	0x6076	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	0	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.63 Torque Actual Value

Provides the actual value of the torque and corresponds to the motor’s instantaneous torque. The value is given per thousand of Motor Rated Torque (0x6076-00).

Related Objects: ➔“Motor Rated Torque” on page 7-146

Name	Torque Actual Value	
Index	0x6077	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	0	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.64 Current Actual Value

Actual measured current can be read. Value is given in [mA].

Name	Current Actual Value	
Index	0x6078	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.65 Target Position

For profiled moves, the object is used as input for the profile generator, the Target Position is the position that the drive is supposed to move to using the current settings of motion control parameters such as velocity, acceleration, and deceleration. For none profiled moves the Target Position is directly used as input for the position controller. Value is given in [position units] (➔page 3-15).

The target position is not set until the command is given by the ➔“Controlword” on page 7-138. In this case, the target position will be interpreted as absolute or relative dependent on the command set to the controlword. Otherwise, the target position is interpreted as absolute value.

Related Objects: ➔“Profile Velocity” on page 7-151 / ➔“Profile Acceleration” on page 7-151 / ➔“Profile Deceleration” on page 7-151

Name	Target Position	
Index	0x607A	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	–	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

7.2.66 Position Range Limit

Name	Position Range Limit
Index	0x607B
Number of Entries	2

7.2.66.1 Min Position Range Limit

Defines the minimum position range limit by limiting the ➔Position Demand Value. Value is given in [position units] (➔page 3-15). Upon reaching or exceeding this limit, the input value automatically skips to the other end of the range.

A value of “−2'147'483'648” disables the minimum position range limit check.

Related Objects: ➔“Position Demand Value” on page 7-144

Name	Min Position Range Limit	
Index	0x607B	
Subindex	0x01	
Data Type	INTEGER32	
Access Type	RW	
Default Value	−2'147'483'648	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.66.2 Max Position Range Limit

Defines the maximum position range limit by limiting the ➔Position Demand Value. Value is given in [position units] (➔page 3-15). Upon reaching or exceeding this limit, the input value automatically skips to the other end of the range.

A value of “2'147'483'647” disables the minimum position range limit check.

Related Objects: ➔“Position Demand Value” on page 7-144

Name	Max Position Range Limit	
Index	0x607B	
Subindex	0x02	
Data Type	INTEGER32	
Access Type	RW	
Default Value	2'147'483'647	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

7.2.67 Software Position Limit

Name	Software Position Limit
Index	0x607D
Number of entries	0x02

7.2.67.1 Min Position Limit

Defines the absolute negative position limit for the position demand value [position units] (➔page 3-15). If the desired or the actual position is lower than the negative position limit, a software position limit error will be launched.

A value of “−2'147'483'648” disables the minimal position limit check.

Name	Min Position Limit	
Index	0x607D	
Subindex	0x01	
Data Type	INTEGER32	
Access Type	RW	
Default Value	−2'147'483'648	
Value Range	−2'147'483'648	2'147'483'647
PDO Mapping	TRXPDO	
Backup	YES	

7.2.67.2 Max Position Limit

Defines the absolute positive position limit for the position demand value [position units] (➔page 3-15). If the desired or the actual position is higher than the positive position limit, a software position limit error will be launched.

A value of “+2'147'483'648” disables the maximal position limit check.

Name	Max Position Limit	
Index	0x607D	
Subindex	0x02	
Data Type	INTEGER32	
Access Type	RW	
Default Value	2'147'483'647	
Value Range	−2'147'483'648	2'147'483'647
PDO Mapping	TRXPDO	
Backup	YES	

7.2.68 Max Profile Velocity

Indicates the configured maximal allowed velocity during a profiled motion. Value is given in [velocity units] (➔page 3-15).

Related Objects: ➔“Profile Velocity” on page 7-151 / ➔“Homing Speeds” on page 7-154

Name	Max Profile Velocity	
Index	0x607F	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	200'000	
Value Range	1	➔Max Motor Speed
PDO Mapping	TRXPDO	
Backup	YES	

7.2.69 Max Motor Speed

Indicates the configured maximal allowed speed for the motor. It serves as protection of the motor. Value is given in [velocity units] (➔page 3-15). For detailed motor specifications ➔maxon catalog.

Related Objects: ➔“Motor Type” on page 7-173 / ➔“Motor Data” on page 7-97 / ➔“Max Profile Velocity” on page 7-150

Name	Max Motor Speed	
Index	0x6080	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	200'000	
Value Range	1	➔Table 7-124
PDO Mapping	NO	
Backup	YES	

Motor Type	Description	Maximum Speed [rpm]
Phase-modulated DC motor	Brushed DC motor (maxon DC motor)	200'000
Sinusoidal PM BL motor	Brushless DC motor (maxon EC motor/BLDC motor)	200'000 / number of pole pairs

Table 7-124 Max Motor Speed

7.2.70 Profile Velocity

Represents the velocity normally attained at the end of the acceleration ramp during a profiled move. Value is given in [velocity units] (➔page 3-15).

Name	Profile Velocity	
Index	0x6081	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	1000	
Value Range	1	➔Max Profile Velocity
PDO Mapping	TRXPDO	
Backup	YES	

7.2.71 Profile Acceleration

Defines the acceleration value used during a profiled move. Value is given in [acceleration units] (➔page 3-15).

Name	Profile Acceleration	
Index	0x6083	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	10'000	
Value Range	1	➔Max Acceleration
PDO Mapping	TRXPDO	
Backup	YES	

7.2.72 Profile Deceleration

Defines the deceleration value used during a profiled move. Value is given in [acceleration units] (➔page 3-15).

Name	Profile Deceleration	
Index	0x6084	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	10'000	
Value Range	1	➔Max Acceleration
PDO Mapping	TRXPDO	
Backup	YES	

7.2.73 Quick Stop Deceleration

Defines the deceleration value used during a profiled move caused by a quick stop command. Value is given in [acceleration units] (➔page 3-15).

Related Objects: ➔“Controlword” on page 7-138 / ➔“Fault Reaction Option Code” on page 7-142 / ➔“Abort Connection Option Code” on page 7-137

Name	Quick Stop Deceleration	
Index	0x6085	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	15'000	
Value Range	1	➔Max Acceleration
PDO Mapping	TRXPDO	
Backup	YES	

7.2.74 Motion Profile Type

Selects the type of motion profile trajectory used in ➔Profile Position Mode (PPM), Homing Mode (HMM), or Profile Velocity Mode (PVM).

Name	Motion Profile Type	
Index	0x6086	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	0	
Value Range	➔Table 7-125	–
PDO Mapping	TRXPDO	
Backup	YES	

Value	Description
0	linear ramp (trapezoidal profile)

Table 7-125 Motion Profile Types – Definition

7.2.75 Homing Method

Used to select the desired homing method.

If the homing method is changed during an ongoing homing process, it will not come into effect before the next homing process is started.

Name	Homing Method	
Index	0x6098	
Subindex	0x00	
Data Type	INTEGER8	
Access Type	RW	
Default Value	37	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	YES	

Value	Description
37	➔Homing Method 37 (Actual Position)
34	➔Homing Method 34 (Index Positive Speed)
33	➔Homing Method 33 (Index Negative Speed)
27	➔Homing Method 27 (Home Switch Negative Speed)
23	➔Homing Method 23 (Home Switch Positive Speed)
18	➔Homing Method 18 (Positive Limit Switch)
17	➔Homing Method 17 (Negative Limit Switch)
11	➔Homing Method 11 (Home Switch Negative Speed & Index)
7	➔Homing Method 7 (Home Switch Positive Speed & Index)
2	➔Homing Method 2 (Positive Limit Switch & Index)
1	➔Homing Method 1 (Negative Limit Switch & Index)
−1	➔Homing Method −1 (Current Threshold Positive Speed & Index)
−2	➔Homing Method −2 (Current Threshold Negative Speed & Index)
−3	➔Homing Method −3 (Current Threshold Positive Speed)
−4	➔Homing Method −4 (Current Threshold Negative Speed)

Table 7-126 Homing Methods

7.2.76 Homing Speeds

Used to search a limit switch in a homing sequence. Value is given in [velocity units] (➔page 3-15).
Related Objects: ➔“Max Profile Velocity” on page 7-150

Name	Homing Speeds
Index	0x6099
Number of Entries	0x02

7.2.76.1 Speed for Switch Search

Name	Speed for Switch Search	
Index	0x6099	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	100	
Value Range	1	➔Max Profile Velocity
PDO Mapping	TRXPDO	
Backup	YES	

7.2.76.2 Speed for Zero Search

Used to search the index in a homing sequence. Value is given in [velocity units] (➔page 3-15).

Name	Speed for Zero Search	
Index	0x6099	
Subindex	0x02	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	10	
Value Range	1	➔Max Profile Velocity
PDO Mapping	TRXPDO	
Backup	YES	

7.2.77 Homing Acceleration

Used to define acceleration and deceleration ramps in the homing profile. Value is given in [acceleration units] (➔page 3-15).
Related Objects: ➔“Max Acceleration” on page 7-163

Name	Homing Acceleration	
Index	0x609A	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	1000	
Value Range	1	➔Max Acceleration
PDO Mapping	TRXPDO	
Backup	YES	

7.2.78 SI Unit Position

Defines the position units. Coding of the user-defined units and prefixes follows ➔chapter “3.3.1 SI Units” on page 3-15.

Write access is only permitted if the corresponding axis is in “Power Disable” state.

Name	SI Unit Position
Index	0x60A8
Subindex	0x00
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00B50000
Value Range	➔Table 7-128
PDO Mapping	TRXPDO
Backup	YES

Bit 31…24	Bit 23…16	Bit 15…8	Bit 7…04
Prefix	Numerator	Denominator	reserved (0)

Table 7-127 SI Units Position – Bits

Value	Description	Symbol
0x00B50000	Increments	inc

Table 7-128 SI Units Position – Value Range

maxon

7.2.79 SI Unit Velocity

Defines the velocity units. Coding of the user-defined units and prefixes follows ➔chapter “3.3.1 SI Units” on page 3-15.

Write access is only permitted if the corresponding axis is in “Power Disable” state.

Name	SI Unit Velocity
Index	0x60A9
Subindex	0x00
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00B44700
Value Range	➔Table 7-130
PDO Mapping	NO
Backup	YES

Bit 31…24	Bit 23…16	Bit 15…8	Bit 7…04
Prefix	Numerator	Denominator	reserved (0)

Table 7-129 SI Units Velocity – Bits

Value	Description	Symbol
0x00B44700	Revolutions/minute	rev/min (rpm)

Table 7-130 SI Units Velocity – Value Range

7.2.80 SI Unit Acceleration

Defines the acceleration units. Coding of the user-defined units and prefixes follows ➔chapter “3.3.1 SI Units” on page 3-15.

Write access is only permitted if the corresponding axis is in “Power Disable” state.

Name	SI Unit Acceleration
Index	0x60AA
Subindex	0x00
Data Type	UNSIGNED32
Access Type	RW
Default Value	0x00C00300
Value Range	➔Table 7-132
PDO Mapping	NO
Backup	YES

Bit 31…24	Bit 23…16	Bit 15…8	Bit 7…04
Prefix	Numerator	Denominator	reserved (0)

Table 7-131 SI Units Acceleration – Bits

Value	Description	Symbol
0x00C00300	(Revolutions/minute)/second	rpm/s

Table 7-132 SI Units Acceleration – Value Range

7.2.81 Position Offset

In CSP, the object provides the offset towards the ➔Target Position. The value itself is absolute but, since it represents an additive position value, it also can be used to control the drive with relative values in respect to the Target Position. Value is given in [position units] (➔page 3-15).

Only supported in Cyclic Synchronous Position Mode (CSP).

Name	Position Offset	
Index	0x60B0	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	–	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

7.2.82 Velocity Offset

In CSV, the object provides the offset towards the ➔Target Velocity. The value itself is absolute but, since it represents an additive velocity value, it also can be used to control the drive with relative values in respect to the Target Velocity. Value is given in [velocity units] (➔page 3-15).

In CSP, the object contains the input value for velocity feed forward.

Only supported in Cyclic Synchronous Position Mode (CSP) and Cyclic Synchronous Velocity Mode (CSV).

Name	Velocity Offset	
Index	0x60B1	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	–	
Value Range	−200'000	+200'000
PDO Mapping	TRXPDO	
Backup	NO	

7.2.83 Torque Offset

Provides the offset of the torque Value is given in per thousand of the rated torque (0x6076).

- In CSP and CSV, the object contains the input value for torque feed forward.
- In CST, the object contains the commanded additive torque of the drive, which is added to the ➔Target Torque.

Related Objects: ➔“Target Torque” on page 7-146

Name	Torque Offset	
Index	0x60B2	
Subindex	0x00	
Data Type	INTEGER16	
Access Type	RW	
Default Value	–	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

7.2.84 Touch Probe Function

Configures the touch probe function.

The main sensor is used. Detection of an edge can only be guaranteed if it occurs at least 2 ms after the previous edge.

Consider ➔section “Digital Input Timing Behavior” on page 5-49 and take note that touch probe function and Homing Mode cannot be used at the same time. After homing, all touch probe states and latched positions are cleared.

Related Objects: ➔“Configuration of Digital Inputs” on page 7-131

Name	Touch Probe Function
Index	0x60B8
Subindex	0x00
Data Type	UNSIGNED16
Access Type	RW
Default Value	0
Value Range	➔Table 7-133
PDO Mapping	TRXPDO
Backup	YES

Bit	Value	Description
15…6	–	reserved
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
3…2	00	Trigger on touch probe 1 input (input mapped to touch probe 1 functionality)
	01	Trigger on main encoder index signal
	10	Touch probe source defined by object 0x60D0.1
	11	reserved
1	0	Trigger first event
	1	Continuous
0	0	Switch off touch probe 1
	1	Enable touch probe 1

Table 7-133 Touch Probe Function

7.2.85 Touch Probe Status

Provides the status of the touch probe.

Status information of the touch probe shall first be evaluated by the control device to check whether the stored touch probe values (➔Touch Probe Position 1 Positive Value and ➔Touch Probe Position 1 Negative Value) are valid.

Related Objects: ➔“Touch Probe Position 1 Positive Value” on page 7-160 / “Touch Probe Position 1 Negative Value” on page 7-161

Name	Touch Probe Status
Index	0x60B9
Subindex	0x00
Data Type	UNSIGNED16
Access Type	RO
Default Value	–
Value Range	➔Table 7-134
PDO Mapping	TXPDO
Backup	NO

Bit	Value	Description
15…3	–	reserved
2	0	Touch probe 1, no negative edge position stored
	1	Touch probe 1, negative edge position stored
1	0	Touch probe 1, no positive edge position stored
	1	Touch probe 1, positive edge position stored
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled

Table 7-134 Touch Probe Status

7.2.86 Touch Probe Position 1 Positive Value

Provides the position value of the touch probe 1 at positive edge detection. Value is given in [position units] (➔page 3-15). The object is only valid if a position is stored (➔Touch Probe Status; bit 1).

Related Objects: ➔“Touch Probe Status” on page 7-160

Name	Touch Probe Position 1 Positive Value	
Index	0x60BA	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.87 Touch Probe Position 1 Negative Value

Provides the position value of the touch probe 1 at negative edge detection. Value is given in [position units] (➔page 3-15). The object is only valid if a position is stored (➔Touch Probe Status; bit 2).

Related Objects: ➔“Touch Probe Status” on page 7-160

Name	Touch Probe Position 1 Negative Value	
Index	0x60BB	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.88 Interpolation Time Period

Indicates the configured interpolation cycle time.

The interpolation time period value (subindex 0x01) is given in $10^{\text{interpolation time index}}$ per second, whereas the interpolation time index (subindex 0x02) is dimensionless.

In DC Sync0 node, the interpolation time period is automatically set to Sync0 cycle time. The displayed value is equal to the ➔Cycle Time.

Writing to the object has actually no influence.

Name	Interpolation Time Period
Index	0x60C2
Number of Entries	0x02

7.2.88.1 Interpolation Time Period Value

Name	Interpolation Time Period Value	
Index	0x60C2	
Subindex	0x01	
Data Type	UNSIGNED8	
Access Type	RW	
Default Value	1	
Value Range	1	1
PDO Mapping	TRXPDO	
Backup	YES	

7.2.88.2 Interpolation Time Index

Name	Interpolation Time Index	
Index	0x60C2	
Subindex	0x02	
Data Type	INTEGER8	
Access Type	RW	
Default Value	−3	
Value Range	−3	−3
PDO Mapping	TRXPDO	
Backup	YES	

7.2.89 Max Acceleration

Used to limit the maximal allowed acceleration to prevent mechanical damage. It represents the limit of all other acceleration/deceleration objects of the axis. Value is given in [acceleration units] (➔page 3-15).

Related Objects: ➔“Profile Acceleration” on page 7-151 / ➔“Profile Deceleration” on page 7-151 / ➔“Quick Stop Deceleration” on page 7-152 / ➔“Homing Acceleration” on page 7-154

Name	Max Acceleration	
Index	0x60C5	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RW	
Default Value	4'294'967'295	
Value Range	1	4'294'967'295
PDO Mapping	NO	
Backup	YES	

7.2.90 Touch Probe Source

Defines the source of the touch probe functions.

Name	Touch Probe Source	
Index	0x60D0	
Number of Entries	0x01	

Name	Touch Probe 1 Source	
Index	0x60D0	
Subindex	0x01	
Data Type	INTEGER16	
Access Type	RO	
Default Value	➔Table 7-135	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Value	Description
5	Hardware index impulse signal of main sensor
4	DigIn4
3	DigIn3
2	DigIn2
1	DigIn1
−1	none
−2	DigIn5
−3	DigIn6

Table 7-135 Touch Probe Source

7.2.91 Touch Probe 1 Positive Edge Counter

Provides a continuous counter being incremented with each positive edge at touch probe 1. The counter is only valid if sampling of the positive edge is enabled (➔Touch Probe Status; bit 0 and bit 4) and cleared when the touch probe is disabled (bit 0).

The counter behavior is as follows:

- Single event measuring: Value is limited to 1
- Continuous measuring: 16 bit value with overflow

Related Objects: ➔“Touch Probe Status” on page 7-160

Name	Touch Probe 1 Positive Edge Counter	
Index	0x60D5	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.92 Touch Probe 1 Negative Edge Counter

Provides a continuous counter being incremented with each negative edge at touch probe 1. The counter is only valid if sampling of the negative edge is enabled (➔Touch Probe Status; bit 0 and bit 5) and cleared when the touch probe is disabled (bit 0).

The counter behavior is as follows:

- Single event measuring: Value is limited to 1
- Continuous measuring: 16 bit value with overflow

Related Objects: ➔“Touch Probe Status” on page 7-160

Name	Touch Probe 1 Negative Edge Counter	
Index	0x60D6	
Subindex	0x00	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.93 Supported Homing Methods

Defines the supported homing methods of the device.

Related Objects: ➔“Homing Method” on page 7-153

Name	Supported Homing Methods	
Index	0x60E3	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	15	
Value Range	–	–

7.2.93.1 Supported Homing Method 1…15

Names	1st Supported Homing Method 2nd Supported Homing Method 3rd Supported Homing Method	4th Supported Homing Method … 15th Supported Homing Method
Index	0x60E3	
Subindex	0x01…0x0F	
Data Type	INTEGER16	
Access Type	RO	
Default Value	➔Table 7-136	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

# of Supported Homing Method	Subindex	Default Value
1st	0x01	1
2nd	0x02	2
3rd	0x03	7
4th	0x04	11
5th	0x05	17
6th	0x06	18
7th	0x07	23
8th	0x08	17
9th	0x09	33
10th	0x0A	24
11th	0x0B	37
12th	0x0C	−1
13th	0x0D	−2
14th	0x0E	−3
15th	0x0F	−4

Table 7-136 Touch Probe – Supported Homing Methods

7.2.94 Additional Position Actual Values

Provides the actual position values of the axis derived by the sensors defined in ➔Axis Configuration. If no sensor is configured in the corresponding field, the position actual value is “0” (zero). Value is given in [position units] (➔page 3-15).

Related Objects: ➔“Position Actual Value” on page 7-144

Name	Additional Position Actual Values	
Index	0x60E4	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	3	
Value Range	–	–

7.2.94.1 Position Actual Value Sensor 1

Name	Position Actual Value Sensor 1	
Index	0x60E4	
Subindex	0x01	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.94.2 Position Actual Value Sensor 2

Name	Position Actual Value Sensor 2	
Index	0x60E4	
Subindex	0x02	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.94.3 Position Actual Value Sensor 3

Name	Position Actual Value Sensor 3	
Index	0x60E4	
Subindex	0x03	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95 Additional Velocity Actual Values

Provides the actual velocity values of the axis derived by the sensors defined in ➔Axis Configuration. If no sensor is configured in the corresponding field, the velocity actual value is “0” (zero). Value is given in [velocity units] (➔page 3-15).

Related Objects: ➔“Velocity Actual Value” on page 7-145 / ➔“Velocity Actual Value Averaged” on page 7-127

Name	Additional Velocity Actual Values	
Index	0x60E5	
Subindex	0x00	
Object Code	ARRAY	
Access Type	RO	
Number of Entries	11	
Value Range	–	–

7.2.95.1 Velocity Actual Value Sensor 1

Name	Velocity Actual Value Sensor 1	
Index	0x60E5	
Subindex	0x01	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95.2 Velocity Actual Value Sensor 2

Name	Velocity Actual Value Sensor 2	
Index	0x60E5	
Subindex	0x02	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95.3 Velocity Actual Value Sensor 3

Name	Velocity Actual Value Sensor 3	
Index	0x60E5	
Subindex	0x03	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95.4 Velocity Actual Value Averaged Sensor 1

Name	Velocity Actual Value Averaged Sensor 1	
Index	0x60E5	
Subindex	0x09	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95.5 Velocity Actual Value Averaged Sensor 2

Name	Velocity Actual Value Averaged Sensor 2	
Index	0x60E5	
Subindex	0x0A	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.95.6 Velocity Actual Value Averaged Sensor 3

Name	Velocity Actual Value Averaged Sensor 3	
Index	0x60E5	
Subindex	0x0B	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.96 Following Error Actual Value

Represents the actual value of the following error. Value is given in [position units] (➔page 3-15).

Name	Following Error Actual Value	
Index	0x60F4	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

7.2.97 Digital Inputs

Displays the state of the digital input functionalities (after polarity correction by ➔“Digital Input Properties” on page 7-130; Polarity). A bit is read as one, if the signal at the corresponding pin is high.

Related Objects: ➔“Digital Input Timing Behavior” on page 5-49 / ➔“Digital Input Properties” on page 7-130 / ➔“Configuration of Digital Inputs” on page 7-131

Name	Digital Inputs	
Index	0x60FD	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TXPDO	
Backup	NO	

Bit	Functionality	Description
31…26	reserved	–
25	Positive limit switch without errors	Used in some homing modes / does not generate limit errors
24	Negative limit switch without errors	Used in some homing modes / does not generate limit errors
23, 22	reserved	–
21	General purpose F	State can be read
20	General purpose E	State can be read
19	General purpose D	State can be read
18	General purpose C	State can be read
17	General purpose B	State can be read
16	General purpose A	State can be read
15…3	reserved	–
2	Home switch	Used in some homing modes
1	Positive limit switch	Used in some homing modes / generates limit error
0	Negative limit switch	Used in some homing modes / generates limit error

Table 7-137 Digital Inputs

7.2.98 Digital Outputs

Configures the state of the digital output functionalities (before polarity correction by ➔“Digital Output Properties” on page 7-133; Polarity). If a bit is set to “1” and the polarity bit is set to “0” (zero), the signal at the corresponding pin is high.

Related Objects: ➔“Digital Output Timing Behavior” on page 5-50 / ➔“Digital Output Properties” on page 7-133 / ➔“Configuration of Digital Outputs” on page 7-134

Name	Digital Outputs
Index	0x60FE
Number of Entries	1

7.2.98.1 Physical Outputs

Name	Physical Outputs	
Index	0x60FE	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	Bit 0…23: RW Bit 24…31: RO	
Default Value	–	
Value Range	–	–
PDO Mapping	TRXPDO	
Backup	NO	

Bit	Functionality	Description
31…25	reserved	–
24	Holding Brake	Output functionality to drive a holding brake (for details ➔“Holding Brake Configuration” on page 7-135)
23…19	reserved	–
18	General purpose C	State can be read / written by the host
17	General purpose B	State can be read / written by the host
16	General purpose A	State can be read / written by the host
15…1	reserved	–
0	Set Brake (GPIO)	

Table 7-138 Digital Outputs

7.2.99 Target Velocity

In profiled motions, used as input for the profile generator. It represents the velocity the drive is supposed to move using the actual settings of motion control parameters, such as velocity, acceleration, and deceleration. For none profiled moves, the Target Velocity is directly used as input for the position controller. Value is given in [velocity units] (➔page 3-15).

For a profiled motion, the Target Velocity is not set until the command is given by the ➔Controlword.

Related Objects: ➔“Max Profile Velocity” on page 7-150 / ➔“Profile Acceleration” on page 7-151 / ➔“Profile Deceleration” on page 7-151

Name	Target Velocity	
Index	0x60FF	
Subindex	0x00	
Data Type	INTEGER32	
Access Type	RW	
Default Value	–	
Value Range	−200'000	+200'000
PDO Mapping	TRXPDO	
Backup	NO	

7.2.100 Motor Type

Defines the motor type of the axis.

Changes are only supported in “Power Disable” state.

Related Objects: ➔“Axis Configuration” on page 7-91 / ➔“Motor Data” on page 7-97

Name	Motor Type
Index	0x6402
Subindex	0x00
Data Type	UNSIGNED16
Access Type	RW
Default Value	10
Value Range	➔Table 7-139
PDO Mapping	NO
Backup	YES

Value	DS-402 Name	Description
1	Phase-modulated DC motor	Brushed DC motor (maxon DC motor)
10	Sinusoidal PM BL motor	Brushless DC motor (maxon EC motor/BLDC motor)

Table 7-139 Motor Types

7.2.101 Supported Drive Modes

Provides an overview of the implemented operating modes in the device. Supported are the following modes:

- ➔Profile Position Mode (PPM)
- ➔Profile Velocity Mode (PVM)
- ➔Homing Mode (HMM)
- ➔Cyclic Synchronous Position Mode (CSP)
- ➔Cyclic Synchronous Velocity Mode (CSV)
- ➔Cyclic Synchronous Torque Mode (CST)

Name	Supported Drive Modes	
Index	0x6502	
Subindex	0x00	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	0x000003A5	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

Bit		Description
31…11	0	reserved
10	0	Cyclic Synchronous Torque Mode With Commutation Angle
9	1	Cyclic Synchronous Torque Mode (CST)
8	1	Cyclic Synchronous Velocity Mode (CSV)
7	1	Cyclic Synchronous Position Mode (CSP)
6	0	Interpolated Position Mode (IPM)
5	1	Homing Mode (HMM)
4	0	reserved
3	0	Torque Mode
2	1	Profile Velocity Mode (PVM)
1	0	Velocity Mode
0	1	Profile Position Mode (PPM)

Table 7-140 Supported Drive Modes – Bits

7.2.102 Modular Device Profile

Contains all information to interpret objects in the modules' object areas.

Name	Modular Device Profile
Index	0xF000
Number of Entries	2

7.2.102.1 Index Distance

Represents the index distance between two modules.

Name	Index Distance	
Index	0xF000	
Subindex	0x01	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	0x10	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.102.2 Maximum Number of Modules

Represents the maximum number of modules in the system.

Name	Maximum Number of Modules	
Index	0xF000	
Subindex	0x02	
Data Type	UNSIGNED16	
Access Type	RO	
Default Value	1	
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.103 Module Profile List

Contains the profile information of each module (such as Module Profile Number).

Name	Module Profile List	
Index	0xF010	
Number of Entries	4	

7.2.103.1 Module 1…4

Names	Module 1 Module 2	Module 3 Module 4
Index	0xF010	
Subindex	0x01…0x04	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	Subindex 0x01: 0x001002E6 Subindex 0x02: 0x002002E6	Subindex 0x03: 0x003002E6 Subindex 0x04: 0x004002E6
Value Range	–	–
PDO Mapping	NO	
Backup	NO	

7.2.104 Detected Module List

Provides the number of detected modules.

Name	Detected Module List	
Index	0xF050	
Number of Entries	1	

7.2.104.1 1st detected Module

Contains the first detected module. The value changes with the selected operation mode.

Name	1st detected Module	
Index	0xF050	
Subindex	0x01	
Data Type	UNSIGNED32	
Access Type	RO	
Default Value	0x001002E6	
Value Range	0x001002E6	0x004002E6
PDO Mapping	NO	
Backup	NO	

8 ERROR HANDLING

8.1 Device Errors

8.1.1 Error Overview

MAXPOS can detect a variety of device errors. The reaction to an error depends on error type and option code. After execution of the fault reaction, the device changes to fault state and the drive will be disabled.

The ➔"Diagnosis History" on page 7-60 holds the error codes that occurred as well as all set error flags and it provides a summary on possible errors. The ➔"Error Code" on page 7-137 holds the last error that occurred in the device.

For fault reaction codes, following notations will be used:

a: Use ➔"Abort Connection Option Code" on page 7-137.

f: Use ➔"Fault Reaction Option Code" on page 7-142.

d: A secure movement is no longer possible. Disable the power stage.

Error Code	Error Register	Name	Fault Reaction Code
0x0000	0000 0000b	No Error	–
0x1000	0000 0001b	➔Generic Error	d
0x2310	0000 0010b	➔Overcurrent Error	d
0x3210	0000 0100b	➔Overvoltage Error	d
0x3220	0000 0100b	➔Undervoltage Error	d
0x4210	0000 1000b	➔Overtemperature Error	d
0x5280	0000 0001b	➔Hardware Defect Error	d
0x5580	0000 0001b	➔Hardware Memory Error	d
0x6100	0000 0001b	➔Internal Software Error	d
0x6320	0000 0001b	➔Software Parameter Error	f
0x7280	0000 0010b	➔Current Offset Error	d
0x7320	0010 0000b	➔Position Sensor Error	d
0x7380	0010 0000b	➔Position Sensor Breach Error	d
0x7381	0010 0000b	➔Position Sensor Resolution Error	d
0x7382	0010 0000b	➔Position Sensor Index Error	d
0x7388	0010 0000b	➔Hall Sensor Error	d
0x7389	0010 0000b	➔Hall Sensor not found Error	d
0x738A	0010 0000b	➔Hall Angle Detection Error	f
0x738B	0010 0000b	➔BiSS Encoder Error	f
0x7390	0010 0000b	➔Missing Main Sensor Error	d
0x7391	0010 0000b	➔Missing Commutation Sensor Error	d
0x8180	0001 0000b	➔EtherCAT Communication Error	a
0x8181	0001 0000b	➔EtherCAT PDO Overload Error	a
0x8188	0001 0000b	➔USB Communication Error	a
0x8331	0010 0000b	➔Torque Fault Error	f
0x8611	1000 0000b	➔Following Error	f
0x8A80	1000 0000b	➔Negative Limit Switch Error	f

Continued on next page.

Error Code	Error Register	Name	Fault Reaction Code
0x8A81	1000 0000b	➔Positive Limit Switch Error	f
0x8A82	1000 0000b	➔Software Position Limit Error	f
0x8A83	0010 0000b	➔Max Speed Error	f
0x8A88	0000 0001b	➔STO Error	d
0xFF01	0000 0001b	➔System Overloaded Error	d
0xFF02	0000 0001b	➔Watchdog Error	d
0xFF10	0010 0000b	➔Controller Gain Error	f
0xFF11	0010 0000b	➔Auto Tuning Identification Error	d

Table 8-141 Error Codes – Overview

8.1.2 Generic Error

Error Code	0x1000
Error Register	0000 0001b
Cause	Unspecific error occurred
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.3 Overcurrent Error

Error Code	0x2310
Error Register	0000 0010b
Cause	Short circuit in motor winding. Controller gains too high and/or deceleration too high. Damaged power stage.
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.4 Overvoltage Error

Error Code	0x3210
Error Register	0000 0100b
Cause	Power supply voltage too high
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	In most cases this error occurs at deceleration, where the motor works as a generator and the energy flows from motor to power supply (resulting in an increased voltage). Usually, a capacitor (e.g. 2200 µF) close to the device will solve the problem. If not, a shunt regulator will be necessary to dissipate brake energy. Reset fault with ➔Controlword (only possible if supply voltage is in valid range).

8.1.5 Undervoltage Error

Error Code	0x3220
Error Register	0000 0100b
Cause	Supply voltage is too low for operation. Power supply cannot supply required acceleration current.
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword (only possible if supply voltage is in valid range)

8.1.6 Overtemperature Error

Error Code	0x4210
Error Register	0000 1000b
Cause	Temperature at device’s power stage too high
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword (only possible if temperature is in valid range)

8.1.7 Hardware Defect Error

Error Code	0x5280
Error Register	0000 1000b
Cause	Hardware problem detected
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset device. If the problem persists, contact your supplier.

8.1.8 Hardware Memory Error

Error Code	0x5580
Error Register	0000 1000b
Cause	Failed to access hardware memory resource
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset device. If the problem persists, contact your supplier.

8.1.9 Internal Software Error

Error Code	0x6100
Error Register	0010 0000b
Cause	Internal software error occurred
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.10 Software Parameter Error

Error Code	0x6320
Error Register	0010 0000b
Cause	Corrupt parameter detected
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.11 Current Offset Error

Error Code	0x7280
Error Register	0000 0010b
Cause	Current offset calculation exceeded an internal limit
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.12 Position Sensor Error

Error Code	0x7320
Error Register	0010 0000b
Cause	Detected position of position sensor is no longer valid due to… • changed/wrong position sensor parameters • other errors that influence the absolute position detection (such as Hall Sensor Error, Position Sensor Index Error, etc.)
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.13 Position Sensor Breach Error

Error Code	0x7380
Error Register	0010 0000b
Cause	Position sensor supervision has detected a bad working condition due to… • wrong/broken wiring of encoder • defective encoder • regulation parameter are not well tuned (➔Current Control Parameter Set)
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.14 Position Sensor Resolution Error

Error Code	0x7381
Error Register	0010 0000b
Cause	Encoder pulses counted between the first two index pulses do not fit the resolution. Setting of encoder resolution is wrong.
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.15 Position Sensor Index Error

Error Code	0x7382
Error Register	0010 0000b
Cause	Encoder index signal was not found within two turns at start-up due to… • incorrect wiring of encoder cables • encoder without or with defective index channel • wrong sensor type • setting for encoder resolution too low Too many encoder index pulses were detected at unexpected positions due to… • big encoder signal noise • input frequency of encoder signals too high
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.16 Hall Sensor Error

Error Code	0x7388
Error Register	0010 0000b
Cause	Motor Hall sensors report an impossible signal combination due to… • incorrect wiring of Hall sensors • incorrect wiring of Hall sensor supply voltage • damaged Hall sensors • big Hall sensor signal noise
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.17 Hall Sensor not found Error

Error Code	0x7389
Error Register	0010 0000b
Cause	No Hall sensor 3 edge found within first motor turn due to… • wrong wiring of Hall sensors • defective Hall sensors • setting for encoder resolution too low
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.18 Hall Angle Detection Error

Error Code	0x738A
Error Register	0010 0000b
Cause	Angle difference measured between encoder and Hall sensors is too high due to… • wrong wiring of Hall sensors • defective Hall sensors • wrong wiring of encoder • defective encoder • wrong setting of encoder resolution or pole pairs
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.19 BiSS Encoder Error

Error Code	0x738B
Error Register	0010 0000b
Cause	• BiSS encoder error as to ➔"BiSS Encoder Statusword" on page 7-109. • The BiSS encoder in use does not support mandatory bidirectional data exchange.
Effect	Device disabled Red LED "ON" Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.20 Missing Main Sensor Error

Error Code	0x7390
Error Register	0010 0000b
Cause	No Main Sensor available. Adapt Settings in ➔Axis Configuration.
Effect	Device disabled Red LED "ON" Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.21 Missing Commutation Sensor Error

Error Code	0x7391
Error Register	0010 0000b
Cause	No Commutation Sensor available. Adapt Settings in ➔Axis Configuration.
Effect	Device disabled Red LED "ON" Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.22 EtherCAT Communication Error

Error Code	0x8180
Error Register	0001 0000b
Cause	EtherCAT State Machine detected an error (communication failed)
Effect	Fault reaction defined in ➔Abort Connection Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.23 EtherCAT PDO Overload Error

Error Code	0x8181
Error Register	0001 0000b
Cause	Too many PDO objects mapped (PDO data has been omitted)
Effect	Device disabled Red LED "ON" Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.24 USB Communication Error

Error Code	0x8188
Error Register	0001 0000b
Cause	Error within the USB communication detected
Effect	Fault reaction defined in ➔Abort Connection Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.25 Torque Fault Error

Error Code	0x8331
Error Register	0010 0000b
Cause	Torque constant 0x3001-05 cannot be “0” (zero) in enabled state. Define the value according to the used motor.
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.26 Following Error

Error Code	0x8611
Error Register	1000 0000b
Cause	Difference between ➔Position Demand Value and ➔Position Actual Value higher than ➔Following Error Window
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.27 Negative Limit Switch Error

Error Code	0x8A80
Error Register	1000 0000b
Cause	Negative limit switch was/is active. Wrong configuration of limit switch function in ➔Digital Inputs.
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.28 Positive Limit Switch Error

Error Code	0x8A81
Error Register	1000 0000b
Cause	Negative limit switch was/is active. Wrong configuration of limit switch function in ➔Digital Inputs.
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.29 Software Position Limit Error

Error Code	0x8A82
Error Register	1000 0000b
Cause	Movement commanded or actual position runs out of software position limit (➔Software Position Limit)
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.30 Max Speed Error

Error Code	0x8A83
Error Register	0010 0000b
Cause	Maximal permitted speed exceeded (➔Max Motor Speed)
Effect	Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.31 STO Error

Error Code	0x8A88
Error Register	0000 0001b
Cause	Error when STO is not active. STO functionality was triggered while power stage was enabled.
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.32 System Overloaded Error

Error Code	0xFF01
Error Register	0000 0001b
Cause	Device has not enough free resources to process new commands
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.33 Watchdog Error

Error Code	0xFF02
Error Register	0000 0001b
Cause	Cyclic monitoring has detected an invalid device status
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.1.34 Controller Gain Error

Error Code	0xFF10
Error Register	0010 0000b
Cause	Control function not possible due to bad controller gains
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword Fault reaction defined in ➔Fault Reaction Option Code
Error Recovery	Reset fault with ➔Controlword

8.1.35 Auto Tuning Identification Error

Error Code	0xFF11
Error Register	0010 0000b
Cause	Error during identification process of Auto Tuning
Effect	Device disabled Red LED “ON” Error flag set in ➔Statusword
Error Recovery	Reset fault with ➔Controlword

8.2 Communication Errors (Abort Codes)

An abort object will be sent over the network instead of a response to a SDO request if the request was going wrong. The same abort code will be sent as part of the response to the USB transfer request.

Abort Code	Name	Cause
0x0000 0000	No Communication Error	Communication successful
0x0503 0000	Toggle Error	Toggle bit not alternated
0x0504 0000	SDO Time Out	SDO protocol timed out
0x0504 0001	Client/Server Specifier Error	Client / server command specifier not valid or unknown
0x0504 0004	CRC Error	CRC check failed
0x0504 0005	Out of Memory Error	Out of memory
0x0601 0000	Access Error	Unsupported access to an object
0x0601 0001	Write Only	Read command to a write only object
0x0601 0002	Read Only	Write command to a read only object
0x0602 0000	Object does not exist Error	Last read or write command had wrong object index or subindex
0x0604 0041	PDO Mapping Error	Object is not mappable to the PDO
0x0604 0042	PDO Length Error	Number and length of objects to be mapped would exceed PDO length
0x0604 0043	General Parameter Error	General parameter incompatibility
0x0604 0047	General internal Incompatibility Error	General internal incompatibility in device
0x0606 0000	Hardware Error	Access failed due to hardware error
0x0607 0010	Service Parameter Error	Data type does not match, length or service parameter does not match
0x0607 0012	Service Parameter too long Error	Data type does not match, length of service parameter too high
0x0607 0013	Service Parameter too short Error	Data type does not match, length of service parameter too low
0x0609 0011	Object Subindex Error	Last read or write command had wrong object subindex
0x0609 0030	Value Range Error	Value range of parameter exceeded
0x0609 0031	Value too high Error	Value of parameter written too high
0x0609 0032	Value too low Error	Value of parameter written too low
0x0609 0036	Maximum less Minimum Error	Maximum value is less than minimum value
0x0800 0000	General Error	General error
0x0800 0020	Transfer or store Error	Data cannot be transferred or stored
0x0800 0021	Local Control Error	Data cannot be transferred or stored to application because of local control
0x0800 0022	Wrong Device State	Data cannot be transferred or stored to application because of present device state
0x0800 0023	No Object Dictionary	Object dictionary dynamic generation fails or no object dictionary is present
0x0F00 FFBC	Error Service Mode	Device is not in service mode
0x0F00 FFBE	Password Error	Password is incorrect
0x0F00 FFBF	Illegal Command Error	Command code is illegal (does not exist)
0x0F00 FFC0	Wrong EtherCAT State Error	Device is in wrong EtherCAT state

Table 8-142 Communication Errors

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9 FIRMWARE VERSION HISTORY

9.1 Version Overview

Date [yyyy-mm]	Version		Application		Description
	Software	Hardware	#	Version	
2015-07	0121h	3001h	0000h	0000h	Bug fixing
2015-02	0120h	3001h	0000h	0000h	New features
2014-08	0110h	3001h	0000h	0000h	New features
2014-05	0100h	3001h	0000h	0000h	Initial release

Table 9-143 Version Overview

9.2 Version History

MAXPOS_0121h_xxxxh_0000h_0000h (Release 2015-07)		
Binary Files	MAXPOS 50/5	MAXPOS_0121h_3001h_0000h_0000h.bin
Changes	PDO handling	Timing and synchronization for all operating modes enhanced
	CSP operation mode	Control behavior improved
	Watchdog	Handling adapted
	Bugfix	General minor bug fixing and improvements

MAXPOS_0120h_xxxxh_0000h_0000h (Release 2015-02)		
Binary Files	MAXPOS 50/5	MAXPOS_0120h_3001h_0000h_0000h.bin
Features	BiSS-C encoder	Support of absolute BiSS-C encoders added
	Firmware Update	New firmware update via EtherCAT with FoE protocol
	Touch Probe	Touch probe functionality as to CiA 402 added
	Data Recorder	Support of data recorder functionality in MAXPOS Studio Software
	Holding Brake	Autonomous control of a holding break based on the device state added
Changes	USB interface	Performance and stability of USB communication improved
	EtherCAT interface	Conformance to the ETG specifications (CTT) enhanced
	Axis State Machine	State changing option code objects according to CiA 402 added
	Regulation Tuning	Tuning process for encoders with higher resolution improved
	Digital Hall Sensor	Digital Hall sensor type with inverted polarity added
	Bugfix	Homing Mode: edge detection of inverted input corrected

MAXPOS_0110h_xxxxh_0000h_0000h (Release 2014-08)		
Binary Files	MAXPOS 50/5	MAXPOS_0110h_3001h_0000h_0000h.bin
Features	Analog Incremental Encoder	Support of analog incremental encoders (sin/cos)
	CSV operation mode	Addition of «Cyclic Synchronous Velocity Mode»
	SSI encoder	Support of absolute SSI encoders
Changes	EtherCAT	Compatibility with the ETG specifications (CTT) enhanced
	Homing Mode	Homing methods using home switch added
	Regulation Tuning	Regulation tuning behavior for DC motors improved
	Bugfix	Device state machine and operation mode switch corrected

MAXPOS_0100h_xxxxh_0000h_0000h (Release 2014-05)		
Binary Files	MAXPOS 50/5	MAXPOS_0100h_3001h_0000h_0000h.bin
Features	Full range	Initial release

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