EPOS

Positioning Controller

Documentation

Firmware Specification

maxon document number: 798675-03

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4 Introduction

This documentation “Firmware Specification” provides the Firmware details of the EPOS positioning controllers. It contains descriptions of architecture, device states, operation modes, error handling and object directory.

The maxon motor EPOS are small-sized full digital smart motion controller. Due to the flexible and high efficient power stage the EPOS drives brushed DC motors with digital encoder as well as brushless EC motors with digital Hall sensors and encoder.

The sinusoidal current commutation by space vector control offers to drive brushless EC motors with minimal torque ripple and low noise. The integrated position-, velocity- and current control functionality allows sophisticated positioning applications.

It is specially designed being commanded and controlled as a slave node in the CANopen network. In addition, the unit can be operated through any RS232 communication port.

The latest edition of these “Firmware Specification”, additional documentation and software to the EPOS positioning controller may also be found on the internet in www.maxonmotor.com category <Service & Downloads>.

5 How to use this guide

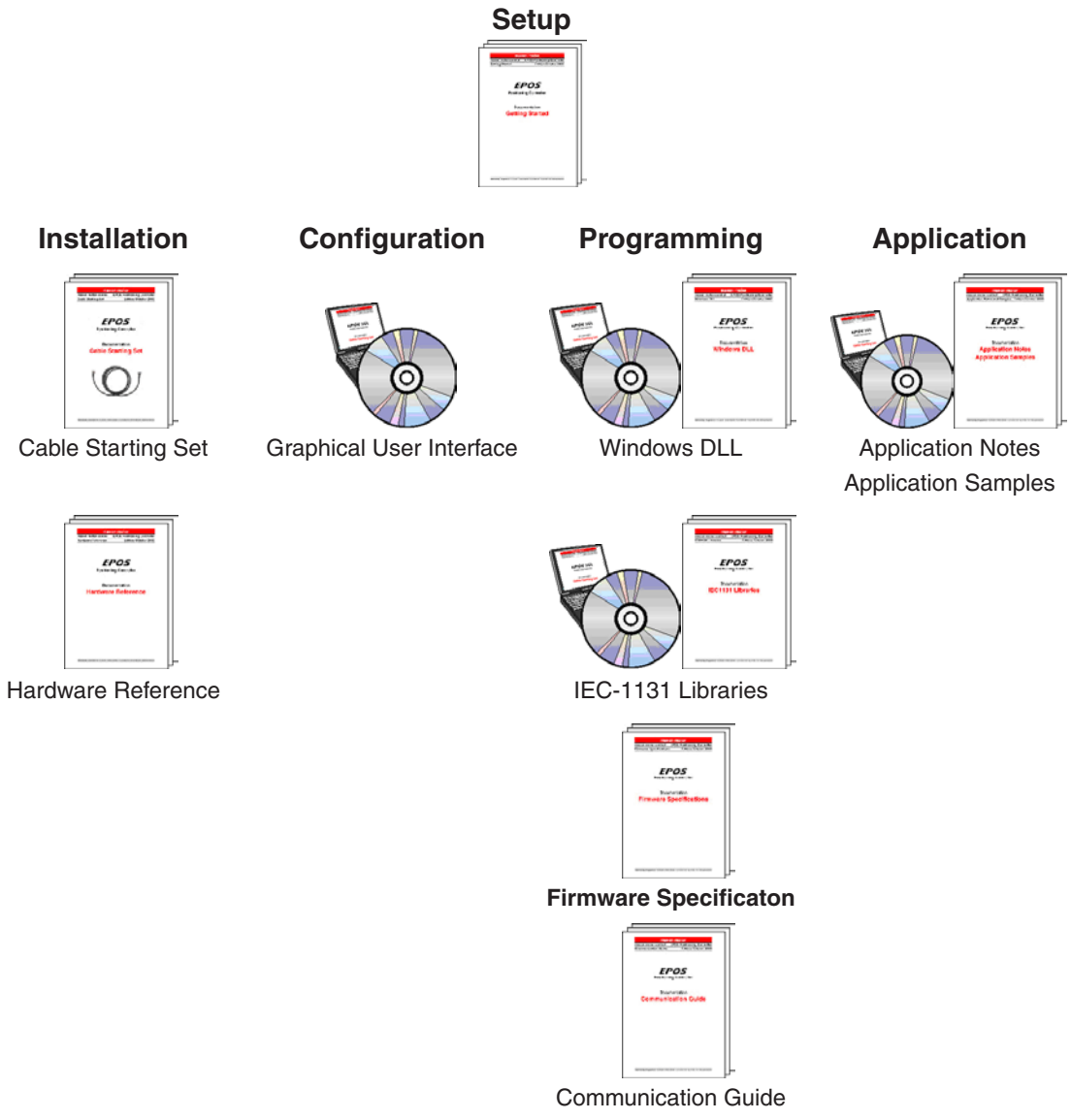


Figure 1: EPOS documentation hierarchy

6 Additional documentations

1	CiA DS-301 Communication Profile for Industrial Systems	www.can-cia.org
2	CiA DSP-402 Device Profile for Drives and Motion Control	www.can-cia.org
3	CiA DSP-305 Layer setting services (LSS) and protocols	www.can-cia.org
4	CiA DSP-306 Electronic Data Sheet Specification	www.can-cia.org
5	Konrad Etschberger: Controller Area Network (ISBN 3-446-21776-2)	
6	maxon motor: EPOS Communication Guide	EPOS CD-ROM or www.maxonmotor.com

7 Overview

7.1 Architecture of the drive

The CAN interface of the EPOS follows the CiA CANopen specification 'DS-301 V4.02 Application Layer and Communication Profile' [1], the 'DSP 402 V2.0 Device Profile Drives and Motion Control' [2] and the 'DSP 306 V1.1 Electronic Data Sheet Specification'.

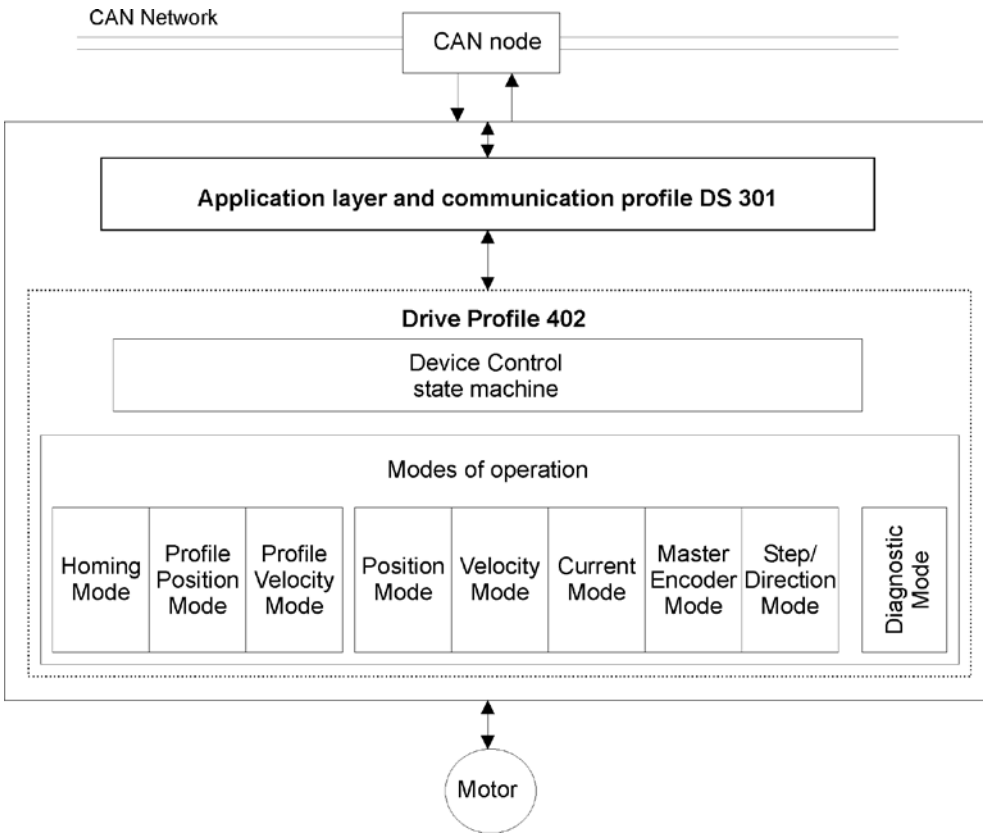


Figure 2: Communication architecture

Device Control: The starting and stopping of the drive and several mode specific commands are executed by the state machine.

Modes of operation: The operation mode defines the behaviour of the drive.

8 Device Control

8.1 State Machine

The state machine describes the device state and the possible control sequence of the drive. A single state represents a special internal or external behaviour. 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 current state can be read using the Statusword.

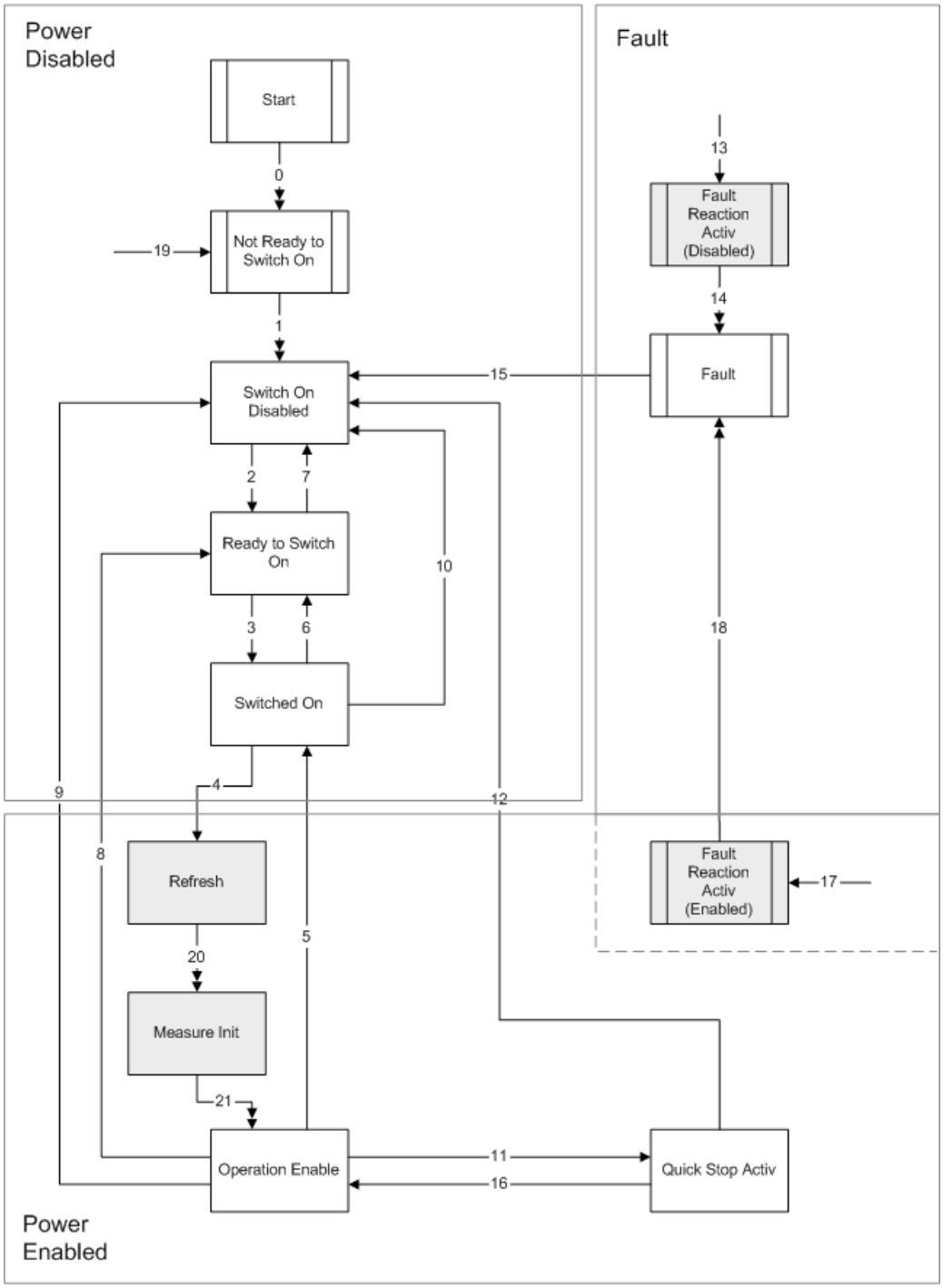


Figure 3: Device State Machine

8.1.1 State of the drive

The following bits of the Statusword indicate the current state of the drive.

State	Statusword [binary]	Description
Start	x0xx xxx0 x000 0000	Bootup
Not Ready to Switch On	x0xx xxx1 x000 0000	The current offset will be measured The drive function is disabled
Switch On Disabled	x0xx xxx1 x100 0000	The drive initialization is complete The drive parameters may be changed The drive function is disabled
Ready to Switch On	x0xx xxx1 x010 0001	The drive parameters may be changed The drive function is disabled
Switched On	x0xx xxx1 x010 0011	The drive function is disabled
Refresh	x1xx xxx1 x010 0011	Refresh power stage
Measure Init	x1xx xxx1 x011 0011	The power is applied to motor The motor resistance or the commutation delay is measured
Operation Enable	x0xx xxx1 x011 0111	No faults have been detected The drive function is enabled and power is applied to motor
Quick Stop Active	x0xx xxx1 x001 0111	The quick stop function is being executed The drive function is enabled and power is applied to motor
Fault Reaction Active (disabled)	x0xx xxx1 x000 1111	A fault has occurred in the drive The drive function is disabled
Fault Reaction Active (enabled)	x0xx xxx1 x001 1111	A fault has occurred in the drive The quick stop function is being executed The drive function is enabled and power is applied to motor
Fault	x0xx xxx1 x000 1000	A fault has occurred in the drive The drive parameters may be changed The drive function is disabled

Table 1: Device state bits

8.1.2 State transitions

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

Transition	Event	Action
0	Reset	Initialize drive
1	The 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; disable drive function
9	'Disable Voltage' command received	Disable power section; disable drive function
10	'Quick Stop' or 'Disable Voltage' command received	
11	'Quick Stop' command received	Setup Quickstop profile
12	'Disable Voltage' command received	Disable power section; disable drive function
13	A fault has occurred not during 'Operation Enable' or 'Quick Stop' State	Disable power section; disable drive function
14	The fault reaction is completed	
15	'Fault Reset' command received	Reset fault condition if no fault exists currently
16	'Enable Operation' command received	Enable drive function
17	A fault has occurred during 'Operation Enable' or 'Quick Stop' State	Setup Quickstop profile
18	The fault reaction is completed	Disable power section; Disable drive function
19	A Node Reset was received	Initialize drive
20	Refresh cycle finished	Enable power section
21	Measure Init cycle finished	Enable drive function

Table 2: Drive state transitions

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.

8.1.3 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 x111	3
Switch On + Enable Operation	0xxx 1111	3 + 4*
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

Table 3: Device control commands

*) Automatic transition to 'Enable Operation' state after executing 'Switched On' state functionality.

9 Operating Modes

9.1 Operating Mode Selection Guide

The device behaviour depends on the activated modes of operation. It can be selected by writing object Modes of operation. The actual mode can be read from Modes of operation display.

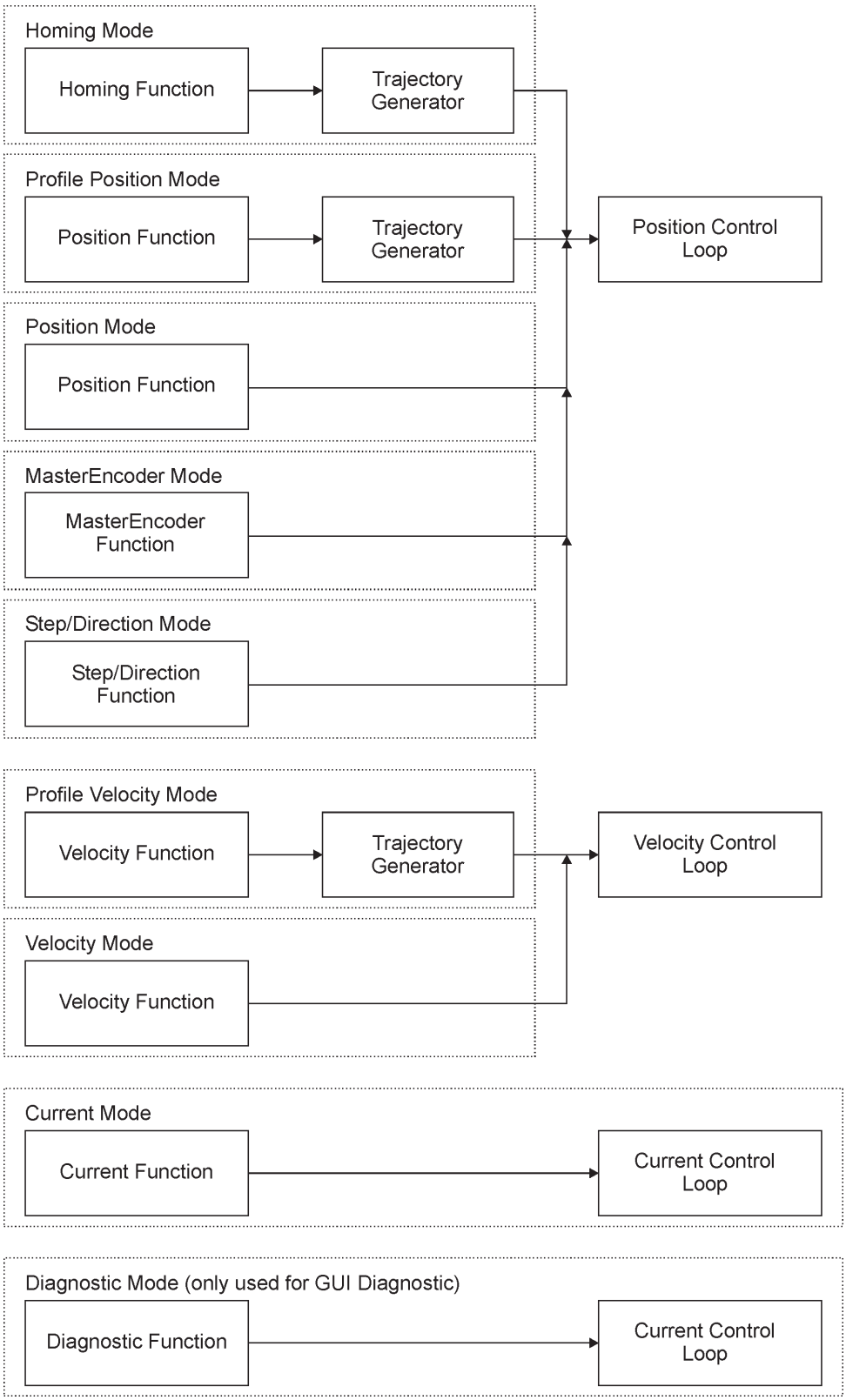


Figure 4: Functional architecture

Homing Mode (6)
This mode has various methods implemented to find a home position (also called: reference point, zero point)

Profile Position Mode (1)
The positioning of the drive is defined in this mode. Speed, position and acceleration can be limited and profiled moves using a Trajectory Generator are possible as well.

Position Mode (-1)
In position mode the position demand value for the position controller can be set direct.

Profile Velocity Mode (3)
The profile velocity mode is used to control the velocity of the drive with no special regard of the position. It supplies limit functions and Trajectory Generation.

Velocity Mode (-2)
In velocity mode the velocity demand value can be set directly. This could be useful when a master position control loop is used.

Current Mode (-3)
In the current mode only the current control loop and a speed limitation are active. This mode is useful when a master position or velocity control loop is used.

Diagnostic Mode (-4)
The diagnostic mode is only used for the Diagnostic Wizard of the Graphical User Interface.

Master Encoder Mode (-5)
In the master encoder mode the position demand value is set by an external (master) encoder. The value is scaled with a numerator and denominator also the polarity is changeable by software.

Step / Direction Mode (-6)
In the step / direction mode the position demand value is set by an external hardware signals. The value is scaled with a numerator and denominator also the polarity is changeable by software.

Trajectory Generator
The chosen operation mode and the corresponding parameters (objects) define the input of the trajectory generator. The trajectory generator supplies the control loop(s) with the demand values. They are generally mode specific.

Controller Structure
The current control loop is used in all operation modes. In the position and velocity based modes there is also a superior position or velocity controller used.

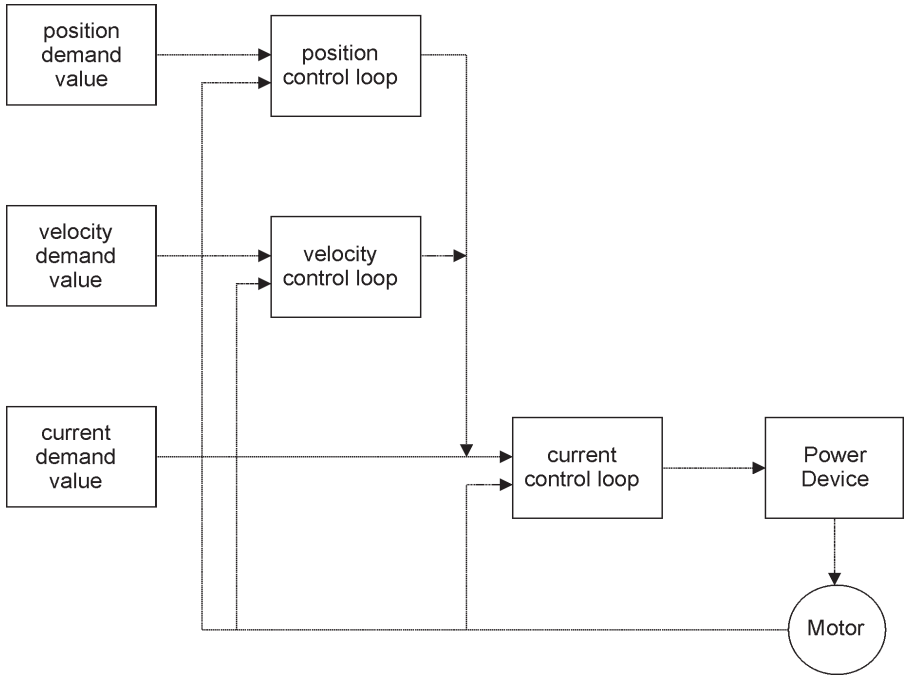


Figure 5: Structure of control loops

9.2 Profile Position Mode

The overall architecture of this mode is shown in Figure 6. A target position is applied to the trajectory generator. It is generating a position demand value for the position control loop described in the Position Control Function chapter.

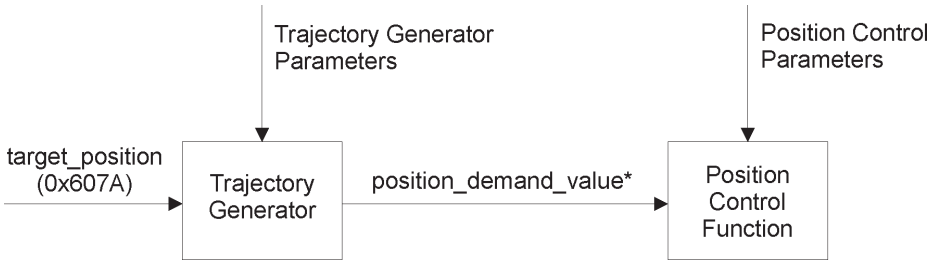


Figure 6: Profile Position Mode overview

Some of the trajectory generator commanding parameters have limits applied before being normalized to internal units.

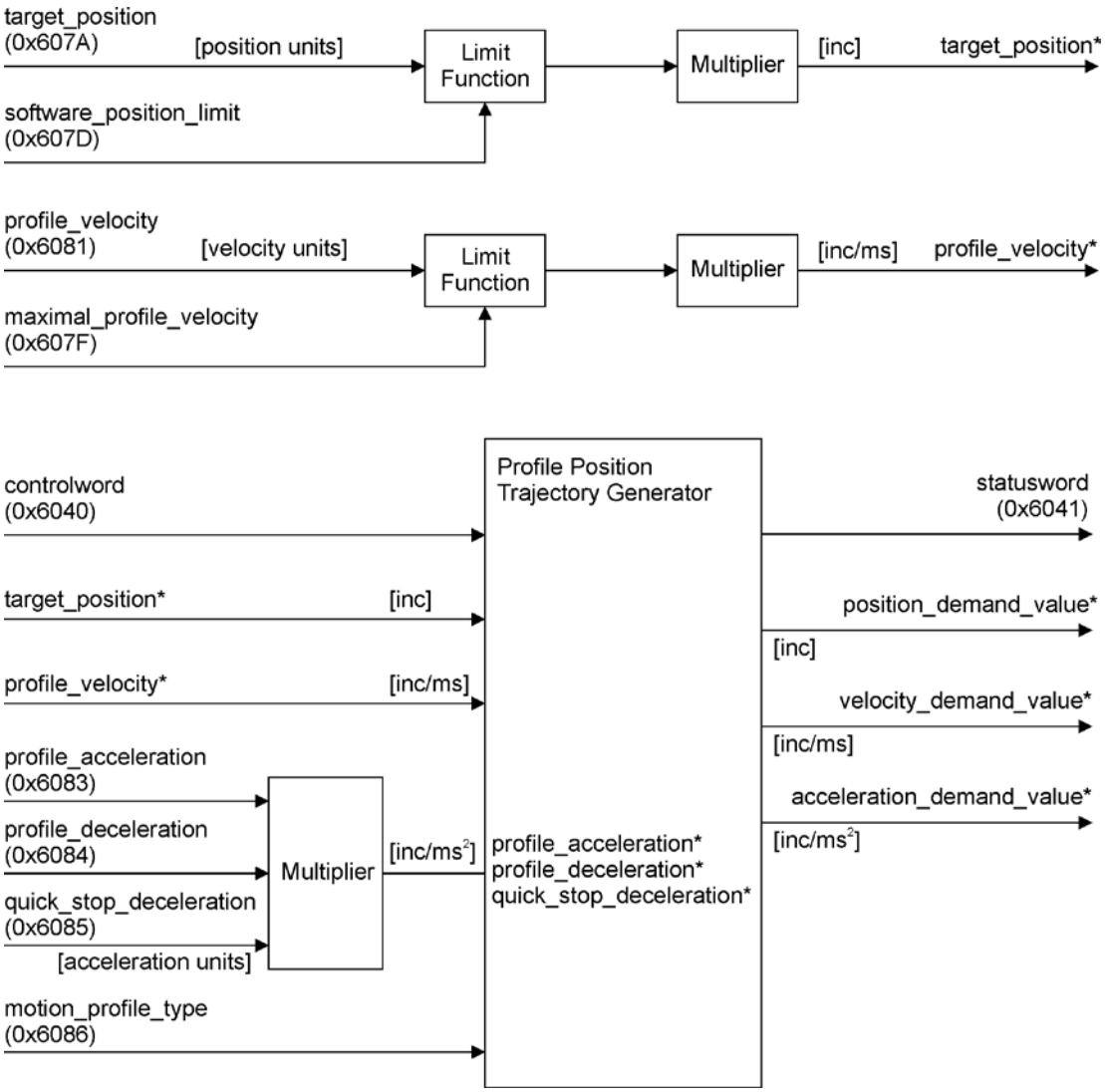


Figure 7: Profile Position Mode Block Diagram

The Target Reached Function offers the possibility to define a position range (Position Window) around the Target position to be reached as valid.

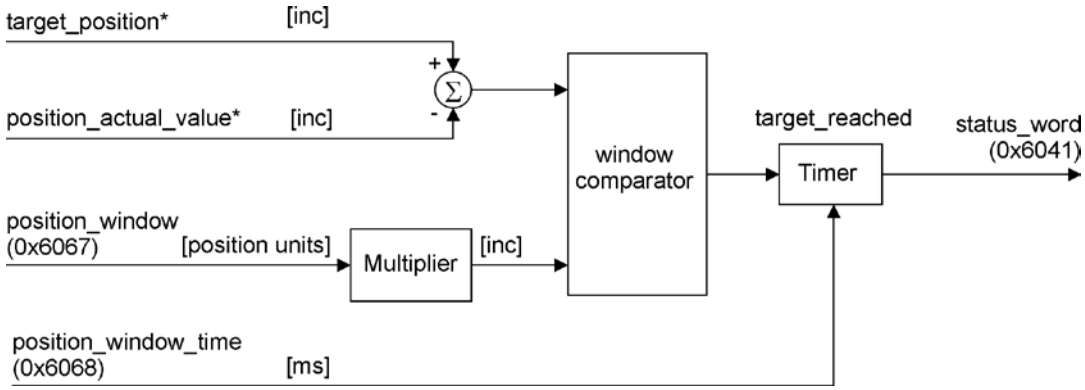


Figure 8: Target Reached Function Block Diagram

9.2.1 Profile Position Trajectory Generator

The trajectory generator in profile position mode is supporting different motion profile types.

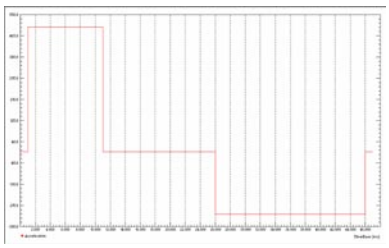
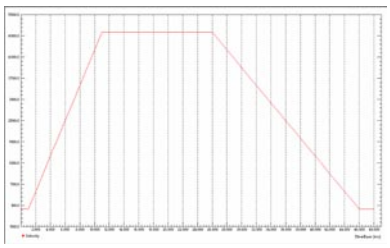
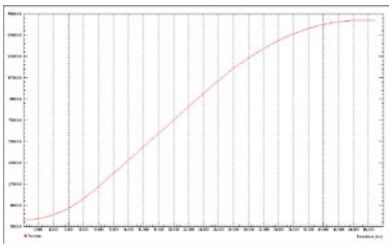
Acceleration	Velocity	Position
		
A_{max} = Profile acceleration A_{min} = Profile deceleration	V_{max} = Profile velocity	Absolute Movement: P_{end} = Target position Relative Movement: P_{end} = Position demand value + Target position

Figure 9: Profile Position Trajectory Linear ramp (trapezoidal profile)

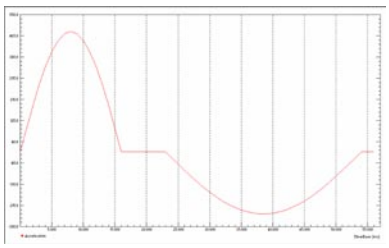
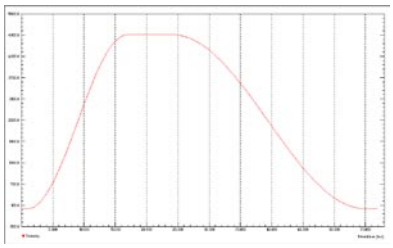
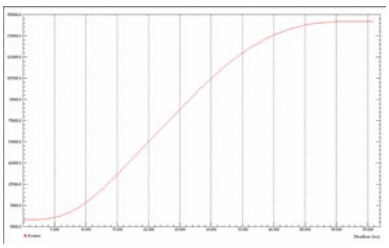
Acceleration	Velocity	Position
		
A_{max} = Profile acceleration A_{min} = Profile deceleration	V_{max} = Profile velocity	Absolute Movement: P_{end} = Target position Relative Movement: P_{end} = Position demand value + Target position

Figure 10: Profile Position Trajectory Sin^2 ramp (sinusoidal profile)

9.2.2 How to use the 'Profile Position Mode'

9.2.2.1 Configuration parameters

Parameter	Index	Description
Software position limit	0x607D	Contains the sub-parameters min position limit and max position limit. These parameters define the absolute position limits for the position demand value. Every new target position will be checked against these limits.
Maximal profile velocity	0x607F	This parameter is the maximal allowed speed in either direction during a profiled move.
Quick stop deceleration	0x6085	Is only used to decelerate in fault reaction state.
Position Window	0x6067	This function offers to define a position range around a target position to be regarded as valid. If the drive is within this area for a specified time the related control bit 10 'Target Reached' in the Statusword is set.
Position Window Time	0x6068	These parameters define the time for the position window.

Table 4: 'Profile Position Mode' Configuration parameters

9.2.2.2 Commanding parameters

Parameter	Index	Description
Controlword	0x6040	The profile position mode will be controlled by a write access to the mode dependent bits of the Controlword.
Target position	0x607A	The Target position is the position that the drive should move to in position profile mode using the current settings of motion control parameters such as velocity, acceleration, motion profile type etc. The target position will be interpreted as absolute or relative depending on the 'abs / rel' flag in the controlword.
Profile velocity	0x6081	This parameter is the velocity normally attained at the end of the acceleration ramp during a profiled move and is valid for both directions of movement.
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 to perform a movement. 0 = linear ramp (trapezoidal profile) 1 = $\sin^2$ ramp (sinusoidal profile)

Table 5: 'Profile Position Mode' Commanding parameters

Controlword (Profile Position Mode specific bits)

Bits 15 - 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bits 3 - 0
(see 14.59)	Halt	(see 14.59)	Abs / rel	Change set immediately	New set-point	(see 14.59)

Name	Value	Description
New set-point	0	Does not assume Target position
	1	Assume Target position
Change set immediately	0	Finish the actual positioning and then start next positioning
	1	Interrupt the actual positioning and start the next positioning
Abs / rel	0	Target position is an absolute value
	1	Target position is a relative value
Halt	0	Execute positioning
	1	Stop axle with Profile deceleration

Table 6: 'Profile Position Mode' bits of the Controlword

9.2.2.3 Output parameters

Parameter	Index	Description
Statusword	0x6041	The profile position mode state can be observed by the specific bits of Statusword.
Position demand value	0x6062	The position demand value is the output of the trajectory generator. This value is the input for the position control function.

Table 7: 'Profile Position Mode' Output parameters

Statusword (Profile Position Mode specific bits)

Bits 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bits 9 - 0
(see 14.60)	Following error	Set-point acknowledge	(see 14.60)	Target reached	(see 14.60)

Name	Value	Description
Target reached	0	Halt = 0: Target position not reached Halt = 1: Axle decelerates
	1	Halt = 0: Target position reached Halt = 1: Velocity of axle is 0
Set-point acknowledge	0	Trajectory generator has not assumed the positioning value (yet)
	1	Trajectory generator has assumed the positioning value
Following error	0	Not following error
	1	Following error

Table 8: 'Profile Position Mode' bits of the Statusword

9.3 Homing Mode

This chapter describes the method by which a drive seeks the home position (also called, reference point or zero point). There are various methods of achieving this using limit switches at the ends of travel or a home switch (zero point switch) in mid-travel, most of the methods also use the index (zero) pulse train from an incremental encoder.

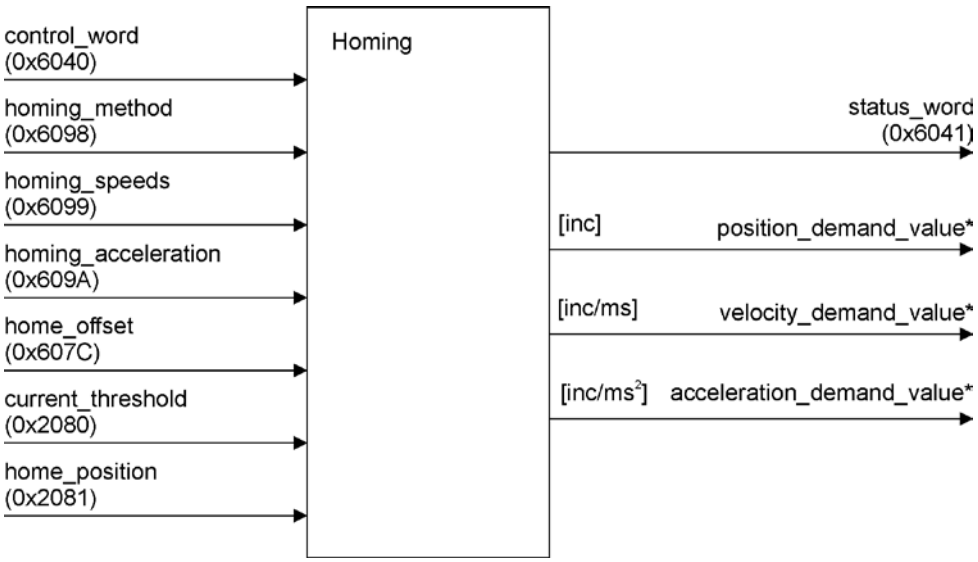


Figure 11: Homing mode block diagram

9.3.1 Homing Trajectory Generator

The trajectory generator in homing mode is supporting different motion profile types. The different movements are mode dependent and the end positions will be calculated internally.

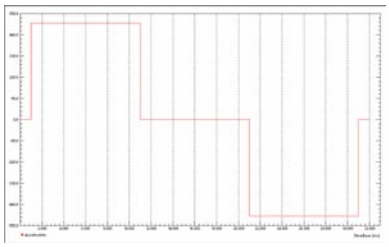
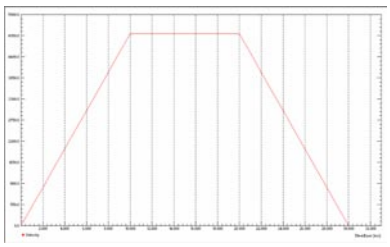
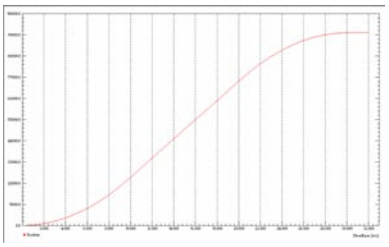
Acceleration	Velocity	Position
		
A_{max} = Homing acceleration A_{min} = -Homing acceleration	V_{max} = speed for switch search or speed for zero search	P_{end} = e.g. reference position + home offset

Figure 12: Homing Trajectory Linear ramp (trapezoidal profile)

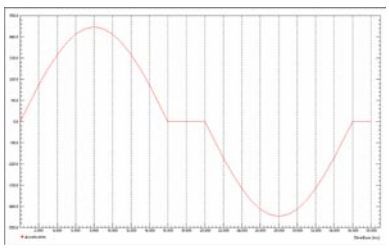
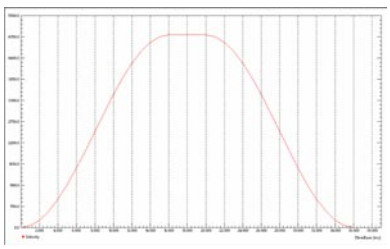
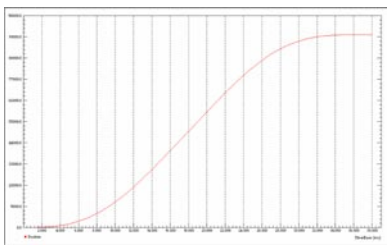
Acceleration	Velocity	Position
		
A_{max} = Homing acceleration A_{min} = -Homing acceleration	V_{max} = speed for switch search or speed for zero search	P_{end} = e.g. reference position + home offset

Figure 13: Homing Trajectory Sin^2 ramp (sinusoidal profile)

9.3.2 How to use the 'Homing Mode'

9.3.2.1 Configuration parameters

Parameter	Index	Description
Configuration of digital inputs	0x2070	The digital input pins of the EPOS can be configured by this to the digital input functionalities especially to the limit and homing switches for homing.
Digital Input Functionalities	0x2071	These functionalities can be masked and changed in polarity by the digital input functionalities object.
Motion profile type	0x6086	Selects the type of motion profile used to perform a movement. 0 = linear ramp (trapezoidal profile) 1 = $\sin^2$ ramp (sinusoidal profile)

Table 9: 'Homing Mode' Configuration parameters

9.3.2.2 Commanding parameters

Parameter	Index	Description
Controlword	0x6040	The homing mode will be controlled by a write access to the mode dependent bits of the Controlword.
Homing method	0x6098	Defines the type of homing procedure.
Homing speeds	0x6099	Specifies the speeds for homing. There are two homing speeds; in a typical cycle the faster speed is used to find the home switch and the slower is used to find the index pulse.
Homing acceleration	0x609A	Specifies the acceleration during homing.
Home offset	0x607C	Distance to move away from a detected position at the end of the homing sequence.
Current Threshold for Homing Mode	0x2080	Current threshold for current index homing methods.
Home position	0x2081	The object home position allows the user to displace zero in the user's coordinate system.

Table 10: Homing Mode' Commanding parameters

Controlword (Homing Mode specific bits)

Bits 15 - 9	Bit 8	Bit 7	Bits 6, 5	Bit 4	Bits 3 - 0
(see 14.59)	Halt	(see 14.59)	reserved	Homing operation start	(see 14.59)

Name	Value	Description
Homing operation start	0	Homing mode inactive
	0 → 1	Start homing mode
	1	Homing mode active
Halt	0	Execute the instruction of Bit 4
	1	Stop axle with Homing acceleration

Table 11: 'Homing Mode' bits of the Controlword

9.3.2.3 Output parameters

Parameter	Index	Description
Statusword	0x6041	The homing mode state can be observed by the specific bits of Statusword.

Table 12: 'Homing Mode' Output parameters

Statusword (Homing Mode specific bits)

Bits 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bits 9 - 0
Position referenced to Home position	(see 14.60)	Homing error	Homing attained	(see 14.60)	Target reached	(see 14.60)

Name	Value	Description
Target reached	0	Halt = 0: Home position not reached Halt = 1: Axle decelerates
	1	Halt = 0: Home position reached Halt = 1: Velocity of axle is 0
Homing attained	0	Homing mode not yet completed
	1	Homing mode carried out successfully
Homing error	0	No homing error
	1	Homing error occurred; Homing mode carried out not successfully; The error cause is found by reading the error code
Position referenced to Home position	0	Not referenced to home position
	1	The Position actual value is referenced to the home position

Table 13: 'Homing Mode' bits of the Statusword

9.3.3 Homing Method 1 (Negative Limit Switch & Index)

Using this method the initial direction of movement is leftward (to negative positions) if the negative limit switch is inactive (here shown as low).

The axis moves with speed for switch search (Homing speeds) to the edge of negative limit switch (1). With speed for zero search (Homing speeds) the axis move to encoder index pulse (2). Now the axis move the Home offset (3). This point is taken as reference for all further moves and is set to Home position (4).

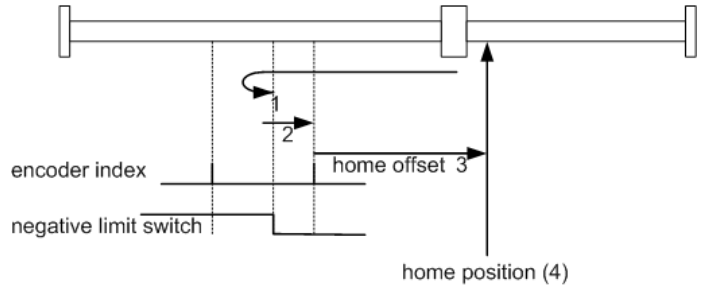


Figure 14: Homing Method 1

9.3.4 Homing Method 2 (Positive Limit Switch & Index)

Using this method the initial direction of movement is rightward (to positive positions) if the positive limit switch is inactive (here shown as low).

The axis moves with speed for switch search (Homing speeds) to the edge of positive limit switch (1). With speed for zero search (Homing speeds) the axis move to encoder index pulse (2). Now the axis move the Home offset (3). This point is taken as reference for all further moves and is set to Home position (4).

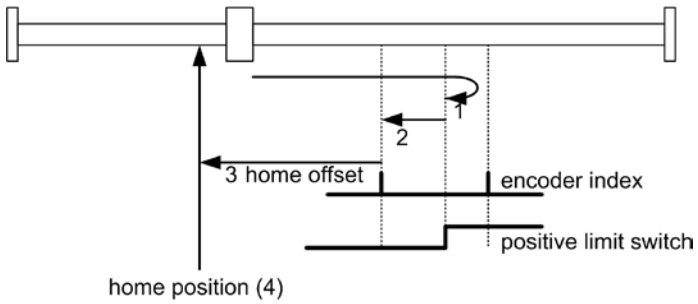


Figure 15: Homing Method 2

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

This method uses a home switch, which is active over only portion of the travel; in effect the switch has a 'momentary' action as the axle's position sweeps past the switch.

Using this method the initial direction of movement is to the right (to positive positions) except if the home switch is already active at start of the motion.

The axis moves with speed for switch search (Homing speeds) to the edge of home switch (1). With speed for zero search (Homing speeds) the axis move to encoder index pulse (2). Now the axis move the Home offset (3). This point is taken as reference for all further moves and is set to Home position (4).

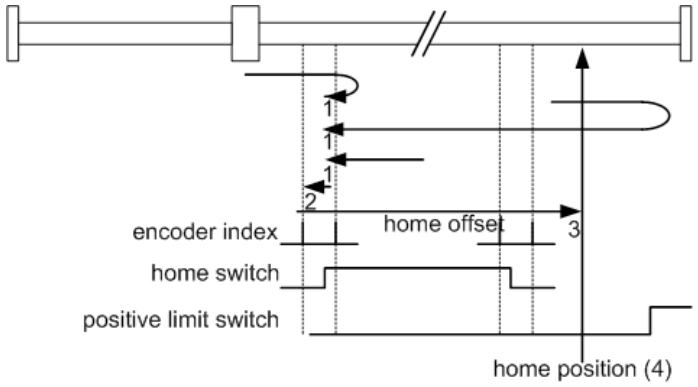


Figure 16: Homing Method 7

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

This method uses a home switch, which is active over only portion of the travel; in effect the switch has a 'momentary' action as the axle's position sweeps past the switch.

Using this method the initial direction of movement is to the left (to negative positions) except if the home switch is already active at start of the motion.

The axis moves with speed for switch search (Homing speeds) to the edge of home switch (1). With speed for zero search (Homing speeds) the axis move to encoder index pulse (2). Now the axis move the Home offset (3). This point is taken as reference for all further moves and is set to Home position (4).

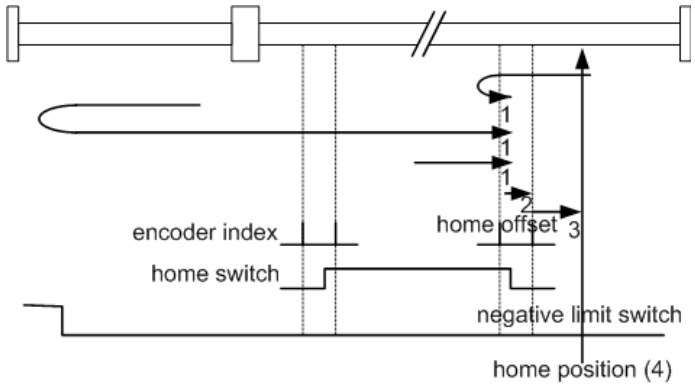


Figure 17: Homing Method 11

9.3.7 Homing Method 17 (Negative Limit Switch)

This method is similar to method 1 except that the Home position is not dependent on the index pulse but only on the negative limit switch.

9.3.8 Homing Method 18 (Positive Limit Switch)

This method is similar to method 2 except that the Home position is not dependent on the index pulse but only on the positive limit switch.

9.3.9 Homing Method 23 (Home Switch Positive Speed)

This method is similar to method 7 except that the Home position is not dependent on the index pulse but only on falling edge of the home switch.

9.3.10 Homing Method 27 (Home Switch Negative Speed)

This method is similar to method 11 except that the Home position is not dependent on the index pulse but only on falling edge of the home switch.

9.3.11 Homing Method 33 and 34 (Index Negative / Positive Speed)

Using method 33 or 34 the direction of homing is negative (method 33) or positive respectively.

The axis moves with speed for zero search (Homing speeds) to the next encoder index pulse (33) or (34). Now the axis moves the Home offset (2). This point is taken as reference for all further moves and is set to Home position (4).

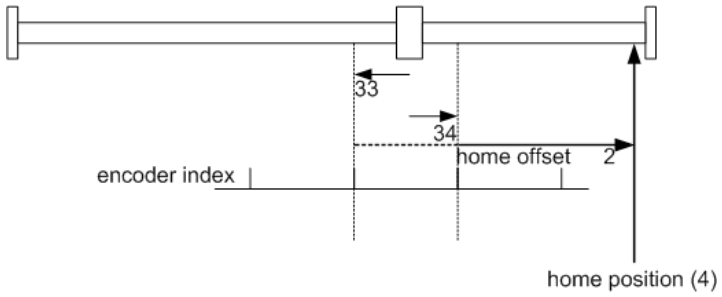


Figure 18: Homing Method 33 and 34

9.3.12 Homing Method 35 (Actual Position)

In method 35 the current position is changed to the value Home position.

9.3.13 Homing Method -1 (Current Threshold Positive Speed & Index)

This method uses a mechanical border on the right (positive) side. This border is detected when the output current rises over the Current Threshold for Homing Mode.

The axis moves with positive 'speed for switch search' (Homing speeds) to the mechanical border (1). Then the axis moves to the next encoder index pulse (2) with 'speed for zero search' (Homing speeds). Now the axis moves the Home offset (3) distance. This end position is taken as reference for all further moves and is set to Home position (4).

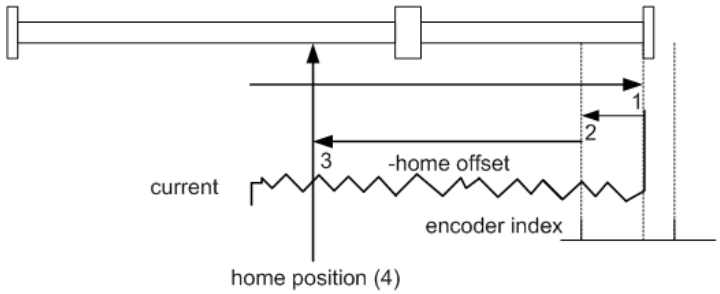


Figure 19: Homing Method -1

9.3.14 Homing Method -2 (Current Threshold Negative Speed & Index)

This method uses a mechanical border on the left (negative) side. This border is detected when the output current rises over the Current Threshold for Homing Mode.

The axis moves with negative 'speed for switch search' (Homing speeds) to the mechanical border (1). Then the axis moves to the next encoder index pulse (2) with 'speed for zero search' (Homing speeds). Now the axis moves the Home offset (3) distance. This end position is taken as reference for all further moves and is set to Home position (4).

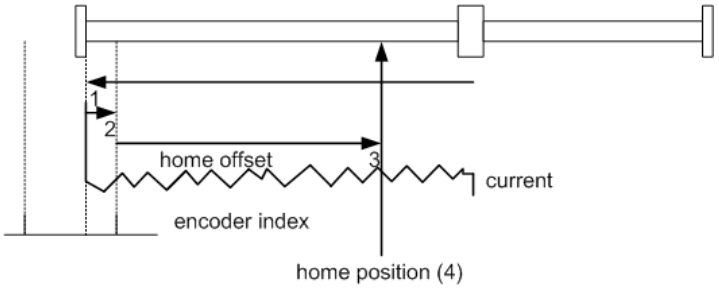


Figure 20: Homing Method -2

9.3.15 Homing Method -3 (Current Threshold Positive Speed)

This method is similar to method -1 except that the Home position is not dependent on the index pulse but only on mechanical border.

9.3.16 Homing Method -4 (Current Threshold Negative Speed)

This method is similar to method -2 except that the Home position is not dependent on the index pulse but only on mechanical border.

9.4 Position Mode

The Position mode setting value is used direct as demand value of the position controller in the position mode. There is no trajectory generator, interpolator nor extrapolator between. The position is imitated with the Software position limit.

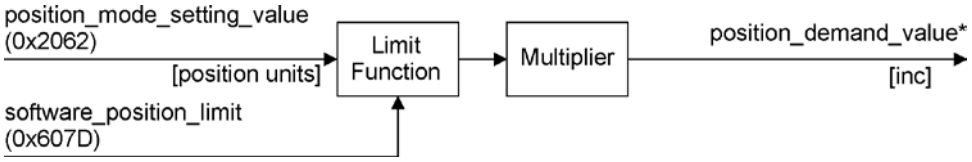


Figure 21: Position Mode Block Diagram

9.4.1 How to use the ‚Position Mode‘

9.4.1.1 Configuration parameters

Parameter	Index	Description
Software position limit	0x607D	The position mode setting value is limited with the software position limit.

Table 14: ‘Position Mode’ Configuration parameters

9.4.1.2 Commanding parameters

Parameter	Index	Description
Position mode setting value	0x2062	The position mode setting value is used direct as demand value of the position controller in the position mode. There is no trajectory generator!

Table 15: ‘Position Mode’ Commanding parameters

9.4.1.3 Output parameters

There are no output parameters in this operating mode.

9.5 MasterEncoder Mode

The master encoder mode uses two digital input pins to command the desired position by an external encoder. The used input pins depend on the hardware. For EPOS 24/1 and EPOS 24/5 the pins are DigIN 2 and DigIN 3. For the EPOS 70/10 and the MCD EPOS 60 W the pins are DigIN 7 together with DigIN 7/ and DigIN 8 together with DigIN 8/.

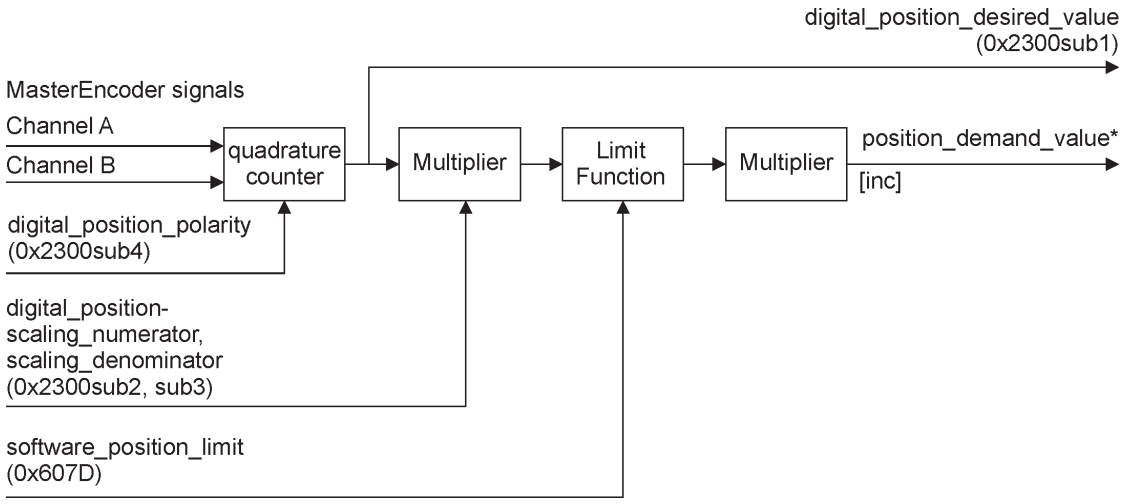


Figure 22: MasterEncoder Mode Block Diagram

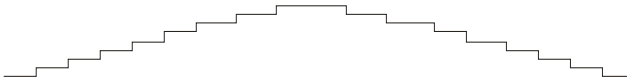
Channel A	Digital Input 3	
Channel B	Digital Input 2	
Digital Position Desired Value (Polarity = 0)		

Figure 23: EPOS 24/1, EPOS 24/5 Quadrature Counter

Channel A	Digital Input 8	
Channel A/	Digital Input 8/	
Channel B	Digital Input 7	
Channel B/	Digital Input 7/	
Digital Position Desired Value (Polarity = 0)		

Figure 24: EPOS 70/10, MCD EPOS 60 W Quadrature Counter

9.5.1 How to use the 'MasterEncoder Mode'

9.5.1.1 Configuration parameters

Parameter	Index	Description
Digital Position Input	0x2300	The commanding encoder signals will be detected and counted by a quadrature encoder pulse counter unit. With the parameter 'Digital Position Input' scaling the polarity (count direction) of this input can be set. The digital position desired value is multiplied by the scaling numerator and divided by the scaling denominator witch allows to use the EPOS as an electronic gear.

Table 16: 'MasterEncoder Mode' Configuration parameters

9.5.1.2 Commanding parameters

There are no commanding parameters. This operation mode is commanded by digital inputs.

9.5.1.3 Output parameters

Parameter	Index	Description
Position Demand Value	0x6062	The position demand value as output of the master encoder mode will be used as input of the position control function. There is also the possibility to observe the digital position desired value (0x2300-01).

Table 17: 'MasterEncoder Mode' Output parameters

9.6 Step/Direction Mode

In the step/direction mode the EPOS behaves as a stepper motor servo drive. Two digital input pins are used to command the desired position by a direction signal and a step pulse signal. This type of signals is often uses to command stepper motor drives. The used input pins depend on the hardware. For EPOS 24/1 and EPOS 24/5 the pins are DigIN 2 and DigIN 3. For the EPOS 70/10 and the MCD EPOS 60 W the pins are DigIN 7 and DigIN 8.

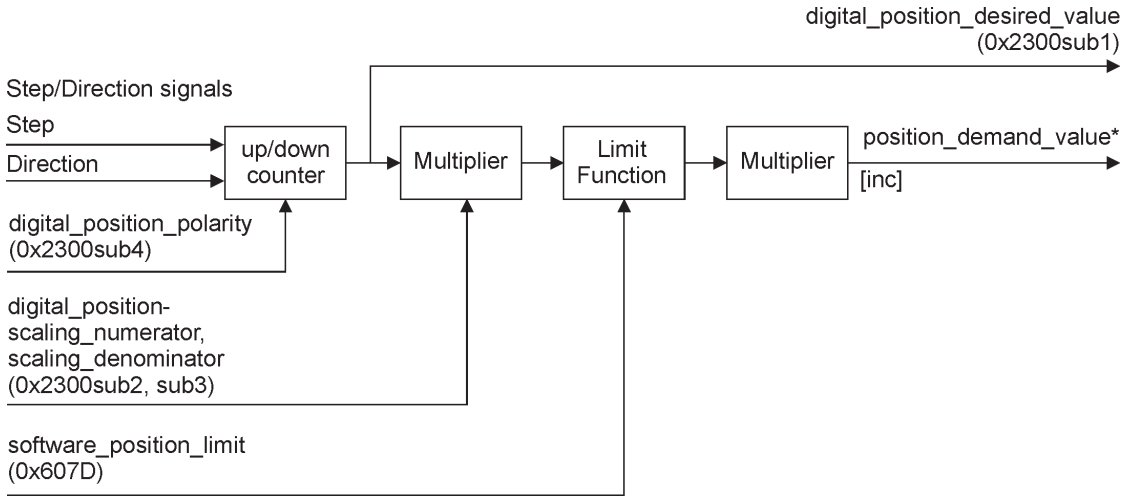


Figure 25: Step/Direction Mode Block Diagram

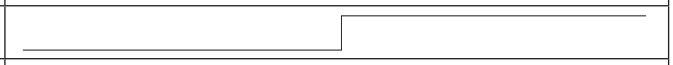
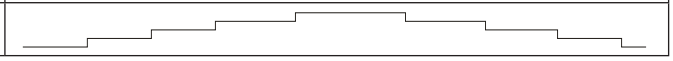
Step	Digital Input 3	
Direction	Digital Input 2	
Digital Position Desired Value (Polarity = 0)		

Figure 26: EPOS 24/1, EPOS 24/5 Up/Down Counter

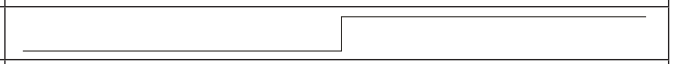
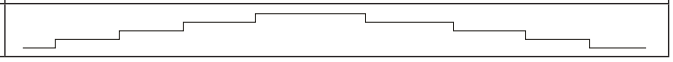
Step	Digital Input 8	
Direction	Digital Input 7	
Digital Position Desired Value (Polarity = 0)		

Figure 27: EPOS 70/10, MCD EPOS 60 W Up/Down Counter

9.6.1 How to use the ‚Step/Direction Mode‘

9.6.1.1 Configuration parameters

Parameter	Index	Description
Digital Position Input	0x2300	The step input signal is used as trigger of the up/down counter unit. The direction signal together with the parameter digital position polarity (‘Digital Position Input’) controls the count direction. The digital position desired value (‘Digital Position Input’) is multiplied by the scaling numerator (‘Digital Position Input’) and divided by the scaling (‘Digital Position Input’) to build the position-desired value as output.

Table 18: ‘Step/Direction Mode’ Configuration parameters

9.6.1.2 Commanding parameters

There are no commanding parameters. This operation mode is commanded by digital inputs.

9.6.1.3 Output parameters

Parameter	Index	Description
Position Demand Value	0x6062	The position demand value as output of the step/direction mode will be used as input of the position control function. There is also the possibility to observe the digital position desired value (0x2300-01).

Table 19: ‘Step/Direction Mode’ Output parameters

9.7 Position Control Function

The position control function is used for all position-based modes such as profile position mode, position mode, homing mode, master encoder mode and step/direction mode. The control loop is fed with the position demand value and with the output of the position detection unit ('Position actual value') like an encoder as input parameter. The behaviour of the control may be influenced by control parameters ('Position control parameter set') which are externally applicable. The output of the controller is a current demand value, which is input for the current controller.

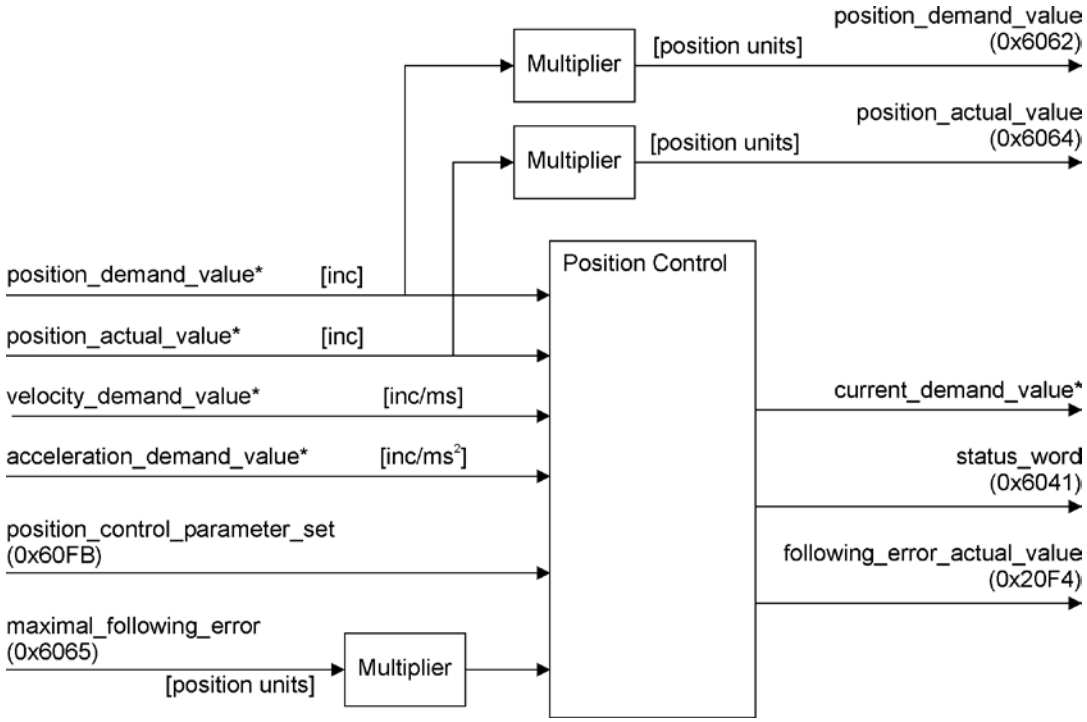


Figure 28: Position Control Function Block Diagram

9.7.1 How to use the 'Position Control Function'

9.7.1.1 Configuration parameters

Parameter	Index	Description
Maximal following error	0x6065	The 'Maximal following error' defines a range of tolerated position values symmetrically to the position demand value. If the position actual value is out of the maximal following error, a following error occurs.
Position control parameter set	0x60FB	With the 'Position control parameter set' the behaviour of the PID controller and the feed forward functionality can be changed.

Table 20: 'Position Control Function' Configuration parameters

9.7.1.2 Commanding parameters

There are no commanding parameters. The position control function is directly commanded by all position based operating modes as profile position mode, position mode, homing mode, master encoder mode and step/direction mode.

9.7.1.3 Output parameters

Parameter	Index	Description
Position demand value	0x6062	The position demand value as output of the position mode will be used as input of the position control function.
Position actual value	0x6064	The actual position is absolute and referenced to system zero position. The value is in position units.

Table 21: 'Position Control Function' Output parameters

9.8 Profile Velocity Mode

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

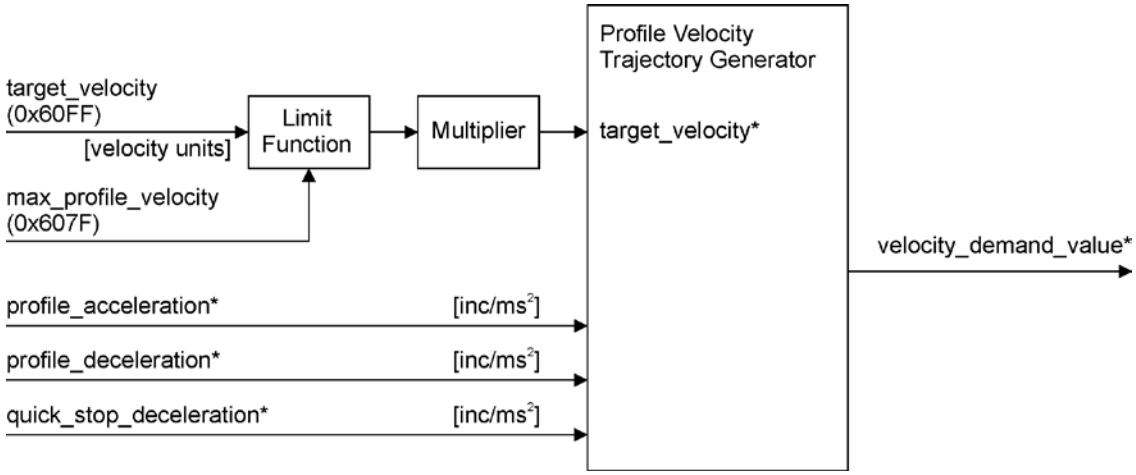


Figure 29: Profile Velocity Mode Block Diagram

9.8.1 Profile Velocity Trajectory Generator

The trajectory generator in profile velocity mode is supporting different motion profile types.

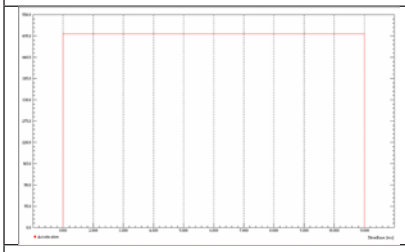
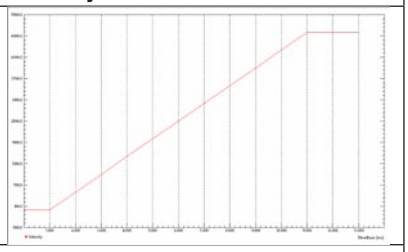
Acceleration	Velocity
	
A_{max} = Profile acceleration A_{min} = -Profile deceleration	V_{end} = Target velocity

Figure 30: Profile Velocity Trajectory Linear ramp (trapezoidal profile)

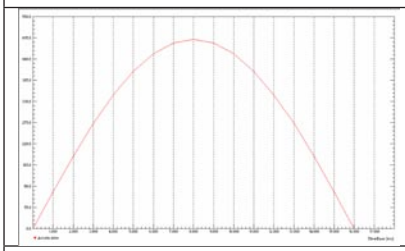
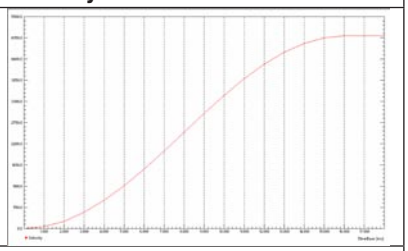
Acceleration	Velocity
	
A_{max} = Profile acceleration A_{min} = -Profile deceleration	V_{end} = Target velocity

Figure 31: Profile Velocity Trajectory Sin^2 ramp (sinusoidal profile)

9.8.2 How to use the 'Profile Velocity Mode'

9.8.2.1 Configuration parameters

Parameter	Index	Description
Maximal profile velocity	0x607F	This parameter is the maximal allowed speed in either direction during a profiled move.
Quick stop deceleration	0x6085	Is only used to decelerate in Fault reaction state.

Table 22: 'Profile Velocity Mode' Configuration parameters

9.8.2.2 Commanding parameters

Parameter	Index	Description
Controlword	0x6040	The profile velocity mode will be controlled by a write access to the mode dependent bits of the Controlword.
Target velocity	0x60FF	The target velocity is the speed that the drive should reach in profile velocity mode.
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 to perform a movement. 0 = linear ramp (trapezoidal profile) 1 = $\sin^2$ ramp (sinusoidal profile)

Table 23: 'Profile Velocity Mode' commanding parameters

Controlword (Profile Velocity Mode specific bits)

Bits 15 - 9	Bit 8	Bit 7	Bits 6-4	Bits 3 - 0
(see 14.59)	Halt	(see 14.59)	reserved	(see 14.59)

Name	Value	Description
Halt	0	Execute the motion
	1	Stop axle

Table 24: 'Profile Velocity Mode' bits of the controlword

9.8.2.3 Output parameters

Parameter	Index	Description
Statusword	0x6041	The profile position mode state can be observed by the specific bits of Statusword.
Velocity demand value	0x606B	The velocity demand value is the rescaled output of the trajectory generator.

Table 25: 'Profile Position Mode' Output parameters

Statusword (Profile Velocity Mode specific bits)

Bits 15, 14	Bit 13	Bit 12	Bit 11	Bit 10	Bits 9 - 0
(see 14.60)	Not used	Speed	(see 14.60)	Target reached	(see 14.60)

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

Table 26: 'Profile Velocity Mode' bits of the statusword

9.9 Velocity Mode

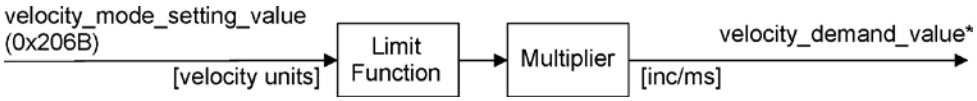


Figure 32: Velocity Mode Block Diagram

9.9.1 How to use the 'Velocity Mode'

9.9.1.1 Configuration parameters

There are no configuration parameters for this operating mode.

9.9.1.2 Commanding parameters

Parameter	Index	Description
Velocity mode setting value	0x206B	The velocity mode setting value is used direct as demand value of the velocity controller in the velocity mode. There is no trajectory generator!

Table 27: 'Velocity Mode' Commanding parameters

9.9.1.3 Output parameters

There are no output parameters for this operating mode.

9.10 Velocity Control Function

The velocity control function is used for all velocity-based modes such as profile velocity mode and velocity. The control loop is fed with the demand velocity and with differentiation of the output of the position detection unit (position actual value) like an encoder as input parameter. The behaviour of the control may be influenced by control parameters, which are externally applicable. The output of the controller is a current demand value, which is input for the current controller.

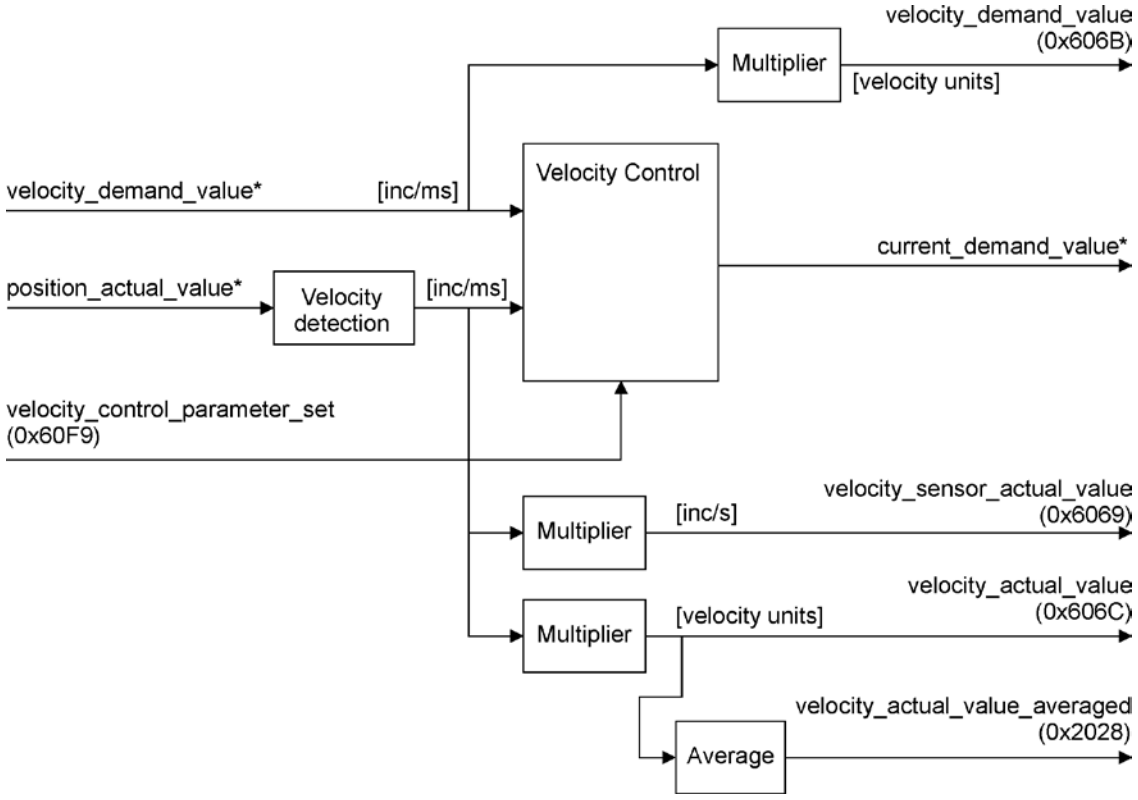


Figure 33: Velocity Control Block Diagram

9.10.1 How to use the 'Velocity Control Function'

9.10.1.1 Configuration parameters

Parameter	Index	Description
Velocity control parameter set	0x60F9	The behaviour of the PI-control may be influenced by the velocity control parameter set.

Table 28: 'Velocity Control Function' Configuration parameters

9.10.1.2 Commanding parameters

There are no commanding parameters. The velocity control function is directly commanded by all velocity based operating modes as profile velocity mode and velocity mode.

9.10.1.3 Output parameters

Parameter	Index	Description
Velocity demand value	0x606B	The velocity demand value is the rescaled output of the trajectory generator.
Velocity actual value	0x606C	This value is the actual velocity in velocity units.
Velocity actual value averaged	0x2028	This value is the averaged velocity in velocity units.
Velocity sensor actual value	0x6069	The object 'Velocity sensor actual value' holds the internal calculated actual velocity.

Table 29: 'Velocity Control Function' Output parameters

9.11 Current Mode

The current mode includes a commanding function, which normalizes the setting value to internal units to command the current control function.

Figure 34: Current Mode Block Diagram

9.11.1 How to use the 'Current Mode'

9.11.1.1 Configuration parameters

There are no configuration parameters for this operating mode.

9.11.1.2 Commanding parameters

Parameter	Index	Description
Current mode setting value	0x2030	The current mode setting value is used as commanding value in current mode.

Table 30: 'Current Mode' Commanding parameters

9.11.1.3 Output parameters

There are no output parameters for this operating mode.

9.12 Current Control Function

The current control function is also used for the other operation modes and the current demand value is get then from the overlaid position or velocity controller.

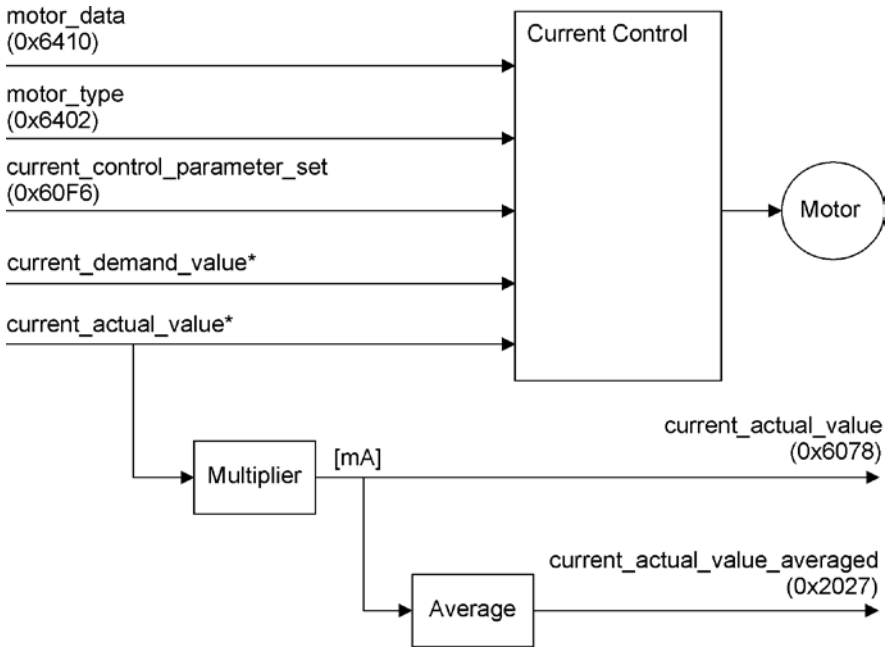


Figure 35: Current Control Function Block Diagram

9.12.1 Output Current Limitation according I²t Method

When setting up the Motor data properly, the EPOS limits the output current according I²t method with the parameters continuous current limit, output current limit and thermal time constant winding. For the I²t method it is assumed that the motor is driven in ambient temperature [25°C]. When this condition is not fulfilled in the given application the output current must be reduced by setting up the parameters continuous current limit, output current limit and thermal time constant winding according to the new ambient temperature.

The heating-up of the motor is given with

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

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

According to the actual winding temperature ϑ (calculated EPOS internally), the continuous current limit, the output current limit and the thermal time constant winding [τ_{th}], the EPOS limits the output current. Each measure interval (T_P) the EPOS calculates the thermal dissipation loss (P_V).

$$P_V = \frac{1}{T_p} \cdot \int_{t}^{t+T_p} i^2 R dt$$

T_P	measure interval
i	actual measured current
R	motor resistance

The measure interval is calculated at the start up of the EPOS device and is given with
$T_P = 1/20 \cdot$ thermal time constant winding.

If the calculated winding temperature (ϑ) reaches a maximal value, the output current is reduced to the continuous current limit.

In the figure bellow the standardized peak current vs. standardized peak current time is given. Using the given figure it is possible to calculate the time the EPOS can source a current.

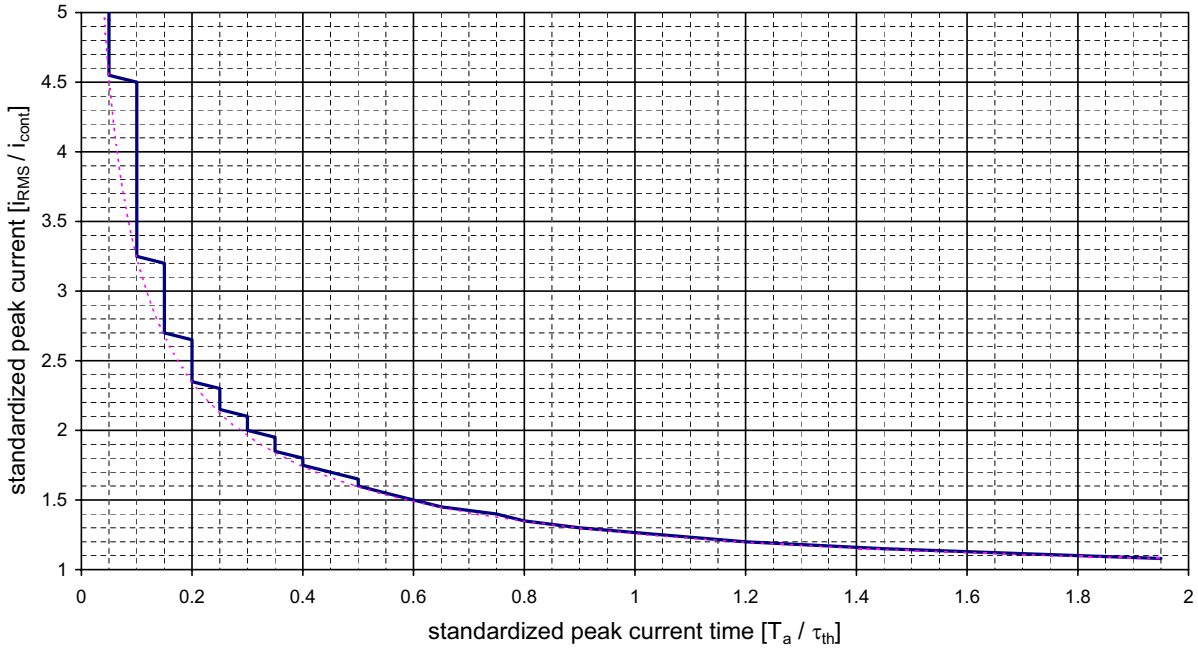


Figure 36: Standardized peak current vs. standardized peak current time

Example:

The continuous current limit was configured as 1470 mA, the output current limit was configured as 2940 mA, and the thermal time constant winding [τ_{th}] was configured as 2.8 s.

At acceleration time T_a the motor needs a higher acceleration current I_a. The EPOS current limiting method according to I²t fulfils this need.

How long does the EPOS maximal source the higher acceleration current I_a = 2940 mA?

standardized peak current = 2940 mA / 1470 mA = 2

standardized peak current time -> 0.3

The resulting acceleration time $Ta = 0.3 \cdot$ thermal time constant winding $= 0.3 \cdot 2.8\ s = 840\ ms$

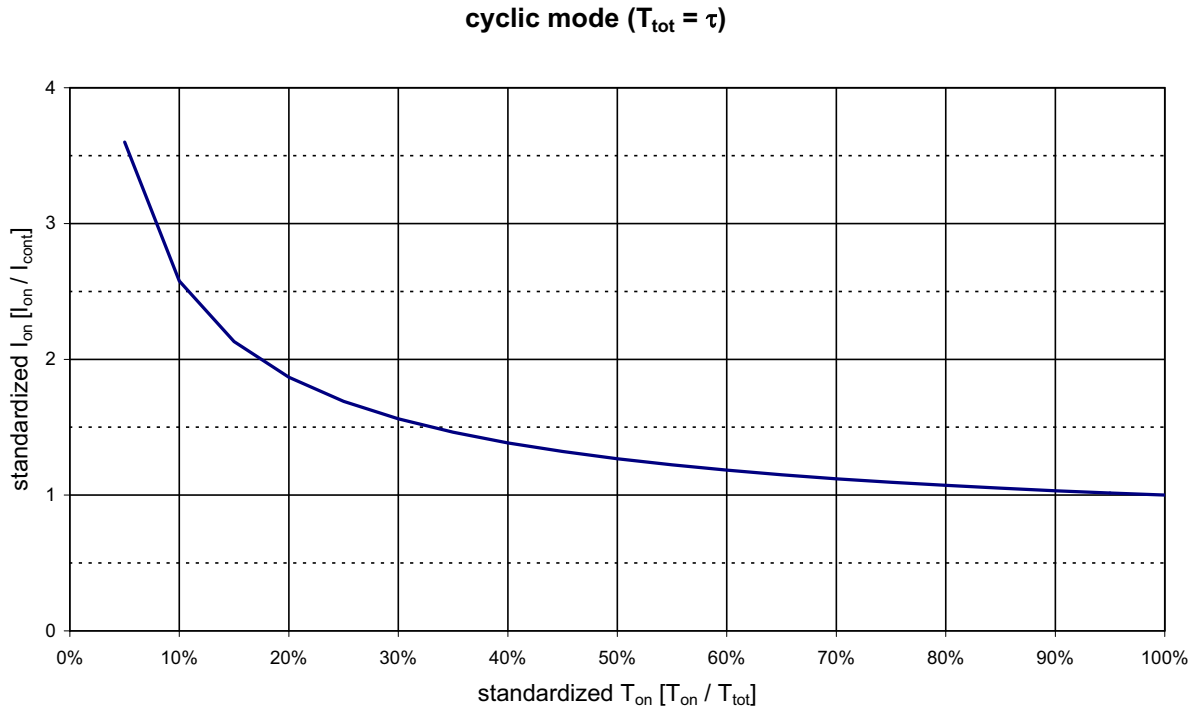


Figure 37: Cyclic Mode standardized I_{on} vs. standardized T_{on}

- standardized T_{on} ratio of “ON time” vs. total time
- standardized I_{on} current at “ON time” standardized with continuous current limit

Example:

For a “cyclic mode” application the current is switched on and off every 2.8 s. thermal time constant winding was configured as 2.8 s and the continuous current limit was configured as 1470 mA. For the “ON time” of 280 ms (10%) a standardized output current of 2.6 is possible. Therefore the possible output current is

$$I_{on} = 2.6 \cdot \text{continuous current limit} = 2.6 \cdot 1470\,mA = 3822\,mA.$$

9.12.2 How to use the 'Current Control Function'

9.12.2.1 Configuration parameters

Parameter	Index	Description
Current control parameter set	0x60F6	The behaviour of the PI-control may be influenced by current control parameter set.
Motor data	0x6410	The motor dependent data can be set with this parameter.
Motor type	0x6402	The motor type can be set with this parameter.

Table 31: 'Current Control Function' Configuration parameters

9.12.2.2 Commanding parameters

There are no commanding parameters. The current control function is directly commanded by the operating mode 'current mode' or by the control loops 'position control function' or 'velocity control function'.

9.12.2.3 Output parameters

Parameter	Index	Description
Current actual value	0x6078	This value is the actual current in current units.
Current actual value averaged	0x2027	This value is the averaged actual current in current units.

Table 32: 'Current Control Function' Output parameters

10 Inputs and Outputs

10.1 Analog Inputs

The device supports two analog inputs with a resolution of 10-bit (4.88mV). They may be used for general purpose process values like temperature, pressure, torque form an external sensor. The MCD EPOS 60 W does not support analog inputs.

Figure 38: Analog Inputs Block Diagram

10.1.1 Output data description

The output values are given in the object Analog Inputs.

10.2 Digital Inputs

The number of supported digital inputs depend on hardware (EPOS 24/1, EPOS 24/5 and MCD EPOS 60 W have six digital inputs; EPOS 70/10 supports eight digital inputs). There are some pre-defined functions for digital inputs like home switch, limit switches, Position Marker and also some general purpose inputs for general purpose process inputs. The configuration of the digital input functions is done with Configuration of digital inputs. The configuration of polarity, execution and a general mask are given in Digital Input Functionalities.

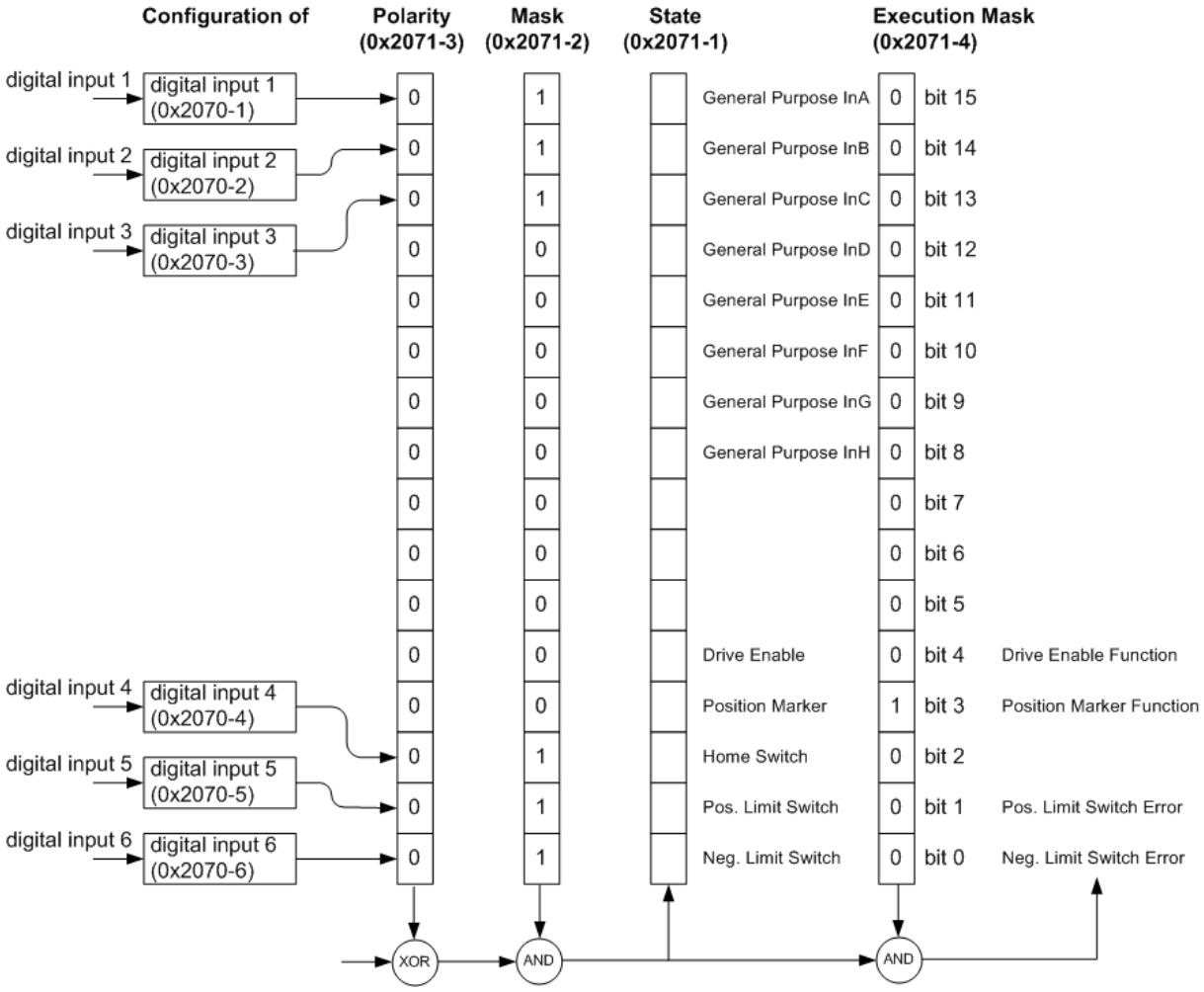


Figure 39: Digital Input Functionality EPOS 24/1 and EPOS 24/5 Overview (default configuration)

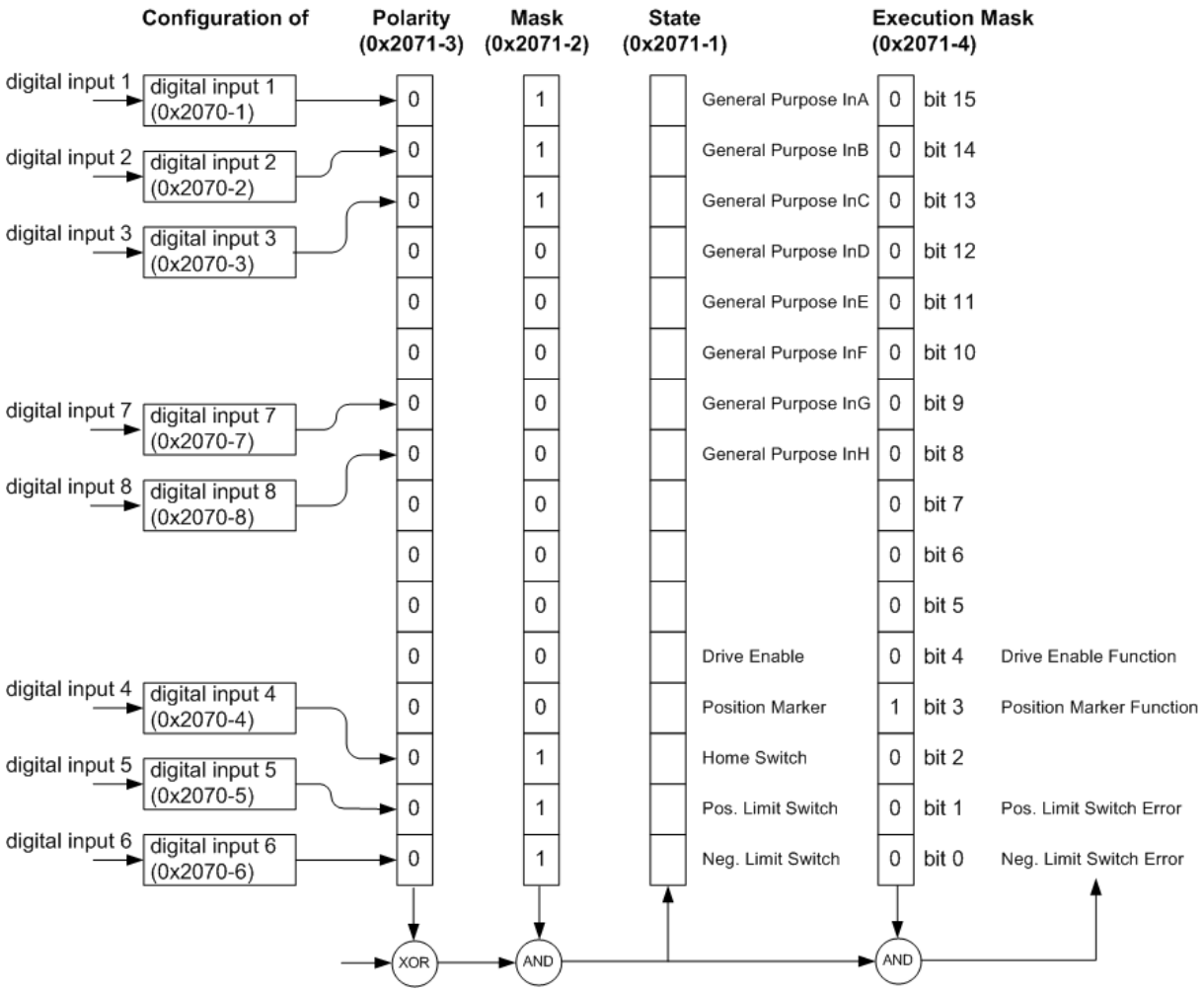


Figure 40: Digital Input Functionality EPOS 70/10 Overview (default configuration)

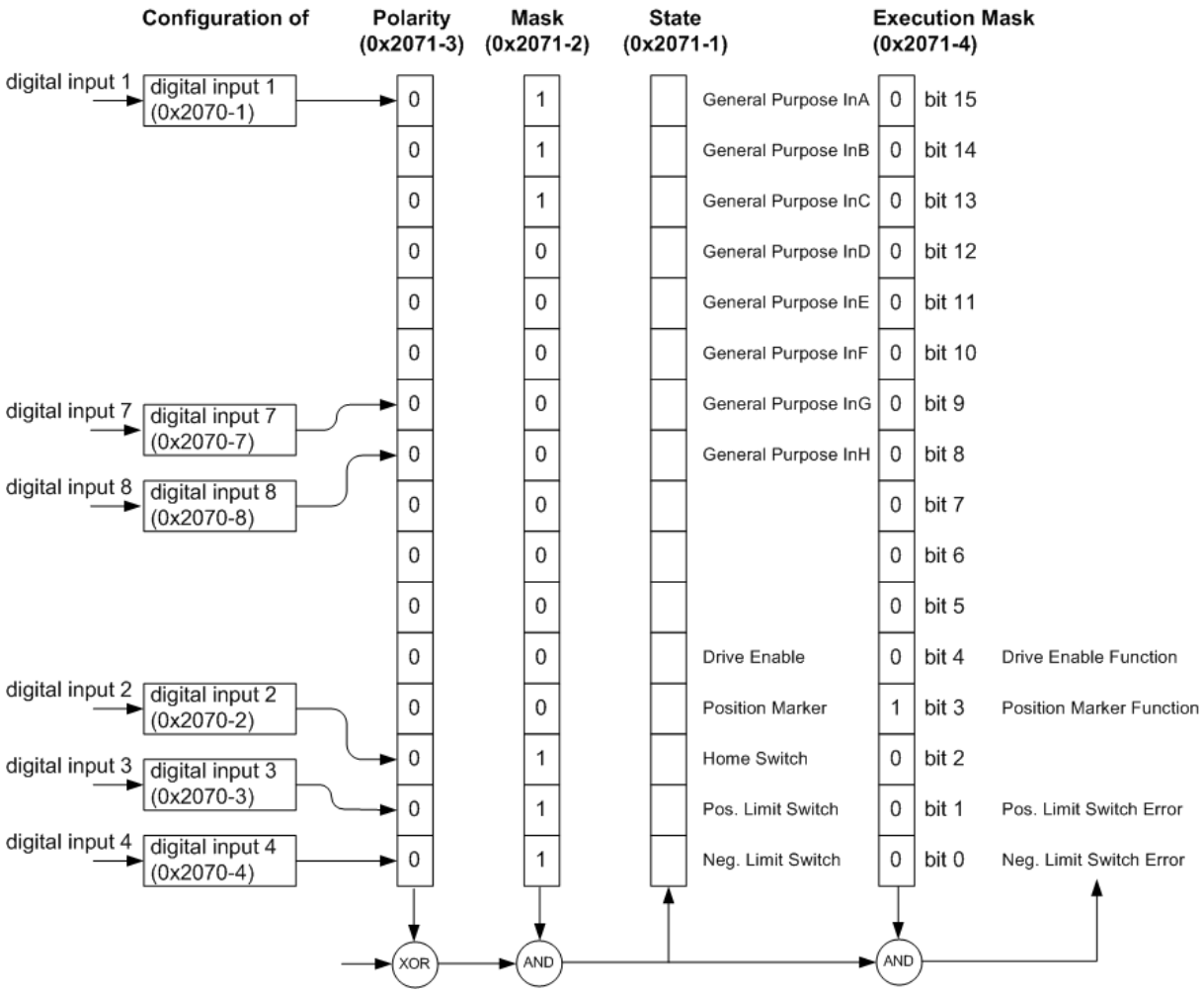


Figure 41: Digital Input Functionality MCD EPOS 60 W Overview (default configuration)

10.3 Digital Outputs

There is a predefined function for digital output: Ready/Fault. If an output is configured with this function then a hardware signal is available if a fault occurs or not. There are also some general purpose outputs for general process controlling for example lighting a lamp. The configuration is similar to the digital inputs configuration and is done with the objects Configuration of digital outputs and Digital Output Functionalities.

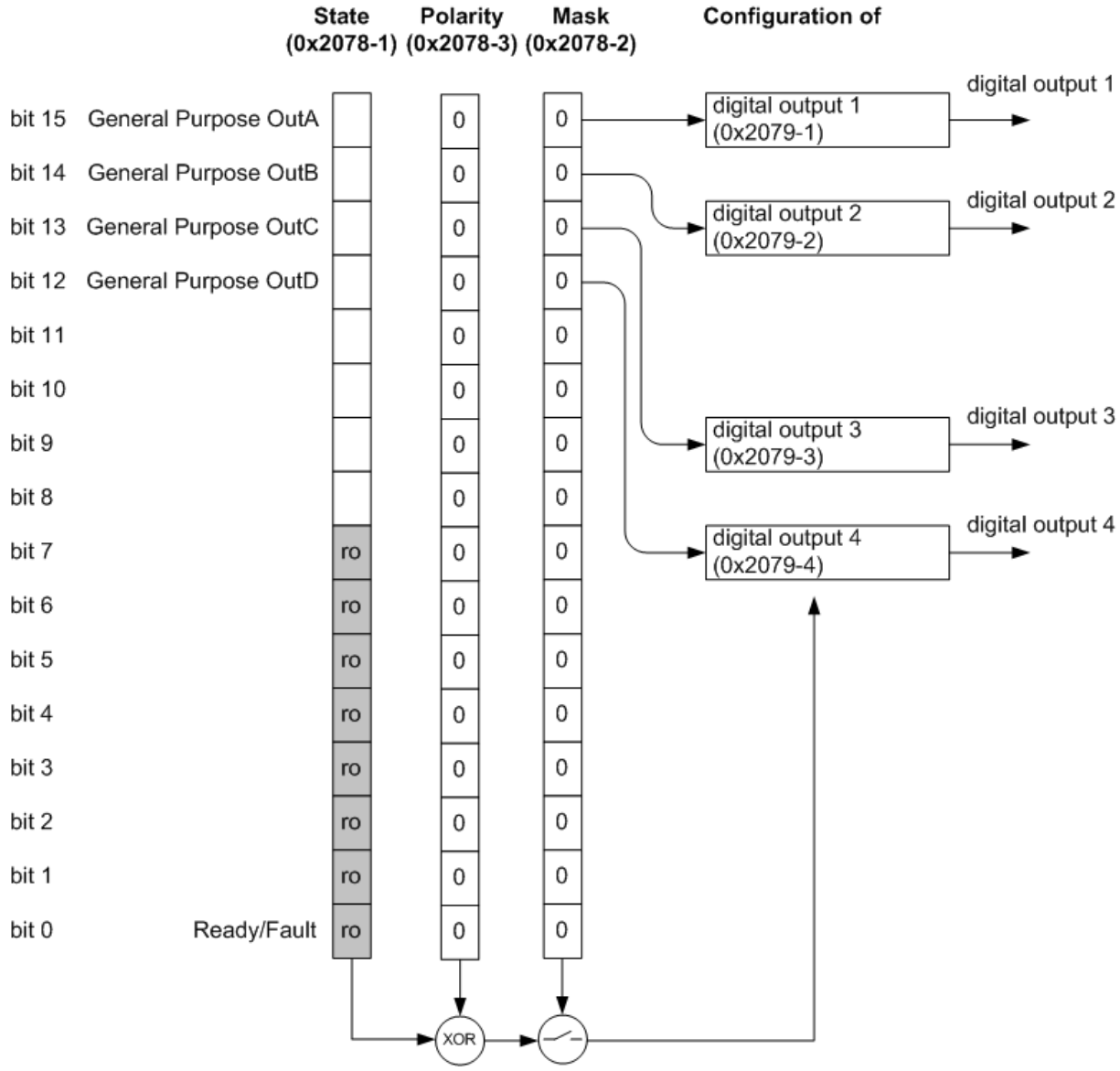


Figure 42: Digital Output Functionality EPOS 24/5 and EPOS 70/10 Overview (default configuration)

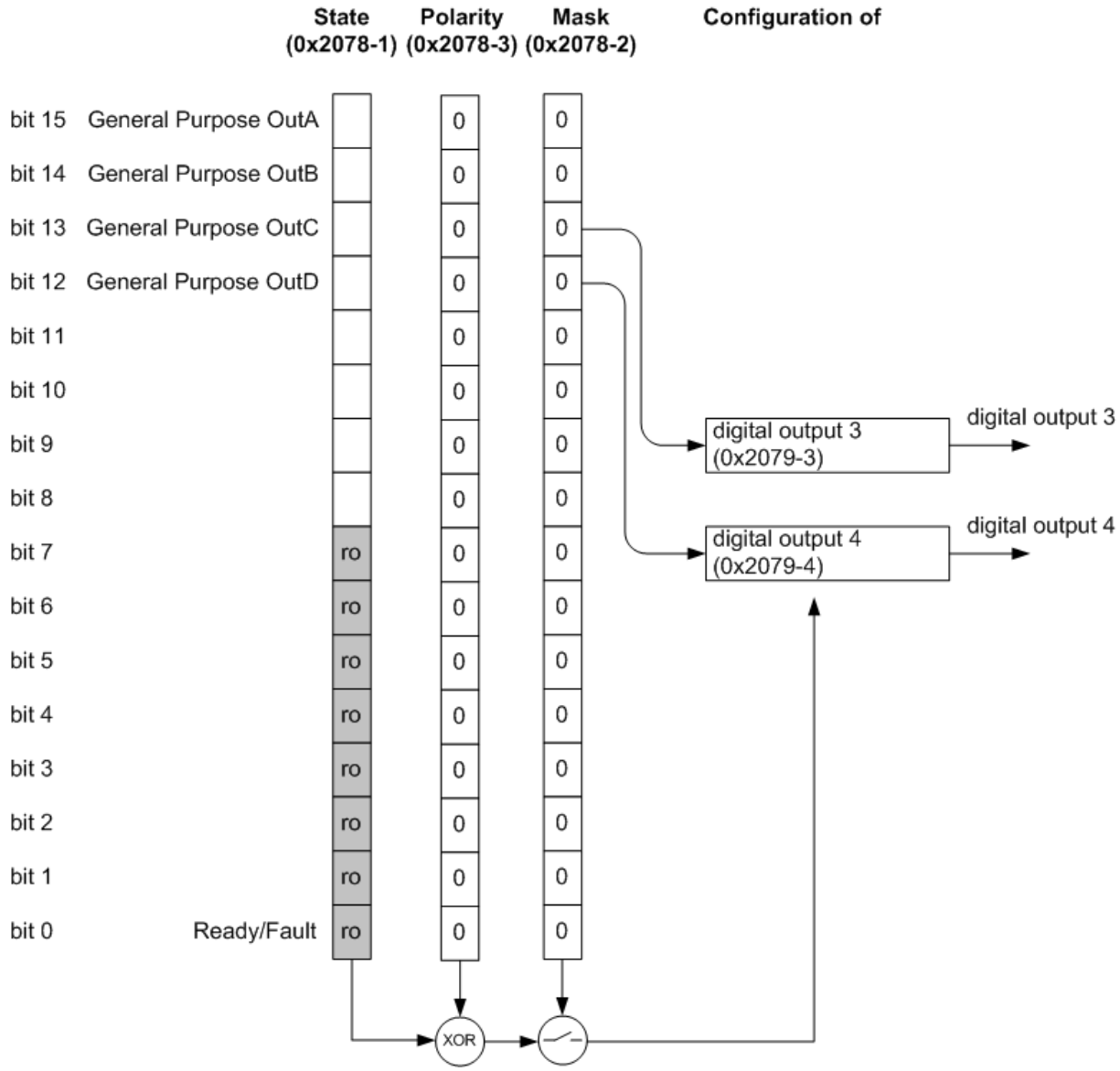


Figure 43: Digital Output Functionality EPOS 24/1 and MCD EPOS 60 W Overview (default configuration)

11 Communication

The EPOS family supports RS232 and CANopen communication profile. For near information about the communication profile refer to Communication Guide.

Important communication objects:

RS232 Baudrate	RS232 Frame Timeout
CAN Bitrate	
Guard time	Life time factor
Consumer Heartbeat Time	Producer Heartbeat Time
Identity object	Verify Configuration
Node ID	
COB-ID EMCY	COB-ID SYNC
Receive PDO 1 parameter	Receive PDO 1 mapping
Receive PDO 2 parameter	Receive PDO 2 mapping
Receive PDO 3 parameter	Receive PDO 3 mapping
Receive PDO 4 parameter	Receive PDO 4 mapping
Transmit PDO 1 parameter	Transmit PDO 1 mapping
Transmit PDO 2 parameter	Transmit PDO 2 mapping
Transmit PDO 3 parameter	Transmit PDO 3 mapping
Transmit PDO 4 parameter	Transmit PDO 4 mapping

11.1 CANopen Node Identification

A Node Identification number (Node ID) is allocated to each CANopen device. This Node ID has to be unique in the CANopen network for each device. The EPOS Node ID can be set by Hardware Switches (not for MCD EPOS 60 W, refer to Hardware Reference, chapter CAN Node Identification), by software (CANopen Object Node ID) or by Layer setting services (LSS, only for MCD EPOS 60 W).

11.2 CAN Bitrate

Within a CANopen network it is important that all CAN devices communicate with the very same CAN Bitrate. The bitrate can be changed by CANopen object CAN Bitrate or by Layer setting services (LSS, for MCD EPOS 60 W only).

11.3 CANopen Network Management (NMT)

The CANopen network management follows a master / slave structure and is node-oriented. It requires one device in the network, which fulfils the function of the NMT Master. The other nodes (as well as the EPOS) are NMT Slaves.

Each NMT slave device has implemented a state machine, which arranges the allowed type of communication with the device.

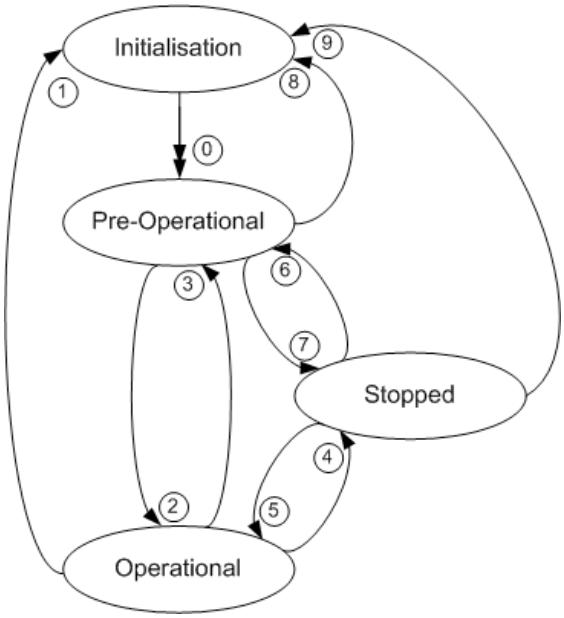


Figure 44: NMT Slave State

CANopen Network Management provides the following five services, which can be distinguished by the command specifier (cs):

Service [1]	**Transition**	**NMT State after Command**	**Remote** [3]	**Functionality**
- [2]	0	Pre-Operational	FALSE	Communication: - Service Data Objects (SDO) Protocol - Emergency Objects - Network Management (NMT) Protocol
Enter Pre-Operational	3, 6	Pre-Operational	FALSE	
Reset Communication	1, 8, 9	Initialisation (Pre-Operational)	FALSE	- Calculate the SDO COB-IDs - Setup Dynamic PDO-Mapping and calculate the PDO COB-IDs - Communication: While initialization is active no communication is supported. After complete a Boot-Up message is send to the CAN bus
Reset Node	1, 8, 9	Initialisation (Pre-Operational)	FALSE	This command generates a general reset of EPOS software. It is the same effect like turn off and on the supply voltage. All not saved parameters are gone and overwritten with values saved to the EEPROM with Save all Parameters.
Start Remote Node	2, 5	Operational	TRUE	Communication: - Service Data Objects (SDO) Protocol - Process Data Objects (PDO) Protocol - Emergency Objects - Network Management (NMT) Protocol
Stop Remote Node	4, 7	Stopped	FALSE	Communication: - Network Management (NMT) Protocol - Layer setting services (LSS) - Lifeguarding (Heartbeating)

Table 33: NMT Commands, Transitions and States

Notes:

[1] Command may be sent with Network Management (NMT) Protocol.

[2] This Transition is generated automatically by the EPOS device after initialisation is completed. After initialisation a Boot-Up message is send.

[3] Remote flag: Bit 9 of the Statusword

11.3.1 Enter Pre-Operational Protocol

The NMT command Enter Pre-Operational is used to change the NMT state of only one or all NMT slaves to Pre-Operational.

In NMT Slave State Pre-Operational the PDO communication may be configured (Receive PDO 1 parameter to Receive PDO 4 parameter, Transmit PDO 1 parameter to Transmit PDO 4 parameter, Receive PDO 1 mapping to Receive PDO 4 mapping, Transmit PDO 1 mapping to Transmit PDO 4 mapping).

Figure 45: NMT Enter Pre-Operational

cs:	0x80:	(NMT command specifier NMT command Enter Pre-Operational)
Node ID:	1-127:	The NMT slave with the given Node ID will enter the NMT state Pre-Operational
	0:	All NMT Slaves will enter the NMT state Pre-Operational

11.3.2 Reset Communication Protocol

The NMT command Reset Communication is used to reset the communication of one or all NMT slaves. After NMT Slave State initialisation, the NMT slave changes automatically to the Pre-Operational state.

Note: The MCD EPOS 60 W changes to the Stopped state if the Node ID is set to not configure.

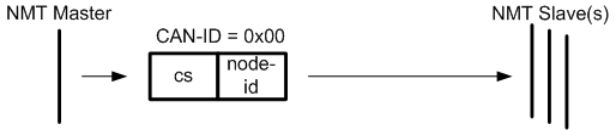


Figure 46: NMT Reset Communication

cs:	0x82:	(NMT command specifier NMT command Reset Communication)
Node ID:	1-127:	The NMT slave with the given Node ID will reset the communication
	0:	All NMT Slaves will reset the communication

11.3.3 Reset Node Protocol

The NMT command Reset Node is used to reset only one or all NMT slaves. After NMT Slave State initialisation, the NMT slave change automatically to the Pre-Operational state.

Note: The MCD EPOS 60 W changes to the Stopped state if the Node ID is set to not configure.

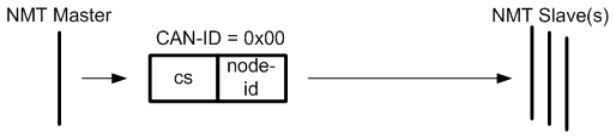


Figure 47: NMT Reset Node

cs:	0x81:	(NMT command specifier NMT command Reset Node)
Node ID:	1-127:	Reset of NMT slave with the given Node ID
	0:	Reset of all NMT Slaves

11.3.4 Start Remote Node Protocol

The NMT command Start Remote Node is used to change the NMT state of one or all NMT slave to Operational. In NMT Slave State Operational all communication protocols are allowed, especially PDO communication.

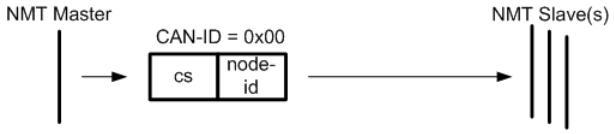


Figure 48: NMT Start Remote Node

cs:	0x01:	(NMT command specifier NMT command Start Remote Node)
Node ID:	1-127:	Start of NMT slave with the given Node ID
	0:	Start of all NMT Slaves

11.3.5 Stop Remote Node Protocol

The NMT command Stop Remote Node is used to change the NMT state of only one or all NMT slave to Stopped. In NMT Slave State Stopped only Network Management, Lifeguarding, Heartbeating and Layer setting services (LSS) are allowed.

Note: Emergency Message Frames will not be launched in this state.

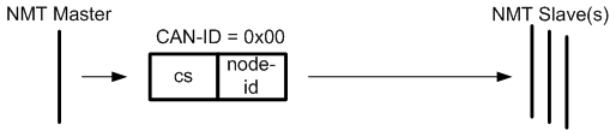


Figure 49: NMT Stop Remote Node

cs:	0x02:	(NMT command specifier NMT command Stop Remote Node)
Node ID:	1-127:	Stop of NMT slave with the given Node ID
	0:	Stop of all NMT Slaves

11.4 Layer setting services (LSS)

By using layer setting services and protocols a LSS slave device may be configured via the CAN network without using DIP-switches for setting the Node ID and bit timing parameters.

The CANopen device that can configure other devices via the CANopen network is called the LSS master device. There shall be only one (active) LSS master in a network.

The CANopen device that will be configured by the LSS master device via the CANopen network is called LSS slave device (e.g. the MCD EPOS 60 W).

An LSS slave device can be identified by its worldwide (at least network-wide) unique LSS address. The LSS address consists of the sub-objects vendor-id, product-code, revision-number and serial number of the CANopen Identity object. There shall exist no other LSS slave device (in the network) with the very same LSS address.

With this unique LSS address it is possible to select only one CANopen device in the network amongst others to allocated the network unique CANopen Node ID to each device.

The Node ID is valid if it is in the range of 0x01 to 0x7F; a value of 0xFF or 0x00 identifies a not configured CANopen device.

The communication between LSS master device and LSS slave devices is accomplished by the LSS protocols. The LSS protocols use only two COB-IDs:
- LSS master message from LSS master device to LSS slave devices (COB-ID 0x7E5)
- LSS slave message from the LSS slave devices to LSS master device (COB-ID 0x7E4).

Only the MCD EPOS 60 W works as a LSS slave device (all other devices of the EPOS family do not support LSS).

The Layer setting services are only accessible in NMT Slave State Stopped. To enter to the Stopped state the Stop Remote Node Protocol is used.

The following table gives an overview of the LSS commands and which LSS command is allowed in LSS state waiting and configuration. To change the LSS state the LSS commands switch state global or switch state selective may be used.

command specifier	LSS command	LSS state waiting	LSS state configuration
0x04	switch state global	yes	yes
0x40 to 0x43	switch state selective	yes	no
0x11	configure Node ID	no	yes
0x13	configure bit timing parameter	no	yes
0x15	activate bit timing	no	yes
0x17	store configuration	no	yes
0x5A	inquire identity vendor-id	no	yes
0x5B	inquire identity product-code	no	yes
0x5C	inquire identity revision-number	no	yes
0x5D	inquire identity serial-number	no	yes
0x5E	inquire identity Node ID	no	yes
0x46 to 0x4B	identify remote slave	yes	yes
0x4C	identify non-configured remote slave	yes	yes

Table 34: LSS command overview

11.4.1 LSS switch state global protocol

The LSS command switch state global is used to change the state of all connected LSS slaves to configuration or back to waiting. Some LSS commands are not allowed in waiting state or configuration state (according table LSS command overview).

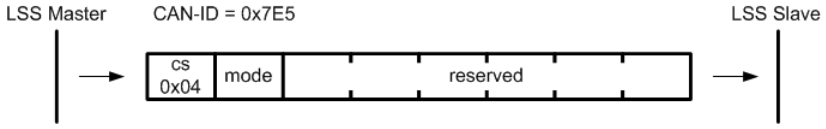


Figure 50: LSS switch state global

cs: LSS command specifier 4 for switch state global

mode: 0: switch to LSS state waiting
1: switch to LSS state configuration

11.4.2 LSS switch state selective protocol

LSS command switch state selective is used to change the state of only one LSS slave from waiting to configuration.

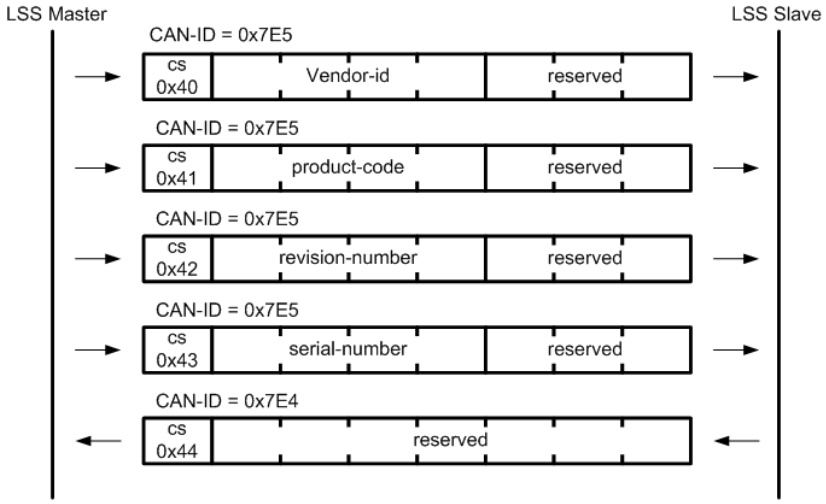


Figure 51: LSS switch state selective protocol

The LSS command specifier 0x40 is used to submit the vendor-id, 0x41 to submit the product-code, 0x42 to submit the revision-number, 0x43 to submit the serial-number (of the Identity object).

Then the single addressed LSS slave changes to configuration state and answers by sending a command specifier 0x44 response.

11.4.3 LSS configure Node ID protocol

The LSS configure Node ID protocol is used to configure the Node ID. Values between 1 and 127 are valid. The LSS master device shall determine the Node ID of the LSS slave device that is in LSS configuration state. The LSS master device is responsible to switch one and only one LSS slave device into LSS configuration (LSS switch state selective protocol) state before requesting this service.

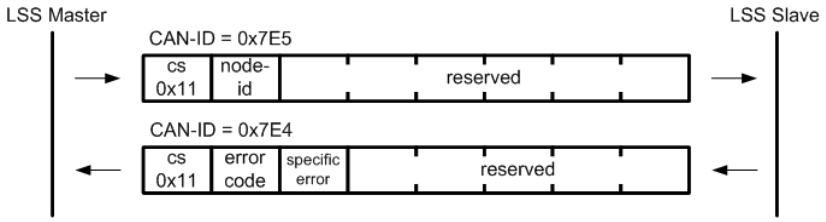


Figure 52: LSS configure Node ID protocol

The LSS slave answer with the error code and specific error.

error code:	0:	protocol successfully completed
	1:	Node ID out of value range
specific error:	always 0	

11.4.4 LSS configure bit timing parameters protocol

By means of the service configure bit timing parameters, the LSS master device shall configure the new bit timing on a single LSS slave device. The new bit timing will be active not before receiving the LSS store configuration protocol and the LSS activate bit timing parameters protocol.

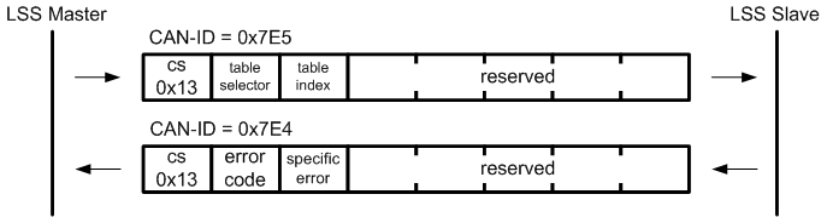


Figure 53: LSS configure bit timing parameters protocol

table selector: always 0

table index:

Index	Bit rate
0	1 Mbit/s
1	800 kbit/s
2	500 kbit/s
3	250 kbit/s
4	125 kbit/s
5	reserved
6	50 kbit/s
7	20 kbit/s

Table 35: LSS bitrate table indices

error code: 0: protocol successfully completed
1: bit timing not supported

specific error: always 0

11.4.5 LSS activate bit timing parameters protocol

To activate the selected bit timing (by LSS configure bit timing parameters protocol) the LSS activate bit timing parameters command is used.

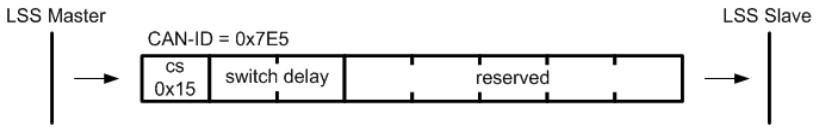


Figure 54: LSS activate bit timing parameters protocol

switch delay: The duration in milliseconds of the two periods of time to wait until the bit timing parameters switch is done (first period) and before transmitting any CAN message with the new bit timing parameters after performing the switch (second period).

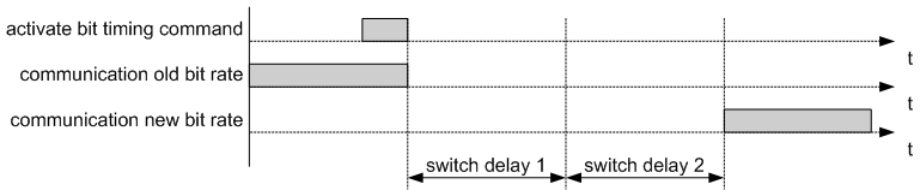


Figure 55: LSS switching delay

After receiving a activate bit timing command the LSS slave stops communication on old (actual) bit rate. After the first switch delay the communication is switched to the new bit rate and after a second switch delay the LSS slave is allowed to communicate with new bit rate.

11.4.6 LSS store configuration protocol

The LSS store configuration command is used to store all parameter to non-volatile memory. The functionality is equal to the store function commanded with object Store.

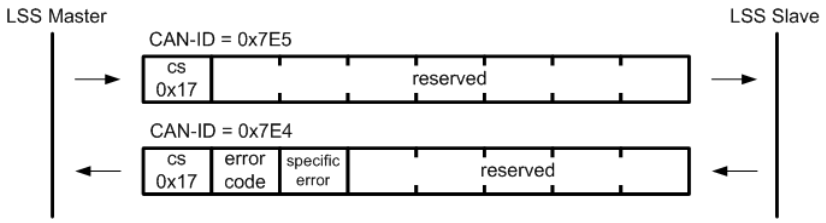


Figure 56: LSS store configuration protocol

error code:	0:	protocol successfully completed
	1:	store configuration is not supported
	2:	storage media access error

specific error: always 0

11.4.7 LSS inquire identity vendor-id protocol

The LSS command inquire identity vendor-id is used to read the vendor-id (Identity object) of a LSS slave device.

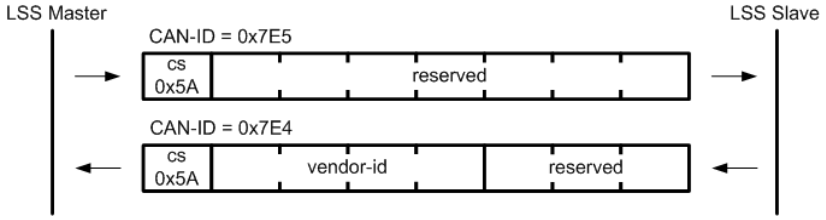


Figure 57: LSS inquire identity vendor-id protocol

vendor-id: LSS slave vendor-id (Identity object)

11.4.8 LSS inquire identity product-code protocol

The LSS command inquire identity product-code is used to read the product-code (Identity object) of a LSS slave device.

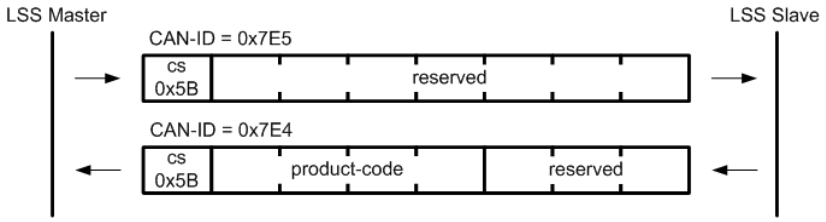


Figure 58: LSS inquire identity product-code protocol

product-code: LSS slave product-code (Identity object)

11.4.9 LSS inquire identity revision-number protocol

The LSS command inquire identity revision-number is used to read the revision-number (Identity object) of a LSS slave device.

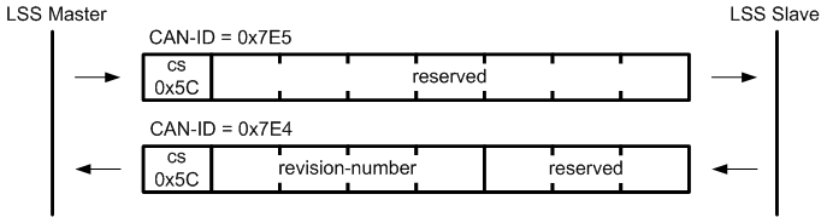


Figure 59: LSS inquire identity revision-number protocol

revision-number: LSS slave revision-number (Identity object)

11.4.10 LSS inquire identity serial-number protocol

The LSS command inquire identity serial-number is used to read the serial-number (Identity object) of a LSS slave device.

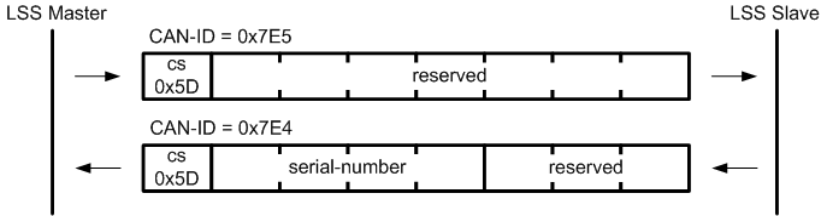


Figure 60: LSS inquire identity serial-number protocol

serial-number: LSS slave serial-number (Identity object)

11.4.11 LSS inquire Node ID protocol

The LSS command inquire Node ID is used to read the Node ID of a LSS slave device.

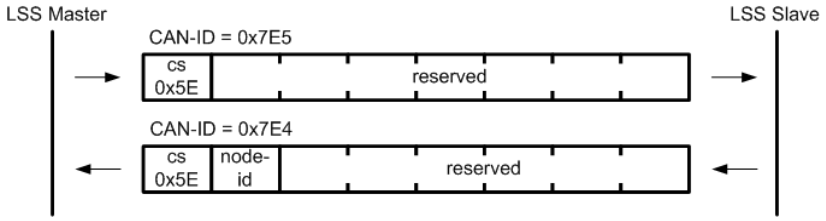


Figure 61: LSS inquire Node ID protocol

Node ID: LSS slave Node ID

11.4.12 LSS identify remote slave protocol

The LSS command identify remote slave is used to detect LSS slave devices in the CAN network. Thereto the LSS master sends a identify remote slave request with a single vendor-id and a single product-code and a span of revision- and serial-numbers determined by a low and a high number to the LSS slave devices. All LSS slave devices which meet this LSS address range (inclusive the boundaries) shall answer by a identify slave response (cs = 0x4F).

With this protocol a binary network search can be implemented for the LSS master. This method sets the LSS address range to the full address area first and requests the identify remote slave. The range, which gets a response from one (or more) LSS slave devices, will be split in two semi-areas. The request to the semi-areas will be repeated until each LSS slave device is identified.

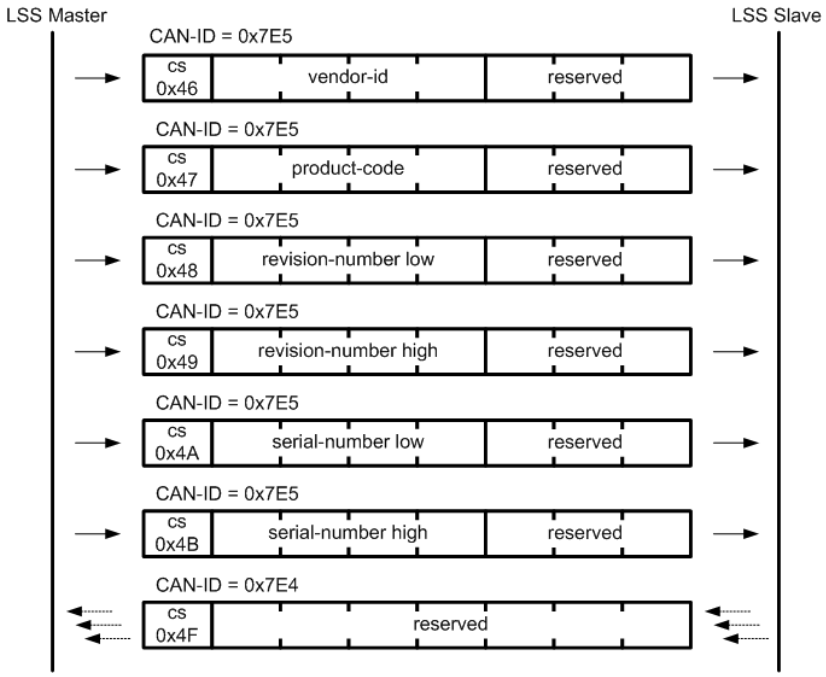


Figure 62: LSS identify remote slave protocol

vendor-id:	vendor-id (Identity object)
product-code:	product-code (Identity object)
revision-number:	revision-number (Identity object)
serial-number:	serial-number (Identity object)

11.4.13 LSS identify non-configured remote slave protocol

The LSS command identify non-configured remote slave allows the LSS master to detect if a non-configured device is present on the network. All LSS slave devices whose Node ID is not configured (0xFF or 0x00) will answer with a command specifier 0x50 response (LSS identity non-configured slave).

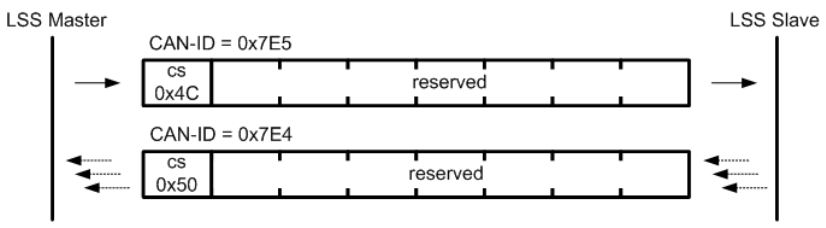


Figure 63: LSS identify non-configured remote slave protocol

12 Error Handling

12.1 Emergency Message Frame

When the EPOS detects a device internal error situation a emergency messages frame will be transmitted over the CANopen network with the COB-ID EMCY. An emergency message frame is transmitted only once per 'error event' and consists of the error code and the actual state of the Error register

Byte	0	1	2	3	4	5	6	7
Description	Error Code		Error register	Not used (always zero)				

Table 36: Emergency message frame

12.2 Device Errors

The EPOS device supports different errors. Dependent on error the reaction is a Quick Stop (Quick stop deceleration) and afterwards disable or disable directly after occurrence of error.

The Error history holds the error codes that have occurred on the device and have been signalled via the Emergency messages in addition.

The Error register holds all set error flags and gets a summary over all occurred errors.

If one or more error occurred, the drive reacts with the described effect:

Quickstop: If the drive is enabled a quick-stop profile will be executed in the Fault Reaction state. Then it changes to the Fault state (see State Machine).

Disable: In fact that a secure movement is not possible after this error the drive will be disabled always in the Fault Reaction state.

Error Code	Error register	Name
0x0000	0000 0000b	No Error
0x1000	0000 0001b	Generic Error
0x2310	0000 0010b	Over Current Error
0x3210	0000 0100b	Over Voltage Error
0x3220	0000 0100b	Under Voltage
0x4210	0000 1000b	Over Temperature
0x5113	0000 0100b	Supply Voltage (+5V) too low
0x6100	0010 0000b	Internal Software Error
0x6320	0010 0000b	Software Parameter Error
0x7320	0010 0000b	Sensor Position Error
0x8110	0001 0000b	CAN Overrun Error (Objects lost)
0x8111	0001 0000b	CAN Overrun Error
0x8120	0001 0000b	CAN Passive Mode Error
0x8130	0001 0000b	CAN Life Guard Error
0x8150	0001 0000b	CAN Transmit COB-ID collision
0x81FD	0001 0000b	CAN Bus Off

Error Code	Error register	Name
0x81FE	0001 0000b	CAN Rx Queue Overrun
0x81FF	0001 0000b	CAN Tx Queue Overrun
0x8210	0001 0000b	CAN PDO length Error
0x8611	0010 0000b	Following Error
0xFF01	1000 0000b	Hall Sensor Error
0xFF02	1000 0000b	Index Processing Error
0xFF03	1000 0000b	Encoder Resolution Error
0xFF04	1000 0000b	Hallsensor not found Error
0xFF06	1000 0000b	Negative Limit Error
0xFF07	1000 0000b	Positive Limit Error
0xFF08	1000 0000b	Hall Angle detection Error
0xFF09	1000 0000b	Software Position Limit Error
0xFF0A	1000 0000b	Position Sensor Breach
0xFF0B	0010 0000b	System Overloaded

Table 37: Error Codes Overview

12.2.1 Generic Error

Error Code	0x1000
Error Register	0000 0001b
Error cause	Unspecific error occurred
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.2 Over Current Error

Error Code	0x2310
Error Register	0000 0010b
Error cause	Short circuit in the motor winding Power supply can not supply enough acceleration current Too high Controller Gains (Velocity control parameter set, Position control parameter set) Profile acceleration and/or Profile deceleration too high Damaged power stage
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.3 Over Voltage Error

Error Code	0x3210
Error Register	0000 0100b
Error cause	The power supply voltage is too high
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	In most cases this error occurs at deceleration. Then the motor works as a generator and the energy flow is from motor to the power supply that increases the voltage. Normally a big capacitor (e.g. 2200µF) near the device solves the problem. If not a shunt regulator is necessary (maxon motor control Art. #235811) to destroy brake energy. Fault reset with Controlword

12.2.4 Under Voltage

Error Code	0x3220
Error Register	0000 0100b
Error cause	The supply voltage is too low for operation. The power supply can't supply the acceleration current
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.5 Over Temperature

Error Code	0x4210
Error Register	0000 1000b
Error cause	The temperature at the device power stage is too high (only on EPOS 24/5, EPOS 70/10 and MCD EPOS 60 W)
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.6 Supply Voltage (+5V) too low

Error Code	0x5113
Error Register	0000 0100b
Error cause	There is a overload on internal generated 5V supply by the hall sensor connector or encoder connector (only on EPOS 24/5)
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.7 Internal Software Error

Error Code	0x6100
Error Register	0010 0000b
Error cause	Internal software error occurred
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.8 Software Parameter Error

Error Code	0x6320
Error Register	0010 0000b
Error cause	Too high Target position with too low Profile velocity
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.9 Sensor Position Error

Error Code	0x7320
Error Register	0010 0000b
Error cause	The detected position from position sensor is no longer valid in case of: - Changed Position Sensor Parameters - Wrong Position Sensor Parameters - Other Errors which influences the absolute position detection (Hall Sensor Error, Encoder Index Error, ...)
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.10 CAN Overrun Error (Objects lost)

Error Code	0x8110
Error Register	0001 0000b
Error cause	One of the CAN mail boxes had a overflow because of too high communication rate
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.11 CAN Overrun Error

Error Code	0x8111
Error Register	0001 0000b
Error cause	The execution of the CAN communication had an overrun because of too high communication rate
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.12 CAN Passive Mode Error

Error Code	0x8120
Error Register	0001 0000b
Error cause	Device changed to CAN passive Mode because: - The CAN baudrate of one CAN node in network is wrong - The CAN network is not connected - The hardware wiring of CAN bus is wrong
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Send NMT Command reset communication

12.2.13 CAN Life Guard Error

Error Code	0x8130
Error Register	0001 0000b
Error cause	The CANopen Life Guarding procedure has failed. The Life Guarding is disabled if Guard time = 0
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.14 CAN Transmit COB-ID collision

Error Code	0x8150
Error Register	0001 0000b
Error cause	The device has received a bad transmit PDO request (valid COB-ID without RTR bit set).
Effect	Maybe another CAN node has configured the same transmit PDO COB-ID
Error recovery	Fault reset with Controlword

12.2.15 CAN Bus Off

Error Code	0x81FD
Error Register	0001 0000b
Error cause	The CAN Controller has entered CAN bus off state
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.16 CAN Rx Queue Overrun

Error Code	0x81FE
Error Register	0001 0000b
Error cause	One of the CAN receive queues had a overrun because of too high communication rate
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.17 CAN Tx Queue Overrun

Error Code	0x81FF
Error Register	0001 0000b
Error cause	One of the CAN transmit queues had a overrun because of too high communication rate: - too high load on the CAN bus - event triggered PDOs defined with to small inhibit time - too much (synchronous) PDO communication configured for such cycle time
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.18 CAN PDO length Error

Error Code	0x8210
Error Register	0001 0000b
Error cause	The received PDO was not processed due to length error (to short)
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.19 Following Error

Error Code	0x8611
Error Register	0010 0000b
Error cause	The difference between Position demand value and Position actual value is higher then Maximal following error
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.20 Hall Sensor Error

Error Code	0xFF01
Error Register	1000 0000b
Error cause	The motor hall sensors report an impossible signal combination: - Wrong wiring of the hall sensors or the hall sensor supply voltage - Damaged hall sensors of the motor - Big noise on the signal
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.21 Index Processing Error

Error Code	0xFF02
Error Register	1000 0000b
Error cause	The encoder index signal was not found within two turns at start-up because: - Wrong wiring of the encoder cables - Encoder without or with none working index channel - Wrong sensor type (Sensor Configuration) - Too low setting of encoder resolution (Sensor Configuration) To many encoder index pulses were detected at unexpected positions because: - Big noise on the encoder signals - Too high input frequency of encoder signals
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.22 Encoder Resolution Error

Error Code	0xFF03
Error Register	1000 0000b
Error cause	The encoder pulses counted between the first two index pulses doesn't fit to the resolution: - Setting of encoder resolution (Sensor Configuration) is wrong.
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.23 Hallsensor not found Error

Error Code	0xFF04
Error Register	1000 0000b
Error cause	No hall sensor 3 edge found within first motor turn: - Wrong wiring or defect hall sensors - Too low setting of encoder resolution (Sensor Configuration)
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	System Reset (by Hardware Reset or EPOS_UserInterface Status->Reset Node or NMT Command Reset Node)

12.2.24 Negative Limit Error

Error Code	0xFF06
Error Register	1000 0000b
Error cause	- The negative limit switch was or is active - The Configuration of Limit switch function is wrong in Digital Input Functionalities
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.25 Positive Limit Error

Error Code	0xFF07
Error Register	1000 0000b
Error cause	- The positive limit switch was or is active - The Configuration of Limit switch function is wrong in Digital Input Functionalities
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.26 Hall Angle detection Error

Error Code	0xFF08
Error Register	1000 0000b
Error cause	The angle difference measured between encoder and hall sensors is too high: - Wrong wiring of Hall sensors or defect Hall sensors - Wrong wiring of encoder or defect encoder - Wrong setting of encoder resolution or pole pairs (Sensor Configuration)
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.27 Software Position Limit Error

Error Code	0xFF09
Error Register	1000 0000b
Error cause	Movement commanded or actual position higher than maximal position limit or lower than minimal position limit (Software position limit)
Effect	Drive stop with Quick stop deceleration and disables after completion Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.2.28 Position Sensor Breach

Error Code	0xFF0A
Error Register	1000 0000b
Error cause	The position sensor supervision has detected a bad working condition - Wrong or broken wiring of encoder - Defect encoder - The regulation parameter are not well tuned (Current control parameter set)
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword If this error occurs frequently and no one of the reasons above are fulfilled the position sensor supervision can be disabled by setting bit 0 respectively bit 1 TRUE in Miscellaneous Configuration

12.2.29 System Overloaded

Error Code	0xFF0B
Error Register	0010 0000b
Error cause	The device has not enough free resources to process the new target value
Effect	Device is disabled Red LED is on Error Flag in the Statusword is set
Error recovery	Fault reset with Controlword

12.3 Communication Errors (Abort Codes)

An abort object will be sent over the CANopen 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 RS232 transfer request.

The following Abort Codes are defined by CANopen Communication Profile DS-301 (the codes greater then 0x0F00 0000 are maxon specific).

Abort Code	Name	Error cause
0x0000 0000	No Communication Error	The RS232 communication was 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 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	The last read or write command had a wrong object index or -sub-index
0x0604 0041	PDO mapping Error	The object is not mappable to the PDO
0x0604 0042	PDO length Error	The number and length of the objects to be mapped would exceed PDO length
0x0604 0043	General Parameter Error	General parameter incompatibility
0x0604 0047	General Intern Incompatibility Error	General internal incompatibility in device
0x0606 0000	Hardware Error	Access failed due to an 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 Sub-Index Error	The last read or write command had a wrong object sub-index
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 the present device state
0x0F00 FFC0	Wrong NMT State Error	The device is in wrong NMT state
0x0F00 FFBF	Illegal Command Error	The RS232 command is illegal (does not exist)
0x0F00 FFBE	Password Error	The password is wrong
0x0F00 FFBC	Error Service Mode	The device is not in service mode
0x0F00 FFB9	Error CAN id	Wrong CAN id

Table 38: Communication Errors

13 System Units

There is a need to interchange physical dimensions and sizes into device internal units. The physical dimensions for position, velocity and acceleration parameters are constant in this implementation (see Table 39).
The dimension index and the notation index can be read at Position notation index, Position dimension index, Velocity notation index, Velocity dimension index, Acceleration notation index and Acceleration dimension index. A write to these objects with other value produces a value range failure.

Position units	steps (quadcounts = 4*Encoder Counts / Revolution)
Velocity units	rpm (Revolutions per Minute)
Acceleration units	rpm/s (Velocity Unit / Second)

Table 39: Default unit dimensions

13.1 Factor Group Tables

Physical dimension	Unit	Dimension index
Revolution / time	rev/s	0xA3
Revolution / time	rev/min	0xA4
Steps	steps	0xAC
Steps / revolution	steps/rev	0xAD

Table 40: Factor group dimension indices

Prefix	Factor	Notation index
	...	...
Mega	10^6	0x06
	…	…
Kilo	10^3	0x03
Hecto	10^2	0x02
Deca	10^1	0x01
-	10^0	0x00
Deci	10^{-1}	0xFF
Centi	10^{-2}	0xFE
Milli	10^{-3}	0xFD
	…	…
Micro	10^{-6}	0xFA
	...	...

Table 41: Factor group notation indices

14 Object Dictionary

14.1 Device type

Name	device type	
Index	0x1000	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RO	
Default Value	0x00020192	
Value range	-	-

Description
This constant describes the device type. The lower word of the device type stands for the supported device profile number. The value 0x0192 (402) mean that device follows the CiA Draft Standard Proposal 402, Device Profile Drives and Motion Control.

The higher word holds information about the drive type. The value 0x0002 means that the drive is a servo drive.

Remarks
-

Related Objects
-

14.2 Error register

Name	error register	
Index	0x1001	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RO	
Default Value	0	
Value range	-	-

Description
This object is an error register for the device. The device maps internal errors in this byte.

Remarks
-

Related Objects
-

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

Table 42: Error register bits

14.3 Error history

Name	error history
Index	0x1003
number of entries	0x05

Description
This object holds the errors that have occurred on the device and have been signalled via the Emergency object.

Name	number of errors	
Index	0x1003	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	0	
Value range	-	-

Description
This entry contains the number of actual errors that are recorded in the array starting at sub-index 1. Writing a “0” deletes the error history (empties the array). Values higher then 0 are not allowed to write.

Remarks
-

Related Objects
-

Name	error history [1]	
Index	0x1003	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RO	
Default Value	0	
Value range	-	-

Name	error history [2]	
Index	0x1003	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RO	
Default Value	0	
Value range	-	-

Name	error history [3]	
Index	0x1003	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RO	
Default Value	0	
Value range	-	-

Name	error history [4]	
Index	0x1003	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RO	
Default Value	0	
Value range	-	-

Name	error history [5]	
Index	0x1003	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RO	
Default Value	0	
Value range	-	-

Description
Every new error code is stored at sub-index 1, the older ones move down the list. The error numbers are of type UNSIGNED32 and are composed of a 16-bit error code and 16-bit additional error information that are always zero.

Remarks
-

Related Objects
-

14.4 COB-ID SYNC

Name	COB-ID SYNC	
Index	0x1005	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000080	
Value range	-	-

Description
Communication Object Identifier of synchronization object.

Remarks
-

Related Objects
-

14.5 Manufacturer device name

Name	manufacturer device name	
Index	0x1008	
Sub-index	0x00	
Type	VISIBLE_STRING	
Access	CONST	
Default Value	“EPOS”	
Value range	-	-

Description
The product name is “EPOS”.

Remarks
-

14.6 Guard time

Name	guard time	
Index	0x100C	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	65535

Description
This object multiplied by life time factor gives the life time for the Life Guarding Protocol. The lifetime is scaled in milliseconds. It is 0 if not used.

Remarks
It is not allowed for one device to use both error control mechanisms Guarding Protocol and Heartbeat Protocol at he same time. If the Producer Heartbeat Time is unequal 0 the heartbeat protocol is used and the guarding protocol is disabled.

Related Objects
Life time factor

14.7 Life time factor

Name	life time factor	
Index	0x100D	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	0	
Value range	0	255

Description
This object multiplied by guard time gives the life time for the Life Guarding Protocol. It is 0 if not used.

Remarks
It is not allowed for one device to use both error control mechanisms Guarding Protocol and Heartbeat Protocol at he same time. If the Producer Heartbeat Time is unequal 0 the heartbeat protocol is used and the guarding protocol is disabled.

Related Objects
Guard time

14.8 Store

Name	store	
Index	0x1010	
number of entries	0x01	

Name	save all parameters	
Index	0x1010	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	-	
Value range	-	-

Description
All parameters of device where stored in non volatile memory, if the code “save” is written to this object.

Byte	MSB			LSB
Character	‘e’	‘v’	‘a’	‘s’
Hexvalue	0x65	0x76	0x61	0x73

Remarks
-

Related Objects
-

14.9 Restore default parameters

Name	restore default parameters	
Index	0x1011	
number of entries	0x02	

Name	restore all default parameters	
Index	0x1011	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	-	
Value range	-	-

Description
All parameters of device where restored with default values, if the code “load” is written to this object.

Byte	MSB			LSB
Character	‘d’	‘a’	‘o’	‘l’
Hexvalue	0x64	0x61	0x6F	0x6C

Remarks
Changes are only in disable state supported.

Related Objects
-

Name	restore default PDO COB-IDs	
Index	0x1011	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	-	
Value range	-	-

Description
The COB-IDs of PDO where calculated with the Node ID, if the code “load” is written to this object.

Byte	MSB			LSB
Character	‘d’	‘a’	‘o’	‘l’
Hexvalue	0x64	0x61	0x6F	0x6C

As a default the PDO COB-IDs are set static to a value (they do not change with changes at the DIP-Switches). If more then one EPOS Controller are used in one CAN network, mostly it make sense to calculate the COB-IDs depending on the Node ID set by DIP-Switches.

Remarks
The changes effects after save all parameters and restart node!

Related Objects
Store

14.10 COB-ID EMCY

Name	COB-ID EMCY	
Index	0x1014	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RO	
Default Value	0x00000080 + Node ID	
Value range	-	-

Description
Communication Object Identifier of emergency object.

Remarks
-

Related Objects
-

14.11 Consumer Heartbeat Time

Name	Consumer Heartbeat Time
Index	0x1016
number of entries	0x02

Name	Consumer 1 Heartbeat Time	
Index	0x1016	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0	
Value range	see Table 43	-

Name	Consumer 2 Heartbeat Time	
Index	0x1016	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0	
Value range	see Table 43	-

Description
The consumer heartbeat times define the expected cycle time of the heartbeat. This heartbeat times are higher then the corresponding producer heartbeat times configured on the CANopen device producing this heartbeat. The monitoring starts after the reception of the first heartbeat. The time is given in multiples of 1 ms.

Remarks
If the heartbeat time is 0 the Node ID can also be set to 0 and the object entry is not used.

Related Objects
Producer Heartbeat Time

Bit 31 - 24	Bit 23 - 16	Bit 15 - 0
reserved (0)	(producer) Node ID	Heartbeat time

Table 43: Structure of Consumer heartbeat time

14.12 Producer Heartbeat Time

Name	Producer heartbeat time	
Index	0x1017	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
The producer heartbeat time defines the cycle time of the heartbeat. The producer heartbeat time is 0 if it not used. The time has to be a multiple of 1 ms.

Remarks
It is not allowed for one device to use both error control mechanisms Guarding Protocol and Heartbeat Protocol at the same time. If the heartbeat producer time is unequal 0 the heartbeat protocol is used and the guarding protocol is disabled.

Related Objects
Guard time, Life time factor

14.13 Identity object

Name	identity object
Index	0x1018
number of entries	0x04

Name	vendor id	
Index	0x1018	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RO	
Default Value	0x000000FB	
Value range	-	-

Description
The CANopen vendor identification of “maxon motor ag” defined by CiA is 0x000000FB.

Remarks
-

Related Objects
-

Name	product code	
Index	0x1018	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RO	
Default Value	-	
Value range	-	-

Description
The high word of this product code contains the hardware version. The low word of the product code contains the application number of the Version array.

Remarks
-

Related Objects
Version

Name	revision number	
Index	0x1018	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RO	
Default Value	-	
Value range	-	-

Description
The high word of this revision number contains the software version. The low word of the revision number contains the application version of the Version array.

Remarks
-

Related Objects
Version

Name	serial number	
Index	0x1018	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RO	
Default Value	-	
Value range	-	-

Description
This identity sub-object contains the last 8 digits of the device serial number in hex format.

Remarks
-

Related Objects
Serial Number

14.14 Verify Configuration

Name	Verify configuration
Index	0x1020
number of entries	0x02

Description
This object indicates the downloaded configuration data and time. This object can be used by a network configuration tool or a CANopen manager to verify the configuration of the EPOS. The configuration tool stores the date and time in that object and stores the same values for example in the DCF-file. Now the configuration tool stores the configuration parameters of the EPOS with the object Store. If any other command changes the configuration parameters, the EPOS resets the object Verify Configuration to 0. A CANopen master is able by checking Configuration date and time with the correct value to verify that the device configuration has not changed. The column Verify Configuration in the object dictionary overview indicate objects how are checked by the firmware. Changing them will reset the configuration time and date.

Remarks
-

Related Objects
Store

Name	Configuration Date	
Index	0x1020	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The configuration date shall contain the number of days since January 1, 1984.

Name	Configuration Time	
Index	0x1020	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The configuration time shall be the number of ms after midnight.

14.15 Server SDO parameter

Name	server SDO parameter	
Index	0x1200	
number of entries	0x02	

Name	COB-ID SDO client to server	
Index	0x1200	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RO	
Default Value	0x00000600 + Node ID	
Value range	-	-

Description
The Communication Object Identifier of service data objects from master to device is shown here.

Remarks
-

Related Objects
-

Name	COB-ID SDO server to client	
Index	0x1200	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RO	
Default Value	0x00000580 + Node ID	
Value range	-	-

Description
The Communication Object Identifier for service data objects from device to master is shown here.

Remarks
-

Related Objects
-

14.16 Receive PDO 1 parameter

Name	receive PDO 1 parameter	
Index	0x1400	
number of entries	0x02	

Name	COB-ID receive PDO 1	
Index	0x1400	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000200 + Node ID	
Value range	see Table 44 & Table 45	-

Description
Communication Object Identifier of receive process data object 1.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 44: Structure of COB-ID RxPDO 1

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 45: Description of COB-ID RxPDO 1 bits

Name	transmission type receive PDO 1	
Index	0x1400	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
255	asynchron

Table 46: Value range transmission type RxPDO 1

Remarks
-

Related Objects
-

14.17 Receive PDO 2 parameter

Name	receive PDO 2 parameter	
Index	0x1401	
number of entries	0x02	

Name	COB-ID receive PDO 2	
Index	0x1401	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000300 + Node ID	
Value range	see Table 47 & Table 48	-

Description
Communication Object Identifier of receive process data object 2.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 47: Structure of COB-ID RxPDO 2

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 48: Description of COB-ID RxPDO 2 bits

Name	transmission type receive PDO 2	
Index	0x1401	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
255	asynchron

Table 49: Value range transmission type RxPDO 2

Remarks
-

Related Objects
-

14.18 Receive PDO 3 parameter

Name	receive PDO 3 parameter
Index	0x1402
number of entries	0x02

Name	COB-ID receive PDO 3
Index	0x1402
Sub-index	0x01
Type	UNSIGNED32
Access	RW
Default Value	0x00000400 + Node ID
Value range	see Table 50 & Table 51

Description
Communication Object Identifier of receive process data object 3.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 50: Structure of COB-ID RxPDO 3

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 51: Description of COB-ID RxPDO 3 bits

Name	transmission type receive PDO 3	
Index	0x1402	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
255	asynchron

Table 52: Value range transmission type RxPDO 3

Remarks
-

Related Objects
-

14.19 Receive PDO 4 parameter

Name	receive PDO 4 parameter	
Index	0x1403	
number of entries	0x02	

Name	COB-ID receive PDO 4	
Index	0x1403	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000500 + Node ID	
Value range	see Table 53 & Table 54	-

Description
Communication Object Identifier of receive process data object 4.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 53: Structure of COB-ID RxPDO 4

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 54: Description of COB-ID RxPDO 4 bits

Name	transmission type receive PDO 4	
Index	0x1403	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
255	asynchron

Table 55: Value range transmission type RxPDO 4

Remarks
-

Related Objects
-

14.20 Receive PDO 1 mapping

Name	receive PDO 1 mapping	
Index	0x1600	
number of entries	-	

Name	number of mapped Application Objects in receive PDO	
Index	0x1600	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	1	
Value range	0	8

Description

-

Remarks

Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects

-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 56: Number of mapped receive PDO 1 objects

Name	1st mapped object	
Index	0x1600	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60400010	
Value range	-	-

Name	2nd mapped object	
Index	0x1600	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	3rd mapped object	
Index	0x1600	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1600	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1600	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1600	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1600	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1600	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 57 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects

-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6040	0x00	0x10 (16)	Controlword
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 57: Receive PDO 1 mapping objects

14.21 Receive PDO 2 mapping

Name	receive PDO 2 mapping	
Index	0x1601	
number of entries	-	

Name	number of mapped Application Objects in receive PDO	
Index	0x1601	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

-

Remarks

Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects

-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 58: Number of mapped receive PDO 2 objects

Name	1st mapped object	
Index	0x1601	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60400010	
Value range	-	-

Name	2nd mapped object	
Index	0x1601	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60600008	
Value range	-	-

Name	3rd mapped object	
Index	0x1601	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1601	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1601	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1601	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1601	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1601	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 59 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects

-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6040	0x00	0x10 (16)	Controlword
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 59: Receive PDO 2 mapping objects

14.22 Receive PDO 3 mapping

Name	receive PDO 3 mapping	
Index	0x1602	
number of entries	-	

Name	number of mapped Application Objects in receive PDO	
Index	0x1602	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

-

Remarks

Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects

-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 60: Number of mapped receive PDO 2 objects

Name	1st mapped object	
Index	0x1602	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60400010	
Value range	-	-

Name	2nd mapped object	
Index	0x1602	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x607A0020	
Value range	-	-

Name	3rd mapped object	
Index	0x1602	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1602	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1602	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1602	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1602	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1602	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 61 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6040	0x00	0x10 (16)	Controlword
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 61: Receive PDO 3 mapping objects

14.23 Receive PDO 4 mapping

Name	receive PDO 4 mapping	
Index	0x1603	
number of entries	-	

Name	number of mapped Application Objects in receive PDO	
Index	0x1603	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

-

Remarks

Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects

-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 62: Number of mapped receive PDO 4 objects

Name	1st mapped object	
Index	0x1603	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60400010	
Value range	-	-

Name	2nd mapped object	
Index	0x1603	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60FF0020	
Value range	-	-

Name	3rd mapped object	
Index	0x1603	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1603	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1603	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1603	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1603	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1603	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 63 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6040	0x00	0x10 (16)	Controlword
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 63: Receive PDO 4 mapping objects

14.24 Transmit PDO 1 parameter

Name	transmit PDO 1 parameter
Index	0x1800
number of entries	0x03

Name	COB-ID transmit PDO 1	
Index	0x1800	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x40000180 + Node ID	
Value range	see Table 64 & Table 65	

Description
Communication Object Identifier of transmit process data object 1.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 64: Structure of COB-ID TxPDO 1

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 65: Description of COB-ID TxPDO 1 bits

Name	transmission type transmit PDO 1	
Index	0x1800	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
253	asynchron on RTR only
255	asynchron on change

Table 66: Value range transmission type TxPDO 1

Remarks
The transmission type 253 means that the PDO is only transmitted on remote transmission request (RTR). If transmission type 255 is selected the PDO is transmitted if the data's change its values. The inhibit time defines a minimum interval therefore.

Related Objects
-

Name	Inhibit time transmit PDO 1	
Index	0x1800	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This time is the minimum interval for event triggered PDO transmission. The value is defined as multiple of 100 µs.

Remarks
Event triggered PDOs can generate a huge CAN bus load and also device load especially if the inhibit time of different PDOs are set to a small value.

Related Objects
-

14.25 Transmit PDO 2 parameter

Name	transmit PDO 2 parameter
Index	0x1801
number of entries	0x03

Name	COB-ID transmit PDO 2	
Index	0x1801	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0xC0000280 + Node ID	
Value range	see Table 67 & Table 68	

Description
Communication Object Identifier of transmit process data object 2.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 67: Structure of COB-ID TxPDO 2

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 68: Description of COB-ID TxPDO 2 bits

Name	transmission type transmit PDO 2	
Index	0x1801	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
253	asynchron on RTR only
255	asynchron on change

Table 69: Value range transmission type TxPDO 2

Remarks
The transmission type 253 means that the PDO is only transmitted on remote transmission request (RTR). If transmission type 255 is selected the PDO is transmitted if the data's change its values. The inhibit time defines a minimum interval therefore.

Related Objects
-

Name	Inhibit time transmit PDO 2	
Index	0x1801	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This time is the minimum interval for event triggered PDO transmission. The value is defined as multiple of 100 µs.

Remarks
Event triggered PDOs can generate a huge CAN bus load and also device load especially if the inhibit time of different PDOs are set to a small value.

Related Objects
-

14.26 Transmit PDO 3 parameter

Name	transmit PDO 3 parameter
Index	0x1802
number of entries	0x03

Name	COB-ID transmit PDO 3	
Index	0x1802	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0xC0000380 + Node ID	
Value range	see Table 70 & Table 71	

Description
Communication Object Identifier of transmit process data object 3.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 70: Structure of COB-ID TxPDO 3

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 71: Description of COB-ID TxPDO 3 bits

Name	transmission type transmit PDO 3	
Index	0x1802	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	255	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
253	asynchron on RTR only
255	asynchron on change

Table 72: Value range transmission type TxPDO 3

Remarks
The transmission type 253 means that the PDO is only transmitted on remote transmission request (RTR). If transmission type 255 is selected the PDO is transmitted if the data's change its values. The inhibit time defines a minimum interval therefore.

Related Objects
-

Name	Inhibit time transmit PDO 3	
Index	0x1802	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This time is the minimum interval for event triggered PDO transmission. The value is defined as multiple of 100 µs.

Remarks
Event triggered PDOs can generate a huge CAN bus load and also device load especially if the inhibit time of different PDOs are set to a small value.

Related Objects
-

14.27 Transmit PDO 4 parameter

Name	transmit PDO 4 parameter
Index	0x1803
number of entries	0x03

Name	COB-ID transmit PDO 4	
Index	0x1803	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0xC0000480 + Node ID	
Value range	see Table 73 & Table 74	

Description
Communication Object Identifier of transmit process data object 4.

Remarks
-

Related Objects
-

Bit 31	Bit 30	Bit 29 - 11	Bit 10 - 0
valid	RTR	0 (CAN base frame)	11-bit Can Id

Table 73: Structure of COB-ID TxPDO 4

Bits		Description
valid	0b 1b	PDO exists / is valid PDO does not exist / is not valid
RTR	0b 1b	RTR allowed on this PDO no RTR allowed on this PDO
11-bit Can Id		11-bit CAN-ID of the CAN base frame Value range: 0x181 .. 0x57F; 0x000 (if valid = 1)

Table 74: Description of COB-ID TxPDO 4 bits

Name	transmission type transmit PDO 4	
Index	0x1803	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	253	
Value range	-	-

Description
The transmission type describes how PDO communication works. The following types are supported:

Value	Description
1	synchron
253	asynchron on RTR only
255	asynchron on change

Table 75: Value range transmission type TxPDO 4

Remarks
The transmission type 253 means that the PDO is only transmitted on remote transmission request (RTR). If transmission type 255 is selected the PDO is transmitted if the data's change its values. The inhibit time defines a minimum interval therefore.

Related Objects
-

Name	Inhibit time transmit PDO 4	
Index	0x1803	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This time is the minimum interval for event triggered PDO transmission. The value is defined as multiple of 100 µs.

Remarks
Event triggered PDOs can generate a huge CAN bus load and also device load especially if the inhibit time of different PDOs are set to a small value.

Related Objects
-

14.28 Transmit PDO 1 mapping

Name	transmit PDO 1 mapping	
Index	0x1A00	
number of entries	-	

Name	number of mapped Application Objects in transmit PDO	
Index	0x1A00	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	1	
Value range	0	8

Description

-

Remarks

Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects

-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 76: Number of mapped transmit PDO 1 objects

Name	1st mapped object	
Index	0x1A00	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60410010	
Value range	-	-

Name	2nd mapped object	
Index	0x1A00	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	3rd mapped object	
Index	0x1A00	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1A00	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1A00	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1A00	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1A00	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1A00	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in the table below are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6041	0x00	0x10 (16)	Statusword
0x6061	0x00	0x08 (08)	Modes of operation display
0x6062	0x00	0x20 (32)	Position demand value
0x6064	0x00	0x20 (32)	Position actual value
0x6069	0x00	0x20 (32)	Velocity sensor actual value
0x606B	0x00	0x20 (32)	Velocity demand value
0x606C	0x00	0x20 (32)	Velocity actual value
0x6078	0x00	0x10 (16)	Current actual value
0x2020	0x00	0x10 (16)	Encoder counter
0x2021	0x00	0x10 (16)	Encoder counter at index pulse
0x2022	0x00	0x10 (16)	Hallsensor pattern
0x2027	0x00	0x10 (16)	Current actual value averaged
0x2028	0x00	0x20 (32)	Velocity actual value averaged
0x2071	0x01	0x10 (16)	Digital Input Functionalities state
0x2074	0x01	0x20 (32)	Position Marker Captured Position
0x2074	0x04	0x10 (16)	Position Marker Counter
0x2074	0x05	0x20 (32)	Position Marker History [1]
0x2074	0x06	0x20 (32)	Position Marker History [2]
0x207C	0x01	0x10 (16)	Analog Input 1
0x207C	0x02	0x10 (16)	Analog Input 2
0x20F4	0x00	0x10 (16)	Following Error Actual Value
0x6040	0x00	0x10 (16)	Controlword

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 77: Transmit PDO 1 mapping objects

14.29 Transmit PDO 2 mapping

Name	transmit PDO 2 mapping	
Index	0x1A01	
number of entries	-	

Name	number of mapped Application Objects in transmit PDO	
Index	0x1A01	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects
-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 78: Number of mapped transmit PDO 2 objects

Name	1st mapped object	
Index	0x1A01	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60410010	
Value range	-	-

Name	2nd mapped object	
Index	0x1A01	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60610008	
Value range	-	-

Name	3rd mapped object	
Index	0x1A01	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1A01	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1A01	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1A01	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1A01	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1A01	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 79 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6041	0x00	0x10 (16)	Statusword
0x6061	0x00	0x08 (08)	Modes of operation display
0x6062	0x00	0x20 (32)	Position demand value
0x6064	0x00	0x20 (32)	Position actual value
0x6069	0x00	0x20 (32)	Velocity sensor actual value
0x606B	0x00	0x20 (32)	Velocity demand value
0x606C	0x00	0x20 (32)	Velocity actual value
0x6078	0x00	0x10 (16)	Current actual value
0x2020	0x00	0x10 (16)	Encoder counter
0x2021	0x00	0x10 (16)	Encoder counter at index pulse
0x2022	0x00	0x10 (16)	Hallsensor pattern
0x2027	0x00	0x10 (16)	Current actual value averaged
0x2028	0x00	0x20 (32)	Velocity actual value averaged
0x2071	0x01	0x10 (16)	Digital Input Functionalities state
0x2074	0x01	0x20 (32)	Position Marker Captured Position
0x2074	0x04	0x10 (16)	Position Marker Counter
0x2074	0x05	0x20 (32)	Position Marker History [1]
0x2074	0x06	0x20 (32)	Position Marker History [2]
0x207C	0x01	0x10 (16)	Analog Input 1
0x207C	0x02	0x10 (16)	Analog Input 2
0x20F4	0x00	0x10 (16)	Following Error Actual Value
0x6040	0x00	0x10 (16)	Controlword

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 79: Transmit PDO 2 mapping objects

14.30 Transmit PDO 3 mapping

Name	transmit PDO 3 mapping	
Index	0x1A02	
number of entries	-	

Name	number of mapped Application Objects in transmit PDO	
Index	0x1A02	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects
-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 80: Number of mapped transmit PDO 3 objects

Name	1st mapped object	
Index	0x1A02	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60410010	
Value range	-	-

Name	2nd mapped object	
Index	0x1A02	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x6064020	
Value range	-	-

Name	3rd mapped object	
Index	0x1A02	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1A02	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1A02	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1A02	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1A02	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1A02	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 81 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6041	0x00	0x10 (16)	Statusword
0x6061	0x00	0x08 (08)	Modes of operation display
0x6062	0x00	0x20 (32)	Position demand value
0x6064	0x00	0x20 (32)	Position actual value
0x6069	0x00	0x20 (32)	Velocity sensor actual value
0x606B	0x00	0x20 (32)	Velocity demand value
0x606C	0x00	0x20 (32)	Velocity actual value
0x6078	0x00	0x10 (16)	Current actual value
0x2020	0x00	0x10 (16)	Encoder counter
0x2021	0x00	0x10 (16)	Encoder counter at index pulse
0x2022	0x00	0x10 (16)	Hallsensor pattern
0x2027	0x00	0x10 (16)	Current actual value averaged
0x2028	0x00	0x20 (32)	Velocity actual value averaged
0x2071	0x01	0x10 (16)	Digital Input Functionalities state
0x2074	0x01	0x20 (32)	Position Marker Captured Position
0x2074	0x04	0x10 (16)	Position Marker Counter
0x2074	0x05	0x20 (32)	Position Marker History [1]
0x2074	0x06	0x20 (32)	Position Marker History [2]
0x207C	0x01	0x10 (16)	Analog Input 1
0x207C	0x02	0x10 (16)	Analog Input 2
0x20F4	0x00	0x10 (16)	Following Error Actual Value
0x6040	0x00	0x10 (16)	Controlword

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 81: Transmit PDO 3 mapping objects

14.31 Transmit PDO 4 mapping

Name	transmit PDO 4 mapping	
Index	0x1A03	
number of entries	-	

Name	number of mapped Application Objects in transmit PDO 4	
Index	0x1A03	
Sub-index	0x08	
Type	UNSIGNED8	
Access	RW	
Default Value	2	
Value range	0	8

Description

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. Before it is possible to enable PDO, it is necessary to map objects.

Related Objects
-

Value	Description
0	PDO is disabled
1-8	one to eight objects are mapped

Table 82: Number of mapped transmit PDO 4 objects

Name	1st mapped object	
Index	0x1A03	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x60410010	
Value range	-	-

Name	2nd mapped object	
Index	0x1A03	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x606C0020	
Value range	-	-

Name	3rd mapped object	
Index	0x1A03	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	4th mapped object	
Index	0x1A03	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	5th mapped object	
Index	0x1A03	
Sub-index	0x05	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	6th mapped object	
Index	0x1A03	
Sub-index	0x06	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	7th mapped object	
Index	0x1A03	
Sub-index	0x07	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Name	8th mapped object	
Index	0x1A03	
Sub-index	0x08	
Type	UNSIGNED32	
Access	RW	
Default Value	0x00000000	
Value range	-	-

Description
The objects in Table 83 are supported to map.

Remarks
Changes in mapping are only possible in **NMT state Pre-Operational**. To change a mapped object it is necessary to disable PDO. The maximal length of a process data object is 64 bit; because of this it is only possible to map two 32-bit values or two 16-bit values and one 32-bit value and so on.

Related Objects
-

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6041	0x00	0x10 (16)	Statusword
0x6061	0x00	0x08 (08)	Modes of operation display
0x6062	0x00	0x20 (32)	Position demand value
0x6064	0x00	0x20 (32)	Position actual value
0x6069	0x00	0x20 (32)	Velocity sensor actual value
0x606B	0x00	0x20 (32)	Velocity demand value
0x606C	0x00	0x20 (32)	Velocity actual value
0x6078	0x00	0x10 (16)	Current actual value
0x2020	0x00	0x10 (16)	Encoder counter
0x2021	0x00	0x10 (16)	Encoder counter at index pulse
0x2022	0x00	0x10 (16)	Hallsensor pattern
0x2027	0x00	0x10 (16)	Current actual value averaged
0x2028	0x00	0x20 (32)	Velocity actual value averaged
0x2071	0x01	0x10 (16)	Digital Input Functionalities state
0x2074	0x01	0x20 (32)	Position Marker Captured Position
0x2074	0x04	0x10 (16)	Position Marker Counter
0x2074	0x05	0x20 (32)	Position Marker History [1]
0x2074	0x06	0x20 (32)	Position Marker History [2]
0x207C	0x01	0x10 (16)	Analog Input 1
0x207C	0x02	0x10 (16)	Analog Input 2
0x20F4	0x00	0x10 (16)	Following Error Actual Value
0x6040	0x00	0x10 (16)	Controlword

1st, 2nd Byte	3rd Byte	4th Byte	
object index	**object sub-index**	**object length in bit**	**object name**
0x6060	0x00	0x08 (08)	Modes of operation
0x6065	0x00	0x20 (32)	Maximal following error
0x607A	0x00	0x20 (32)	Target position
0x607C	0x00	0x20 (32)	Home offset
0x6081	0x00	0x20 (32)	Profile velocity
0x6083	0x00	0x20 (32)	Profile acceleration
0x6084	0x00	0x20 (32)	Profile deceleration
0x6085	0x00	0x20 (32)	Quick stop deceleration
0x6086	0x00	0x10 (16)	Motion profile type
0x6098	0x00	0x08 (08)	Homing method
0x6099	0x01	0x20 (32)	Homing speeds for switch search
0x6099	0x02	0x20 (32)	Homing speeds for zero search
0x609A	0x00	0x20 (32)	Homing acceleration
0x60F6	0x01	0x10 (16)	Current control parameter set P-gain
0x60F6	0x02	0x10 (16)	Current control parameter set I-gain
0x60F9	0x01	0x10 (16)	Velocity control parameter set P-gain
0x60F9	0x02	0x10 (16)	Velocity control parameter set I-gain
0x60FB	0x01	0x10 (16)	Position control parameter set P-gain
0x60FB	0x02	0x10 (16)	Position control parameter set I-gain
0x60FB	0x03	0x10 (16)	Position control parameter set D-gain
0x60FB	0x04	0x10 (16)	Position control parameter set velocity FF-Factor
0x60FB	0x05	0x10 (16)	Position control parameter set accel FF-Factor
0x60FF	0x00	0x20 (32)	Target velocity
0x6410	0x01	0x10 (16)	Motor data continuous current limit
0x6410	0x02	0x10 (16)	Motor data output current limit
0x6410	0x04	0x10 (16)	Motor data maximal speed in current mode
0x2030	0x00	0x10 (16)	Current mode setting value
0x2062	0x00	0x20 (32)	Position mode setting value
0x206B	0x00	0x20 (32)	Velocity mode setting value
0x2078	0x01	0x10 (16)	Digital Output Functionalities state
0x2080	0x00	0x10 (16)	Current Threshold for Homing Mode
0x2081	0x00	0x20 (32)	Home position

Table 83: Transmit PDO 4 mapping objects

14.32 Node ID

Name	Node ID	
Index	0x2000	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	Node ID	
Value range	1	127

Description
The Node ID is the identification of the CANopen node. It is given from hardware switches or the Layer setting services (LSS).

Remarks
Changes to this object take only affect after restart. Therefore it is necessary to store all parameters after changing and set DIP-Switches to 0 before restart.

Related Objects
-

14.33 CAN Bitrate

Name	CAN bitrate	
Index	0x2001	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	6

Description
The bit rate of the CAN interface can be changed with the CAN bitrate parameter.

Remarks
Changes to this object take only effect after restart. Therefore it is necessary to store all parameters after changing and then restart.

Related Objects
-

Value	Bit rate
0	1 Mbit/s
1	800 kbit/s
2	500 kbit/s
3	250 kbit/s
4	125 kbit/s
5	50 kbit/s
6	20 kbit/s

Table 84: CAN bit rate codes

14.34 RS232 Baudrate

Name	RS232 baudrate	
Index	0x2002	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	3	
Value range	0	5

Description
The baud rate of the serial communication interface can be changed with the RS232 baudrate parameter.

Remarks
Changes to this object takes only effect after restart. Therefore it is necessary to store all parameters after changing and then restart.

Related Objects
-

Value	Baud rate
0	9.6 kBaud
1	14.4 kBaud
2	19.2 kBaud
3	38.4 kBaud
4	57.6 kBaud
5	115.2 kBaud

Table 85: RS232 baud rate codes

14.35 Version

Name	version	
Index	0x2003	
number of entries	0x05	

Name	software version	
Index	0x2003	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This objects contains the software version of the EPOS.

Remarks
-

Related Objects
-

Name	hardware version	
Index	0x2003	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object contains the hardware version (and the device type).

Remarks
-

Related Objects
-

Value	Description
601x	EPOS 24/1
621x	EPOS 24/5
641x	EPOS 70/10
661x	MCD EPOS 60 W

Table 86: Hardware versions

Name	application number	
Index	0x2003	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
If the value of this object is not zero an application specific firmware is installed on this EPOS.

Remarks
-

Related Objects
-

Name	application number	
Index	0x2003	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
The application version is used as version number of an application or as internal revision number.

Remarks
-

Related Objects
-

Name	internal object	
Index	0x2003	
Sub-index	0x05	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object is used internally and by GUI also.

Remarks
-

Related Objects
-

14.36 Serial Number

Name	serial number	
Index	0x2004	
Sub-index	0x00	
Type	UNSIGNED64	
Access	CONST	
Default Value	-	
Value range	-	-

Description
The serial number of the EPOS can be read here.

Remarks
If the value is zero the serial number is unknown.

Related Objects
-

14.37 RS232 Frame Timeout

Name	RS232 frame timeout	
Index	0x2005	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	500	
Value range	-	-

Description
This parameter defines the timeout over a RS232 communication frame. It is scaled in milliseconds.

Remarks
-

Related Objects

14.38 Miscellaneous Configuration

Name	miscellaneous configuration	
Index	0x2008	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0x0000	
Value range	-	-

Description
This configuration word is used for miscellaneous operations.

Remarks
Changes are only in disable state supported.

Related Objects
-

Bit	Description
15 - 4	reserved
3	1 = Measure motor speed exacting by detecting encoder pulse time
2	0 = Measure (DC-) motor resistance at first change to enable 1 = Measure (DC-) motor resistance at every change to enable (used for position sensor supervision by software)
1	reserved
0	1 = Disable position sensor supervision

Table 87: Miscellaneous Configuration bits

14.39 Custom persistent memory

Name	custom persistent memory	
Index	0x200C	
number of entries	4	

Name	custom persistent memory 1	
Index	0x200C	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	0x0000	
Value range	-	-

Name	custom persistent memory 1	
Index	0x200C	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x0000	
Value range	-	-

Name	custom persistent memory 2	
Index	0x200C	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	0x0000	
Value range	-	-

Name	custom persistent memory 3	
Index	0x200C	
Sub-index	0x03	
Type	UNSIGNED32	
Access	RW	
Default Value	0x0000	
Value range	-	-

Name	custom persistent memory 4	
Index	0x200C	
Sub-index	0x04	
Type	UNSIGNED32	
Access	RW	
Default Value	0x0000	
Value range	-	-

Description
This persistent memory can be used to store custom values (e.g. axis numbers, identifications …) on the EPOS. These values would not be evaluated by the firmware, but they will be cleared by setting default parameters.

Remarks
-

Related Objects
-

14.40 Encoder counter

Name	encoder counter	
Index	0x2020	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object holds the internal counter register of the encoder. It shows the actual encoder position in quad-counts.

Remarks
-

Related Objects
-

14.41 Encoder counter at index pulse

Name	encoder counter at index pulse	
Index	0x2021	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object holds the encoder counter reached at last detected encoder index pulse.

Remarks
-

Related Objects
-

14.42 Hallsensor pattern

Name	hallsensor pattern	
Index	0x2022	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object displays the actual state of the three hall sensors as a pattern.

Remarks
-

Related Objects
-

Bit number	Hardware signal
0	hallsensor 1
1	hallsensor 2
2	hallsensor 3

Table 88: Hallsensor pattern

14.43 Current actual value averaged

Name	current actual value averaged	
Index	0x2027	
Sub-index	0x00	
Type	INTEGER16	
Access	RO	
Default Value	-	
Value range	-32768	32767

Description
The current actual value averaged [mA] represents the current actual value filtered by 1st order digital low-pass filter with a cut-off frequency of 50 Hz.

The linear difference equation is given with:

$$y[k] = (1-\lambda) \cdot y[k-1] + \lambda \cdot x[k]$$

where the transfer function results:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\lambda}{1-(1-\lambda) \cdot z^{-1}} \qquad \lambda = 2^{-5}$$

With the numerical values $\lambda=2^{-5}$, sampling time $Ts = 0.1\ ms$ and $z = e^{j2\pi fTs}$ the following amplitude response results.

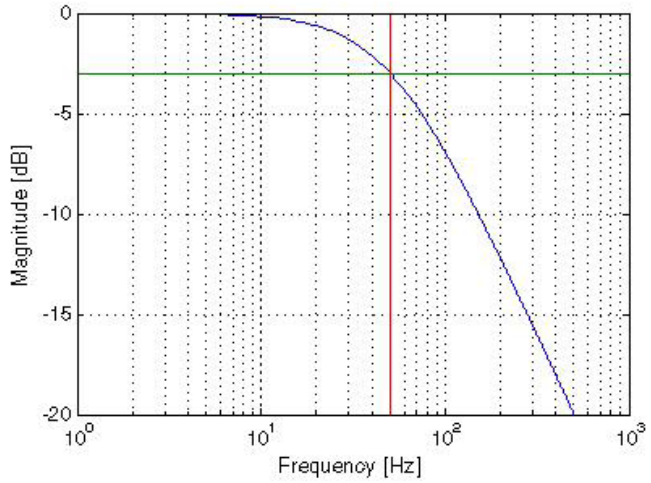


Figure 64: Current actual value averaged amplitude response

Remarks
-

Related Objects
Current actual value

14.44 Velocity actual value averaged

Name	velocity actual value averaged	
Index	0x2028	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-2147483648	2147483647

Description
The velocity actual value averaged [Velocity units] represents the velocity actual value [Velocity units] filtered by 1st order digital low-pass filter with a cut-off frequency of 5 Hz.

The linear difference equation is given with:

$$y[k] = (1-\lambda) \cdot y[k-1] + \lambda \cdot x[k]$$

where the transfer function results:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\lambda}{1-(1-\lambda) \cdot z^{-1}} \qquad \lambda = 2^{-5}$$

With the numerical values $\lambda=2^{-5}$, sampling time $Ts = 0.1\ ms$ and $z = e^{j2\pi fTs}$ the following amplitude response results.

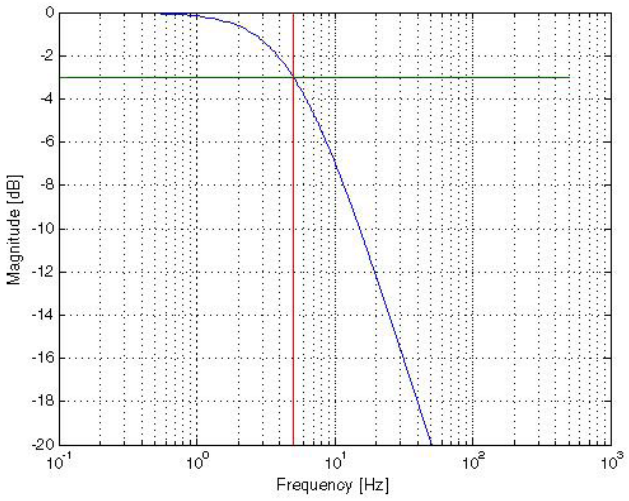


Figure 65: Velocity actual value averaged amplitude response

Remarks
The resolution of the short time velocity measurement (Velocity actual value, Velocity sensor actual value) is dependent on the encoder pulse number (Sensor Configuration) and the velocity measurement method (Miscellaneous Configuration bit 3). To improve the short time velocity measurement resolution set the Miscellaneous Configuration bit 3 to 1 or use a encoder with higher resolution.

For example the short time velocity resolution with a 500 pulse encoder and Miscellaneous Configuration bit 3 = 0 is: 1 quadcount / ms = 60'000 / (4 · 500) = 30 rpm.

Related Objects
Velocity actual value

14.45 Current mode setting value

Name	current mode setting value	
Index	0x2030	
Sub-index	0x00	
Type	INTEGER16	
Access	RW	
Default Value	0	
Value range	-32768	32767

Description
Setting value of current regulator in current mode [mA].

Remarks
-

Related Objects
-

14.46 Position mode setting value

Name	position mode setting value	
Index	0x2062	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	0	
Value range	-2147483648	2147483647

Description
Position mode setting value is the set value of the position regulator [Position units].

Remarks
The difference between position demand value and position mode setting value is the access type. In Profile Position mode it is not possible to write directly to position demand value. The values are generated internally from profile generator. In position mode the profile must be generated by CANopen Master.

Related Objects
Position demand value

14.47 Velocity mode setting value

Name	velocity mode setting value	
Index	0x206B	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	-	
Value range	-2147483648	2147483647

Description
Velocity mode setting value is the set value of the velocity regulator [Velocity units].

Remarks
The difference between velocity demand value and velocity mode setting value is the access type. In profile velocity mode it is not possible to write directly to velocity demand value, values are generated internally from trajectory generator. In velocity mode, a profile must be generated by CANopen Master.

Related Objects
Velocity demand value

14.48 Configuration of digital inputs

Name	configuration of digital inputs	
Index	0x2070	
number of entries	depend on hardware	

Name	configuration of digital input 1	
Index	0x2070	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 2	
Index	0x2070	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 3	
Index	0x2070	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 4	
Index	0x2070	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 5 (not valid for MCD EPOS 60 W)	
Index	0x2070	
Sub-index	0x05	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 6 (not valid for MCD EPOS 60 W)	
Index	0x2070	
Sub-index	0x06	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	15

Name	configuration of digital input 7 (EPOS 70/10 and MCD EPOS 60 W)	
Index	0x2070	
Sub-index	0x07	
Type	UNSIGNED16	
Access	RW	
Default Value	9	
Value range	0	15

Name	configuration of digital input 8 (EPOS 70/10 and MCD EPOS 60 W)	
Index	0x2070	
Sub-index	0x08	
Type	UNSIGNED16	
Access	RW	
Default Value	8	
Value range	0	15

Description
Configures which functionality will be assigned to digital input 1 to 8.

Remarks
-

Related Objects
Digital Input Functionalities

Value	Functionality	Description
15	general purpose A	State can be read
14	general purpose B	State can be read
13	general purpose C	State can be read
12	general purpose D	State can be read
11	general purpose E	State can be read
10	general purpose F	State can be read
9	general purpose G	State can be read
8	general purpose H	State can be read
7 – 5	reserved	
4	device enable	Enables / Disables Device
3	position marker	Samples actual position
2	home switch	Used in some homing modes
1	positive limit switch	Generates Limit error / used in some homing modes
0	negative limit switch	Generates Limit error / used in some homing modes

Table 89: Digital Input configuration

14.49 Digital Input Functionalities

Name	digital input functionalities	
Index	0x2071	
number of entries	4	

Name	digital input functionalities state	
Index	0x2071	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
Display the state of the digital input functionalities (after polarity correction and filtering by 'Digital Input Functionalities Polarity' and 'Digital Input Functionalities Mask'). If a bit is read as one the functionality is activated.

Remarks
-

Related Objects
-

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
general purpose A	general purpose B	general purpose C	general purpose D	general purpose E	general purpose F	general purpose G	general purpose H
bit 7	**bit 6**	**bit 5**	**bit 4**	**bit 3**	**bit 2**	**bit 1**	**bit 0**
reserved	reserved	reserved	device enable	position marker	home switch	positive limit switch	negative limit switch

Table 90: Digital input functionalities state

Name	digital input functionalities mask	
Index	0x2071	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	-	-

Description
With this mask displayed state of the digital input functionalities can be filtered. If a bit is set to one the functionality state will be displayed.

Remarks
-

Related Objects
-

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
general purpose A	general purpose B	general purpose C	general purpose D	general purpose E	general purpose F	general purpose G	general purpose H
bit 7	**bit 6**	**bit 5**	**bit 4**	**bit 3**	**bit 2**	**bit 1**	**bit 0**
reserved	reserved	reserved	device enable	position marker	home switch	positive limit switch	negative limit switch

Table 91: Digital input functionalities mask

Name	digital input functionalities polarity	
Index	0x2071	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0x0000	
Value range	-	-

Description
With this bit field the polarity of the digital input functionalities can be set.

If a bit is set to zero the associated pin is high active.

bit	0	1
associated pin	high active	low active

Remarks
-

Related Objects
-

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
general purpose A	general purpose B	general purpose C	general purpose D	general purpose E	general purpose F	general purpose G	general purpose H
bit 7	**bit 6**	**bit 5**	**bit 4**	**bit 3**	**bit 2**	**bit 1**	**bit 0**
reserved	reserved	reserved	device enable	position marker	home switch	positive limit switch	negative limit switch

Table 92: Digital input functionalities polarity

Name	digital input functionalities execution mask	
Index	0x2071	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0x0008	
Value range	-	-

Description
With the execution mask the digital input functionalities can be keeping off from execution. The function (Negative or Positive Limit Switch Error Routine) will be executed when the associated bit in functionalities state register goes high and the bit in this execution mask is set.

Remarks
-

Related Objects
-

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
bit 7	**bit 6**	**bit 5**	**bit 4**	**bit 3**	**bit 2**	**bit 1**	**bit 0**
reserved	reserved	reserved	device enable	position marker	reserved	positive limit switch	negative limit switch

Table 93: Digital input functionalities execution mask

14.50 Position Marker

Name	position marker
Index	0x2074
number of entries	6

Name	position marker captured position	
Index	0x2074	
Sub-index	0x01	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object holds the last captured position.

Remarks
-

Related Objects
Configuration of digital inputs
Digital Input Functionalities

Name	position marker edge type	
Index	0x2074	
Sub-index	0x02	
Type	UNSIGNED8	
Access	RW	
Default Value	0	
Value range	-	-

Description
The value of this object defines on what kind of edge the position should be captured.

Value	Detects	Description
0	All Edge	Digital Input Functionalities State change from 0 to 1 or from 1 to 0
1	Rising Edge	Digital Input Functionalities State change from 0 to 1
2	Falling Edge	Digital Input Functionalities State change from 1 to 0

Remarks
The digital inputs are filtered by software additionally to the hardware input filter to suppress spikes. Due to this even if a high speed input is used as position marker input the level should be stable for more then 1 ms that a state change (edge) is detected as valid. A second capture edge should not occur earlier then after 2 ms for a valid detection of both positions.

The high-speed digital inputs (DigIn 2 or DigIn 3 on EPOS 24/1 and EPOS 24/5 respectively DigIn 7 or DigIn 8 on EPOS 70/10 and MCD EPOS 60 W) are detected by an interrupt. Therefore the position can be captured exacting with this inputs (latency time shorter then 45 µs). For the other digital inputs the latency time is longer due to polling of inputs (maximum 2 ms) plus the switching time of the hardware filtering (please refer to Hardware Specification).

Related Objects
-

Name	position marker mode	
Index	0x2074	
Sub-index	0x03	
Type	UNSIGNED8	
Access	RW	
Default Value	1	
Value range	-	-

Description
This object defines the position marker-capturing mode.

Value	Captures	Description
0	Continuous	On every detected edge (of correct kind) the position will be captured
1	Single	Only the position at the first detected edge will be captured
2	Multiple	The positions at the detected edges will be captured until the history buffer is full (position marker counter = 3)

Remarks
-

Related Objects
-

Name	position marker counter	
Index	0x2074	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This object counts the number of the detected edges. The counter and the captured positions can be cleared by writing zero to this object.

Remarks
-

Related Objects
-

Name	position marker history [1]	
Index	0x2074	
Sub-index	0x05	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-	-

Name	position marker history [2]	
Index	0x2074	
Sub-index	0x06	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-	-

Description
If more then one position is captured in “multiple capture mode” or “continuous capture mode” the older captured positions will be shifted to this objects.

Remarks
If more the three positions are captured in “continuous capture mode” the oldest marker positions are lost.

Related Objects
-

14.51 Digital Output Functionalities

Name	digital output functionalities	
Index	0x2078	
number of entries	3	

Name	digital output functionalities state	
Index	0x2078	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RW	
Default Value	-	
Value range	-	-

Description
With this object the state of the Digital Outputs can be set.

Remarks
The bits 0 to 7 are read only. They will be modified by the device state. The state of these bits by a write access has no effect.

Related Objects
Configuration of digital outputs

bit 15	bit 14	bit 13	bit 12	bits 11 … 1	bit 0
general purpose OutA	general purpose OutB	general purpose OutC	general purpose OutD	reserved	Ready / Fault* (read only)

Table 94: Digital output functionalities state

Name	digital output functionalities mask	
Index	0x2078	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	0x0000	
Value range	-	-

Description
With this object the digital outputs can be filtered. Only the digital outputs, which have set its bit to one in this register, will be modified.

Remarks
-

Related Objects
-

bit 15	bit 14	bit 13	bit 12	bits 11 … 1	bit 0
general purpose OutA	general purpose OutB	general purpose OutC	general purpose OutD	reserved	Ready / Fault*

Table 95: Digital output functionalities mask

Name	digital output functionalities polarity	
Index	0x2078	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	0x0000	
Value range	-	-

Description

With this object the polarity of the digital outputs can be changed.

If a bit of this object is set to one the associated output will be inverted the output. That means that a 1 in the Digital Output Functionalities State will set the output pin to low.

Remarks

-

Related Objects

-

bit 15	bit 14	bit 13	bit 12	bits 11 … 1	bit 0
general purpose OutA	general purpose OutB	general purpose OutC	general purpose OutD	reserved	Ready / Fault*

Table 96: Digital output functionalities polarity

14.52 Configuration of digital outputs

Name	configuration of digital outputs	
Index	0x2079	
number of entries	Depend on hardware	

Name	configuration of digital output 1	
Index	0x2079	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RW	
Default Value	15	
Value range	0	15

Name	configuration of digital output 2	
Index	0x2079	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	14	
Value range	0	15

Name	configuration of digital output 3	
Index	0x2079	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	13	
Value range	0	15

Name	configuration of digital output 4	
Index	0x2079	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	12	
Value range	0	15

Description
Configures which output functionality will be assigned to digital outputs 1 to 4.

Remarks
Digital outputs 1 and 2 are not connected on the EPOS 24/1 and MCD EPOS 60 W.

Related Objects
-

Value	Functionality	Description
15	general purpose OutA	Can be written by state
14	general purpose OutB	Can be written by state
13	general purpose OutC	Can be written by state
12	general purpose OutD	Can be written by state
11 – 8	not used	
7 – 1	reserved	
0	Ready / Fault*	Active on Device Ready / Inactive on Fault

Table 97: Digital Input configuration

14.53 Analog Inputs

Name	analog inputs	
Index	0x207C	
number of entries	2	

Name	analog input 1	
Index	0x207C	
Sub-index	0x01	
Type	INTEGER16	
Access	RO	
Default Value	-	
Value range	depend on hardware	depend on hardware

Description
The voltage measured at analog input 1 [mV].

Remarks
The MCD EPOS 60 W does not support analog inputs.

Related Objects
-

Name	analog input 2	
Index	0x207C	
Sub-index	0x02	
Type	INTEGER16	
Access	RO	
Default Value	-	
Value range	depend on hardware	depend on hardware

Description
The voltage measured at analog input 2 [mV].

Remarks
The MCD EPOS 60 W does not support analog inputs.

Related Objects
-

14.54 Current Threshold for Homing Mode

Name	current threshold for homing mode	
Index	0x2080	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	500	
Value range	0	depend on hardware

Description
This value is used for homing modes '-1', '-2', '-3' and '-4'. A mechanical border will be detected when the measured motor current rises over this threshold [mA].

Remarks
-

Related Objects
-

14.55 Home position

Name	home position	
Index	0x2081	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	0	
Value range	-2147483648	2147483647

Description
The home position defines the position, which will be set to the absolute position counter at the zero position [Position units].

Remarks
-

Related Objects
-

14.56 Following Error Actual Value

Name	following error actual value	
Index	0x20F4	
Sub-index	0x00	
Type	INTEGER16	
Access	RO	
Default Value	-	
Value range	-	-

Description
This object represents the actual value of the following error. It is given in internal position units [qc].

Remarks
-

Related Objects
-

14.57 Sensor Configuration

Name	sensor configuration
Index	0x2210
number of entries	4

Name	encoder pulse number	
Index	0x2210	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RW	
Default Value	500	
Value range	16 x (Motor data ->pole pair number)	7500

Description
The encoder pulse number should be set to number of counts per revolution of the connected incremental encoder.

Minimal Value: 16 pulse per turn

Maximal Value: 7500 pulse per turn

Remarks
The absolute position of the position sensor could be corrupt after changing this parameter. This will be indicated by an Error 0x7320.

This parameter has no influence if the sensor type 3 (hall sensors) is selected.

For MCD EPOS 60 W valid value are 500 and 1000.

Changes are only in disable state supported.

Related Objects
-

Name	position sensor type	
Index	0x2210	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	0x01	
Value range	see Table 98	-

Description
The position sensor type can be changed with this parameter.

Remarks
Please consider that some homing modes would not work with an encoder without index because no index can be detected.

The sensor type 'Hall Sensors' (code 3) can only be selected if Motor type 'Trapezoidal PM BL motor' (code 11) is set. The motor works without an encoder in this configuration.

Not changeable for MCD EPOS 60 W.

Changes are only in disable state supported.

Related Objects
-

Value	Description
1	Incremental Encoder with index (3-channel)
2	Incremental Encoder without index (2-channel)
3	Hall Sensors (Remark: consider worse resolution)

Table 98: Position sensor types

Name	internal used
Index	0x2210
Sub-index	0x03

Description
Please do not change!

Name	position sensor polarity	
Index	0x2210	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0x00	
Value range	see Table 99	-

Description
With this parameter the position sensor and the hall sensor polarity can be changed.

Remarks
Changes to this object are only in disable state supported.
Not changeable for MCD EPOS 60 W.

Related Objects
-

Bit	Description
15-2	Reserved (0)
1	Hall sensors polarity 0: normal / 1: inverted
0	Encoder polarity 0: normal / 1: inverted (or encoder mounted on motor shaft side)

Table 99: Position sensor polarity

14.58 Digital Position Input

Name	digital position input
Index	0x2300
number of entries	4

Description
The object Digital Position Input is used to configure the interpretation of digital position set values (MasterEncoder Mode, Step/Direction Mode). The Digital Position Desired Value is given from the Digital Inputs. The demand value for the position controller is calculated with Digital Position Scaling Numerator and Digital Position Scaling Denominator. The polarity (direction) is configured with digital position polarity.

Remarks

$$\text{Digital Position Desired Value} = \begin{cases} \text{quadrature- (up/down-) counter value} & \mid \text{Digital Position Polarity} = 0 \\ \text{- quadrature- (up/down-) counter value} & \mid \text{Digital Position Polarity} = 1 \end{cases}$$

Position Demand Value* = Digital Position Desired Value * Scaling Numerator / Scaling Denominator

Related Objects
Modes of operation

Name	digital position desired value	
Index	0x2300	
Sub-index	0x01	
Type	INTEGER32	
Access	RO	
Default Value	0	
Value range	-	-

Name	digital position scaling numerator	
Index	0x2300	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	1	
Value range	-	-

Name	digital position scaling denominator	
Index	0x2300	
Sub-index	0x03	
Type	UNSIGNED16	
Access	RW	
Default Value	1	
Value range	-	-

Name	digital position polarity	
Index	0x2300	
Sub-index	0x04	
Type	UNSIGNED8	
Access	RW	
Default Value	0	
Value range	0	1

14.59 Controlword

Name	controlword	
Index	0x6040	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	-	
Value range	-	-

Description
The controlword consist of bits for:

- the Device control commands (bits 0-3 and 7)
- the controlling of operating modes (bits 4-6 and 8) (Controlword (Profile Position Mode specific bits), Controlword (Homing Mode specific bits), Controlword Profile Velocity Mode specific bits))

Remarks
-

Related Objects
Statusword

Bit	Description	PPM	PVM	HMM
15-11	not used			
10,9	reserved			
8	Operation mode specific	Halt	Halt	Halt
7	Fault reset			
6	Operation mode specific	Abs / rel	reserved	reserved
5	Operation mode specific	Change set immediately	reserved	reserved
4	Operation mode specific	New set-point	reserved	Homing operation start
3	Enable operation			
2	Quick stop			
1	Enable voltage			
0	Switch on			

Table 100: Controlword bits

14.60 Statusword

Name	Statusword	
Index	0x6041	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RO	
Default Value	-	
Value range	-	-

Description
The statusword indicates the current state of the drive. These bits are not latched.

The Statusword bits are used for:

- current State of the drive (bits 0-6, 8 and 14)
- the operating state of the mode (bits 10, 12 and 13) (Statusword (Profile Position Mode specific bits), Statusword (Homing Mode specific bits), Statusword (Profile Velocity Mode specific bits))
- position refenced 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)

Remarks
-

Related Objects
Controlword

Bit	Description	PPM	PVM	HMM
15	Position referenced to home position			
14	Refresh cycle of power stage			
13	Operation mode specific	Following error	Not used	Homing error
12	Operation mode specific	Set-point ack	Speed	Homing attained
11	Internal limit active			
10	Operation mode specific	Target reached	Target reached	Target reached
9	Remote (NMT Slave State Operational)			
8	Offset current measured			
7	not used (Warning)			
6	Switch on disable			
5	Quick stop			
4	Voltage enabled (power stage on)			
3	Fault			
2	Operation enable			
1	Switched on			
0	Ready to switch on			

Table 101: Statusword bits

14.61 Modes of operation

Name	modes of operation	
Index	0x6060	
Sub-index	0x00	
Type	INTEGER8	
Access	RW	
Default Value	1	
Value range	-	-

Description
The parameter mode of operation switches the actually chosen operation mode.

Remarks
After change the mode of operational it is recommended to check the mode with modes of operational display.

Related Objects
Modes of operation display

Operation Mode	Description
6	Homing Mode
3	Profile Velocity Mode
1	Profile Position Mode
-1	Position Mode
-2	Velocity Mode
-3	Current Mode
-4	Diagnostic Mode
-5	MasterEncoder Mode
-6	Step/Direction Mode

Table 102: Modes of operation

14.62 Modes of operation display

Name	modes of operation display	
Index	0x6061	
Sub-index	0x00	
Type	INTEGER8	
Access	RO	
Default Value	1	
Value range	-	-

Description
The modes of operation display show the actual mode of operation. The meaning of the returned value corresponds to the Table 102 mode of operation code.

Remarks
-

Related Objects
Modes of operation

14.63 Position demand value

Name	position demand value	
Index	0x6062	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	0	
Value range	-2147483648	2147483647

Description
Position demand value is generated by profile generator and is the set value of the position regulator [Position units].

Remarks
-

Related Objects
Position mode setting value

14.64 Position actual value

Name	position actual value	
Index	0x6064	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	0	
Value range	-2147483648	2147483647

Description
The actual position is absolute and referenced to system zero position [Position units].

Remarks
-

Related Objects
-

14.65 Maximal following error

Name	maximal following error	
Index	0x6065	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	2000	
Value range	0	4294967295

Description
Maximal allowed difference of position actual value to position demand value. If difference of position demand value and position actual value is bigger, a following error occurs [Position units].

Remarks
If the value of the Maximal Following Error is 2^{32}-1, the following control is switched off.

Related Objects
-

14.66 Position Window

Name	position window	
Index	0x6067	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	4294967295	
Value range	0	4294967295

Description
In Profile Position Mode the position window defines a symmetrical range of accepted positions relatively to Target position. If the actual value of the position encoder is within the position window, this target position is regarded as reached.

Remarks
If the value of the position window is 2^{32}-1, the position window is switched off and the corresponding bit 10 target reached in the Statusword will be set to one at the end of the trajectory.

Related Objects
Position Window Time

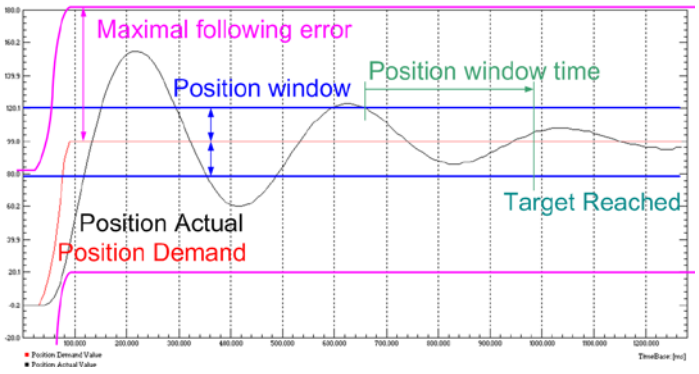


Figure 66: Position Window

14.67 Position Window Time

Name	position window time	
Index	0x6068	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	65535

Description
When the Position actual value actual position is within the position window during the defined Position Window time, which is given in multiples of milliseconds, the corresponding bit 10 target reached in the Statusword will be set to one.

Remarks
-

Related Objects
-

14.68 Velocity sensor actual value

Name	velocity sensor actual value	
Index	0x6069	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-2147483648	2147483647

Description
The velocity sensor actual value is given in quadcounts per second [inc/s].

Remarks
The resolution of the short time velocity measurement (Velocity actual value**,** Velocity sensor actual value**) is dependent on the encoder pulse number** (Sensor Configuration) and the velocity measurement method (Miscellaneous Configuration bit 3). To improve the short time velocity measurement resolution set the Miscellaneous Configuration bit 3 to 1 or use an encoder with higher resolution.

For example the short time velocity resolution with a 500-pulse encoder and Miscellaneous Configuration Bit 3 = 0 is: 1 quadcount / ms = 60'000 / (4 * 500) = 30 rpm.

Related Objects
Velocity actual value averaged

14.69 Velocity demand value

Name	velocity demand value	
Index	0x606B	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-2147483648	2147483647

Description
Velocity demand value is generated by profile generator and is the set value for the velocity controller [Velocity units].

Remarks
-

Related Objects
-

14.70 Velocity actual value

Name	velocity actual value	
Index	0x606C	
Sub-index	0x00	
Type	INTEGER32	
Access	RO	
Default Value	-	
Value range	-2147483648	2147483647

Description
The velocity actual value is coupled to the velocity used as input to velocity controller [Velocity units].

Remarks
The resolution of the short time velocity measurement (Velocity actual value**,** Velocity sensor actual value**) is dependent on the encoder pulse number** (Sensor Configuration) and the velocity measurement method (Miscellaneous Configuration bit 3). To improve the short time velocity measurement resolution set the Miscellaneous Configuration bit 3 to 1 or use an encoder with higher resolution.

For example the short time velocity resolution with a 500-pulse encoder and Miscellaneous Configuration Bit 3 = 0 is: 1 quadcount / ms = 60'000 / (4 * 500) = 30 rpm.

Related Objects
Velocity actual value averaged

14.71 Current actual value

Name	current actual value	
Index	0x6078	
Sub-index	0x00	
Type	INTEGER16	
Access	RO	
Default Value	-	
Value range	-32768	32767

Description
The actual measured current can be read in this object [mA].

Remarks
-

Related Objects
-

14.72 Target position

Name	target position	
Index	0x607A	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	0	
Value range	-2147483648	2147483647

Description
The target position is the position that the drive should move to in profile position mode using the current settings of motion control parameters such as velocity, acceleration, and deceleration. The target position will be interpreted as absolute or relative depend on controlword [Position units].

Remarks
-

Related Objects
Controlword

14.73 Home offset

Name	home offset	
Index	0x607C	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	0	
Value range	-2147483648	2147483647

Description
The home offset is a moving distance in homing procedure. It is useful to move away from a detected position e.g. mechanical border or limit switch at the end of the homing sequence. This move could prevent the axis from a border damage respectively limit switch error.

Remarks
-

Related Objects
Home position

14.74 Software position limit

Name	software position limit	
Index	0x607D	
number of entries	0x02	

Name	minimal position limit	
Index	0x607D	
Sub-index	0x01	
Type	INTEGER32	
Access	RW	
Default Value	-2147483648	
Value range	-2147483648	2147483647

Description
Minimal position limit defines the absolute negative position limit for the position demand value [Position units]. If the desired or the actual position is lower then the negative position limit a software position limit Error will be launched.

Remarks
A value of -2147483648 disables the minimal position limit check.

Related Objects
-

Name	maximal position limit	
Index	0x607D	
Sub-index	0x02	
Type	INTEGER32	
Access	RW	
Default Value	2147483647	
Value range	-2147483648	2147483647

Description
Maximal position limit defines the absolute positive position limit for the position demand value [Position units]. If the desired or the actual position is higher then the positive position limit a software position limit Error will be launched.

Remarks
A value of 2147483647 disables the maximum position limit check.

Related Objects
-

14.75 Maximal profile velocity

Name	maximal profile velocity	
Index	0x607F	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	25000	
Value range	1	25000

Description
This value is used as velocity limit in a position (or velocity) profile move [Velocity units].

Remarks
-

Related Objects
-

14.76 Profile velocity

Name	profile velocity	
Index	0x6081	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	1000	
Value range	1	25000

Description
The profile velocity is the velocity normally attained at the end of the acceleration ramp during a profiled move [Velocity units].

Remarks
-

Related Objects
-

14.77 Profile acceleration

Name	profile acceleration	
Index	0x6083	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	1000	
Value range	1	4294967295

Description
This value is used as acceleration in a position (or velocity) profile move [Acceleration units].

Remarks
-

Related Objects
-

14.78 Profile deceleration

Name	profile deceleration	
Index	0x6084	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	10000	
Value range	1	4294967295

Description
This value is used as deceleration in a position (or velocity) profile move [Acceleration units].

Remarks
-

Related Objects
-

14.79 Quick stop deceleration

Name	quick stop deceleration	
Index	0x6085	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	10000	
Value range	1	4294967295

Description
The Quick stop deceleration is used with quickstop command given with the according Controlword. The quick stop deceleration is also used in fault reaction state when the quick-stop profile is allowed. The deceleration is given in Acceleration units.

Remarks
-

Related Objects
Controlword

14.80 Motion profile type

Name	motion profile type	
Index	0x6086	
Sub-index	0x00	
Type	INTEGER16	
Access	RW	
Default Value	0	
Value range	-	-

Description
This object selects the type of the motion profile for trajectories used in Profile Position Mode, Homing Mode or Profile Velocity Mode.

Remarks
-

Related Objects
-

Value	Motion profile type
0	linear ramp (trapezoidal profile)
1	$\sin^2$ ramp (sinusoidal profile)

Table 103: Motion profile types

14.81 Position notation index

Name	position notation index	
Index	0x6089	
Sub-index	0x00	
Type	INTEGER8	
Access	RW	
Default Value	0x00	
Value range	0x00	0x00

Description
The position notation index is used to scale the position objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 41: Factor group notation indices

14.82 Position dimension index

Name	position dimension index	
Index	0x608A	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	0xAC	
Value range	0xAC	0xAC

Description
The position dimension index is used to scale the position objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 40: Factor group dimension indices

14.83 Velocity notation index

Name	velocity notation index	
Index	0x608B	
Sub-index	0x00	
Type	INTEGER8	
Access	RW	
Default Value	0x00	
Value range	0x00	0x00

Description
The velocity notation index is used to scale the velocity objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 41: Factor group notation indices

14.84 Velocity dimension index

Name	velocity notation index	
Index	0x608C	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	0xA4	
Value range	0xA4	0xA4

Description
The velocity dimension index is used to scale the velocity objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 40: Factor group dimension indices

14.85 Acceleration notation index

Name	acceleration notification index	
Index	0x608D	
Sub-index	0x00	
Type	INTEGER8	
Access	RW	
Default Value	0x00	
Value range	0x00	0x00

Description
The acceleration notation index is used to scale the acceleration objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 41: Factor group notation indices

14.86 Acceleration dimension index

Name	acceleration dimension index	
Index	0x608E	
Sub-index	0x00	
Type	UNSIGNED8	
Access	RW	
Default Value	0xA4	
Value range	0xA4	0xA4

Description
The acceleration dimension index is used to scale the acceleration objects.

Remarks
Changes are only in disable state supported.

Related Objects
Table 40: Factor group dimension indices

14.87 Homing method

Name	homing method	
Index	0x6098	
Sub-index	0x00	
Type	INTEGER8	
Access	RW	
Default Value	7	
Value range	-	-

Description
The homing method can be selected by writing this object.

Remarks
-

Related Objects
-

Method Number	Description
35	Homing Method 35 (Actual Position)
34	Homing Method 33 and 34 (Index Negative / Positive Speed)
33	Homing Method 33 and 34 (Index Negative / Positive 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)
0	No homing operation required
-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 104: Homing methods

14.88 Homing speeds

Name	homing speeds	
Index	0x6099	
number of entries	0x02	

Name	speed for switch search	
Index	0x6099	
Sub-index	0x01	
Type	UNSIGNED32	
Access	RW	
Default Value	100	
Value range	0	4294967295

Description
This speed is used to search a limit switch in a homing sequence [Velocity units].

Remarks
-

Related Objects
-

Name	speed for zero search	
Index	0x6099	
Sub-index	0x02	
Type	UNSIGNED32	
Access	RW	
Default Value	10	
Value range	0	4294967295

Description
This speed is used to search the index in a homing sequence [Velocity units].

Remarks
-

Related Objects
-

14.89 Homing acceleration

Name	homing acceleration	
Index	0x609A	
Sub-index	0x00	
Type	UNSIGNED32	
Access	RW	
Default Value	1000	
Value range	0	4294967295

Description
This acceleration is used for the acceleration and deceleration ramps in the homing profile moves [Acceleration units].

Remarks
-

Related Objects
-

14.90 Current control parameter set

Name	current control parameter set
Index	0x60F6
number of entries	0x02

Description
Current control is done by a digital PI-Regulator

Name	current regulator P-gain	
Index	0x60F6	
Sub-index	0x01	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description

This parameter represents the proportional gain of the current controller.

Remarks

-

Related Objects

-

Name	current regulator I-gain	
Index	0x60F6	
Sub-index	0x02	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description

This parameter represents the integral gain of the current controller.

Remarks

-

Related Objects

-

14.91 Velocity control parameter set

Name	velocity control parameter set
Index	0x60F9
number of entries	0x02

Description

Velocity control is done by a digital PI-Regulator

Name	velocity regulator P-gain	
Index	0x60F9	
Sub-index	0x01	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description

This parameter represents the proportional gain of the velocity controller.

Remarks

-

Related Objects

-

Name	velocity regulator I-gain	
Index	0x60F9	
Sub-index	0x02	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description
This parameter represents the integral gain of the velocity controller.
Remarks
-
Related Objects
-

14.92 Position control parameter set

Name	position control parameter set
Index	0x60FB
number of entries	0x05

Description
Position control is done by a digital PID-Regulator

Name	position regulator P-gain	
Index	0x60FB	
Sub-index	0x01	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description
This parameter represents the proportional gain of the position controller.
Remarks
-
Related Objects
-

Name	position regulator I-gain	
Index	0x60FB	
Sub-index	0x02	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description
This parameter represents the integral gain of the position controller.

Remarks
-

Related Objects
-

Name	position regulator D-gain	
Index	0x60FB	
Sub-index	0x03	
Type	INTEGER16	
Access	RW	
Default Value	depend on hardware	
Value range	0	32767

Description
This parameter represents the differential gain of the position controller.

Remarks
-

Related Objects
-

Name	velocity feed forward factor	
Index	0x60FB	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	65535

Description
This parameter represents the velocity feed forward factor of the position controller.

Remarks
-

Related Objects
-

Name	acceleration feed forward factor	
Index	0x60FB	
Sub-index	0x05	
Type	UNSIGNED16	
Access	RW	
Default Value	0	
Value range	0	65535

Description
This parameter represents the acceleration feed forward factor of the position controller.

Remarks
-

Related Objects
-

14.93 Target velocity

Name	target velocity	
Index	0x60FF	
Sub-index	0x00	
Type	INTEGER32	
Access	RW	
Default Value	-	
Value range	-2147483648	2147483647

Description
The target velocity is the input for the trajectory generator [Velocity units].

Remarks
-

Related Objects
-

14.94 Motor type

Name	motor type	
Index	0x6402	
Sub-index	0x00	
Type	UNSIGNED16	
Access	RW	
Default Value	10	
Value range	see Table 105	

Description
The type of the motor driven by this controller has to be selected.

Remarks
If the sensor type 'Hall Sensors' (code 3) is selected in Sensor Configuration no other motor type then 'Trapezoidal PM BL motor' (code 11) can be selected. In this case please change the sensor type first to change the motor type.

Changes are only in disable state supported.

Not changeable for MCD EPOS 60 W.

Related Objects
-

Value	DS-402 Motor Type	Description
1	Phase modulated DC motor	brushed DC motor
10	Sinusoidal PM BL motor	EC motor sinus commutated
11	Trapezoidal PM BL motor	EC motor block commutated

Table 105: Motor types

14.95 Motor data

Name	motor data	
Index	0x6410	
number of entries	0x06	

Name	continuous current limit	
Index	0x6410	
Sub-index	0x01	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	depends on hardware

Description
This object represents the maximal permissible continuous current of the motor [mA]. Operation the motor continuously 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. Depending how the motor is mounted, this value can be increased substantially.

Remarks
See also the specification of your motor in maxon motor catalogue.

Related Objects
-

Name	output current limit	
Index	0x6410	
Sub-index	0x02	
Type	UNSIGNED16	
Access	RW	
Default Value	depends on hardware	
Value range	0	depends on hardware

Description
It is recommended to set the output current limit to a value doubles of continuous current limit [mA].

Remarks
-

Related Objects
-

Name	pole pair number	
Index	0x6410	
Sub-index	0x03	
Type	UNSIGNED8	
Access	RW	
Default Value	1	
Value range	1	255

Description
Number of magnetic pole pairs (number of poles / 2) from rotor of a brushless DC motor.

Remarks
Not changeable for MCD EPOS 60 W.

Changes are only in disable state supported.

Related Objects
-

Name	maximal speed in current mode	
Index	0x6410	
Sub-index	0x04	
Type	UNSIGNED16	
Access	RW	
Default Value	30000	
Value range	1	65535

Description
To prevent mechanical destroys in current mode it is possible to limit the velocity [rpm].

Remarks
Speed Regulator has to be well tuned for correct function of speed limitation in current mode.

Related Objects
-

Name	thermal time constant winding	
Index	0x6410	
Sub-index	0x05	
Type	UNSIGNED16	
Access	RW	
Default Value	40	
Value range	1	1440 (EPOS 24/1), 5400 (24/5, 70/10, MCD EPOS 60 W)

Description
The thermal time constant of motor winding is used to calculate the time how long the maximal output current is allowed for the connected motor [100 ms].

Remarks
Example: If a time constant of 4 seconds is desired a value of 40 has to be set.

Not changeable for MCD EPOS 60 W.

Related Objects
-

14.96 Supported drive modes

Name	supported drive modes
Index	0x6502
Sub-index	0x00
Type	UNSIGNED32
Access	CONST
Default Value	40
Value range	0x003F0025

Description
This object gives an overview of the implemented operating modes in the device.

This code means that the Profile Position Mode, the Homing Mode and the Profile Velocity Mode of the CANopen Profile DSP 402 are supported. Additionally the maxon motor specific Position Mode, Master-Encoder Mode, Step/Direction Mode, Velocity Mode, Current Mode and a special Diagnostic Mode are implemented.

Remarks
-

Related Objects
-

Bits 31 -22	21	20	19	18	17	16	Bits 15 -7	6	5	4	3	2	1	0
reserved	Maxon Step/Direction Mode	Maxon MasterEncoder Mode	Maxon Diagnostic Mode	Maxon Current Mode	Maxon Velocity Mode	Maxon Position Mode	reserved	(Interpolated Position Mode)	Homing Mode	reserved	(Torque Mode)	Profile Velocity Mode	(CANopen Velocity Mode)	Profile Position Mode
0 - 0	1	1	1	1	1	1	0 - 0	0	1	0	0	1	0	1

Table 106: Supported drive modes bits

14.97 Object dictionary overview

Index	Name	Data type	Access type	Configuration parameter
0x1000	Device type	UNSIGNED32	RO	
0x1001	Error register	UNSIGNED8	RO	
0x1003	Error history	ARRAY	RO	
0x1005	COB-ID SYNC	UNSIGNED32	RW	
0x1008	Manufacturer device name	VISIBLE_STRING	CONST	
0x100C	Guard time	UNSIGNED16	RW	X
0x100D	Life time factor	UNSIGNED8	RW	X
0x1010	Store	ARRAY	RW	
0x1011	Restore default parameters	ARRAY	RW	
0x1014	COB-ID EMCY	UNSIGNED32	RO	
0x1016	Consumer Heartbeat Time	ARRAY	RW	X
0x1017	Producer Heartbeat Time	UNSIGNED16	RW	X
0x1018	Identity object	RECORD	RO	
0x1020	Verify Configuration	ARRAY	RW	
0x1200	Server SDO parameter	RECORD	RO	
0x1400	Receive PDO 1 parameter	RECORD	RW	X
0x1401	Receive PDO 2 parameter	RECORD	RW	X
0x1402	Receive PDO 3 parameter	RECORD	RW	X
0x1403	Receive PDO 4 parameter	RECORD	RW	X
0x1600	Receive PDO 1 mapping	RECORD	RW	X
0x1601	Receive PDO 2 mapping	RECORD	RW	X
0x1602	Receive PDO 3 mapping	RECORD	RW	X
0x1603	Receive PDO 4 mapping	RECORD	RW	X
0x1800	Transmit PDO 1 parameter	RECORD	RW	X
0x1801	Transmit PDO 2 parameter	RECORD	RW	X
0x1802	Transmit PDO 3 parameter	RECORD	RW	X
0x1803	Transmit PDO 4 parameter	RECORD	RW	X
0x1A00	Transmit PDO 1 mapping	RECORD	RW	X
0x1A01	Transmit PDO 2 mapping	RECORD	RW	X
0x1A02	Transmit PDO 3 mapping	RECORD	RW	X
0x1A03	Transmit PDO 4 mapping	RECORD	RW	X
0x2000	Node ID	UNSIGNED8	RW	
0x2001	CAN Bitrate	UNSIGNED16	RW	
0x2002	RS232 Baudrate	UNSIGNED16	RW	
0x2003	Version	RECORD	RO	
0x2004	Serial Number	UNSIGNED64	CONST	

Index	Name	Data type	Access type	Configuration parameter
0x2005	RS232 Frame Timeout	UNSIGNED16	RW	
0x2008	Miscellaneous Configuration	UNSIGNED16	RW	X
0x200C	Custom persistent memory	RECORD	RW	X
0x2021	Encoder counter at index pulse	UNSIGNED16	RO	
0x2022	Hallsensor pattern	UNSIGNED16	RO	
0x2027	Current actual value averaged	INTEGER16	RO	
0x2028	Velocity actual value averaged	INTEGER32	RO	
0x2030	Current mode setting value	INTEGER16	RW	
0x2062	Position mode setting value	INTEGER32	RW	
0x206B	Velocity mode setting value	INTEGER32	RW	
0x2070	Configuration of digital inputs	RECORD	RW	X
0x2071	Digital Input Functionalities	RECORD	RW	X
0x2074	Position Marker	RECORD	RO	X
0x2078	Digital Output Functionalities	RECORD	RW	X
0x2079	Configuration of digital outputs	RECORD	RW	X
0x207C	Analog Inputs	RECORD	RO	
0x2080	Current Threshold for Homing Mode	UNSIGNED16	RW	X
0x2081	Home position	UNSIGNED32	RW	
0x20F4	Following Error Actual Value	INTEGER16	RO	
0x2210	Sensor Configuration	RECORD	RW	X
0x2300	Digital Position Input	RECORD	RW	X
0x6040	Controlword	UNSIGNED16	RW	
0x6041	Statusword	UNSIGNED16	RO	
0x6060	Modes of operation	INTEGER8	RW	
0x6061	Modes of operation display	INTEGER8	RO	
0x6062	Position demand value	INTEGER32	RO	
0x6064	Position actual value	INTEGER32	RO	
0x6065	Maximal following error	UNSIGNED32	RW	X
0x6067	Position Window	UNSIGNED32	RW	X
0x6068	Position Window Time	UNSIGNED16	RW	X
0x6069	Velocity sensor actual value	INTEGER32	RO	
0x606B	Velocity demand value	INTEGER32	RO	
0x606C	Velocity actual value	INTEGER32	RO	
0x6078	Current actual value	INTEGER16	RO	
0x607A	Target position	INTEGER32	RW	
0x607C	Home offset	INTEGER32	RW	X
0x607D	Software position limit	ARRAY	RW	X

Index	Name	Data type	Access type	Configuration parameter
0x607F	Maximal profile velocity	UNSIGNED32	RW	X
0x6081	Profile velocity	UNSIGNED32	RW	
0x6083	Profile acceleration	UNSIGNED32	RW	
0x6084	Profile deceleration	UNSIGNED32	RW	
0x6085	Quick stop deceleration	UNSIGNED32	RW	
0x6086	Motion profile type	INTEGER16	RW	X
0x6089	Position notation index	INTEGER8	RW	
0x608A	Position dimension index	UNSIGNED8	RW	
0x608B	Velocity notation index	INTEGER8	RW	
0x608C	Velocity dimension index	UNSIGNED8	RW	
0x608D	Acceleration notation index	INTEGER8	RW	
0x608E	Acceleration dimension index	UNSIGNED8	RW	
0x6098	Homing method	INTEGER8	RW	X
0x6099	Homing speeds	ARRAY	RW	X
0x609A	Homing acceleration	UNSIGNED32	RW	X
0x60F6	Current control parameter set	RECORD	RW	X
0x60F9	Velocity control parameter set	ARRAY	RW	X
0x60FB	Position control parameter set	RECORD	RW	X
0x60FF	Target velocity	INTEGER32	RW	
0x6402	Motor type	UNSIGNED16	RW	X
0x6410	Motor data	RECORD	RW	X
0x6502	Supported drive modes	UNSIGNED32	CONST	

Table 107: Object dictionary overview

Type	Description	Size [Bits]	Range
INTEGER8	Signed Integer	8	-128 .. 127
INTEGER16	Signed Integer	16	-32768 .. 32767
INTEGER32	Signed Integer	32	-2 147 483 648 .. 2 147 483 647
UNSIGNED8	Unsigned Integer	8	0 .. 255
UNSIGNED16	Unsigned Integer	16	0 .. 65 535
UNSIGNED32	Unsigned Integer	32	0 .. 4 294 967 265
UNSIGNED64	Unsigned Integer	64	0 .. 18 446 744 073 709 551 615
VISIBLE_STRING	Array of (8-Bit) characters	n * 8	-
RECORD	Structure of other Types	-	-

Table 108: Object data types

Attribute	Description
RW	read and write access
RO	read only access
CONST	read only access, value is constant

Table 109: Object access types

15 Firmware Version History

15.1 Firmware Version Overview

Date	Software Version	Hardware Version	Application Number	Application Version	Description
11.11.2003	2000h	6010h, 6210h	0000h	0000h	First Firmware Release
04.12.2003	2000h	6010h, 6210h	0000h	0004h	Bug Fixing
01.04.2004	2010h	6010h, 6210h, 6410h	0000h	0000h	New Features
23.04.2004	2011h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
19.07.2004	2012h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
18.01.2005	2020h	6010h, 6210h, 6410h	0000h	0000h	New Features, Bug Fixing
24.01.2005	2021h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
02.05.2005	2022h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
07.02.2006	2023h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
26.04.2006	2024h	6010h, 6210h, 6410h	0000h	0000h	Bug Fixing
01.05.2006	2030h	6010h, 6210h, 6211h, 6410h	0000h	0000h	New features, support of new hardware revision, bug fixing
19.06.2006	2031h	6010h, 6210h, 6211h, 6410h, 6610h	0000h	0000h	Support of new hardware
10.11.2006	2032h	6010h, 6210h, 6211h, 6410h, 6610h	0000h	0000h	Bug Fixing
01.06.2007	2033h	6010h, 6210h, 6211h, 6410h, 6610h	0000h	0000h	Bug Fixing

Table 110: Firmware Versions Overview

15.2 Software Version 2000h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2000h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2000h_6210h_0000h_0000h.bin

Description Changes

Change	Description
No Change	This version is the base version

Description New Features

New Feature	Description
No New Feature	This version is the base version

15.3 Software Version 2000h, Application Version 0004h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2000h_6010h_0000h_0004h.bin
EPOS 24/5	Epos_2000h_6210h_0000h_0004h.bin

Description Changes

Change	Description
BugFix	Detection of mounted EPOS 24/1 adapter. Has only effect at restore all default parameters.
EDS-File	Format adaptations in embedded EDS-File (electronic data sheet).

Description New Features

New Feature	Description
No New Feature	No New Feature

15.4 Software Version 2010h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2010h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2010h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2010h_6410h_0000h_0000h.bin

Description Changes

Change	Description
RS232 Command Set	New RS232 command set supporting gateway functionality. See document 'Communication Guide'. **Remark: The old command set is NO more supported!**
Digital Output Configuration	The default configuration of the digital outputs is changed. Bit 12 instead of bit 0 is default configuration for Digital Output 4. Configuration of digital outputs (Object 0x2079)

Description New Features

New Feature	Description
Operation Modes	Master Encoder Mode Step/Direction Mode Modes of operation (Object 0x6060)
Motor Type	EC motor with block commutation (Trapezoidal PM BL motor) Motor type (Object 0x6402)
Position Sensor Type	Hall Sensors Sensor Configuration (Object 0x2210)
Gateway RS232 to CAN	New gateway functionality. RS232 command set changed. See document 'Communication Guide'
Encoder Supervision	New Encoder position sensor supervision for DC motors and EC motors with block commutation (Trapezoidal PMBL motors). Can be disabled by writing to the object Miscellaneous Configuration (Object 0x2008).
Position Marker	New position marker functionality. Position Marker (Object 0x2074)

Home Position	New Object for Homing Mode. At the end of the homing procedure the actual position is set to the value of Home Position. Home position (Object 0x2081)
Statusbit 'Referenced'	New Statusbit (Statusword bit 15) to indicate absolute position is referenced to Home. Statusword (Object 0x6041)
Digital Input Functionality 'Device Enable'	New functionality 'Device Enable' for digital inputs. By default this functionality is not activated. Digital Inputs Configuration of digital inputs (Object 0x2070)
Digital Output Configuration	The digital outputs can be mapped to different functionalities. By default the digital outputs are mapped to general purpose. Digital Outputs
Digital Output Functionality 'Ready'	New functionality 'Ready' for digital outputs. By default this functionality is not activated. Digital Outputs Configuration of digital outputs (Object 0x2079)
Software Parameter Error	New Error 'Software Parameter'. Too high Target Position with too low Profile Velocity. Software Parameter Error (Error Code 0x6320)

15.5 Software Version 2011h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2011h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2011h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2011h_6410h_0000h_0000h.bin

Description Changes

Change	Description
BugFix	PDO Communication: position commanding in Profile Position Mode
BugFix	Unexpected occurrence of Software Position Limit Error

Description New Features

New Feature	Description
No New Feature	No New Feature

15.6 Software Version 2012h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2012h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2012h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2012h_6410h_0000h_0000h.bin

Description Changes

Change	Description
BugFix	Enable Life Guarding Functionality also after restart
BugFix	Digital Output Set Function: Allow setting of digital outputs also with PDO
BugFix	EPOS 70/10: Polarity of digital output 4 corrected
BugFix	EPOS 70/10: Block commutation corrected
BugFix	Digital Output Functionalities Mask behaviour corrected
BugFix	Current Actual Values will be cleared on disable Current actual value (Object 0x6078 sub-index 0x00) Current actual value averaged (Object 0x2027 sub-index 0x00)
BugFix	EPOS 24/1 Default for EC6: Current reduced to 100/200mA, Thermal Time Constant to 5 (0.5s)

Description New Features

New Feature	Description
No New Feature	No New Feature

15.7 Software Version 2020h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2020h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2020h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2020h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Motor / sensor configuration	The Motor type and sensor type in Sensor Configuration can be setup now without prior storing parameters and restart.
Encoder supervision	The hardware encoder supervision of EPOS 70/10 can be deactivated also (Miscellaneous Configuration). The software encoder supervision algorithm is improved (EPOS 24/1, EPOS 24/5).
PDO Cob-IDs	The COB-IDs can be changed without storing of the parameters The COB-IDs are coupled to the device Node ID by default
PDO mapping	All the 4 receive and the 4 transmit PDOs are full dynamic mappable. The group of the mappable objects is supplemented. (Table 57, Table 77)
Encoder / hall sensor polarity	The polarity of the position sensor (encoder) and the polarity of the hallsensors are configurable in Sensor Configuration.
Homing	The Software position limit is deactivated during a homing mode
Position Marker	The Position Marker is interrupt driven now if one of the high-speed inputs is used. A position history is implemented.
Digital Input	The digital inputs are filtered additionally by software to prevent that signal spikes disturbs the execution of Digital Input Functionalities such as Position Marker.
ThermalTimeConstant	The parameter ‘thermal time constant winding’ in Motor data is limited to a reasonable value.
Error Handling	New Errors CAN PDO length Error and System Overloaded.
Remote	The Remote bit of the Statusword shows the NMT state ‘operational’
Bugfix	In Step/Direction Mode the counting direction of ‘Digital Position Desired Value’ (Digital Position Input) is corrected for the EPOS 70/10.
Bugfix	Bad hall sensor states during operation produces a Hall Sensor Error (no longer a Hall Angle detection Error)

Bugfix	The 'New set-point' bit in Controlword (Profile Position Mode specific bits) and the ' Set-point acknowledge' bit in Statusword (Profile Position Mode specific bits) are handled now as specified in CiA standard DSP-402
Bugfix	The default values of the controller parameters are adapted to give stable start conditions for a wider field of motors (also for auto tuning).
Bugfix	The word order of the error code in the RS232 communication response data is corrected.

Description New Features

New Feature	Description
Sinusoidal profile	A sinusoidal trajectory generator can be selected by Motion profile type.
Feed forward	The position controller is extended by velocity and acceleration feed forward parameters in Position control parameter set.
Event triggered PDOs	The transmit PDOs can be configured as event triggered by setting the transmission type (e.g. in Transmit PDO 1 parameter) to 255.
Following error actual	The new object Following Error Actual Value displays the actual value of the position controller error.
Position window	The behaviour of the position reached status flag in Profile Position Mode can be configured by Position Window and Position Window Time.
Heartbeating	The heartbeat protocol can be configured with Producer Heartbeat Time.
Custom Memory	The Custom persistent memory can be used to store custom data's
Velocity measurement	A exacting and less noisy velocity measurement based on encoder pulse time can be enabled by bit 3 of Miscellaneous Configuration
Serial Number	The device serial number is shown in Serial Number
Firmware download over CAN	The firmware can be downloaded over the CAN bus also (e.g. via a Gateway) if a firmware version 2020h or higher is already on the EPOS.

15.8 Software Version 2021h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2021h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2021h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2021h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	The receive PDOs work correct with more then one object mapped also.

15.9 Software Version 2022h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2022h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2022h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2022h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	Communication abort codes over the built-in gateway unswaped
Bugfix	The bad response to node-guard and PDO requests on some EPOS is fixed
Bugfix	The position controller works now in Position Mode, MasterEncoder Mode and Step/Direction Mode also with higher velocities correct
Bugfix	Proper digital output levels during start-up
Bugfix	Range checking of Maximal profile velocity and Profile velocity corrected
Bugfix	The static limit switch check works in Position Mode, Velocity Mode, MasterEncoder Mode and Step/Direction Mode also
Bugfix	All position sensor errors will be detected correct
Bugfix	Correct firmware version in Electronic Data Sheet file

15.10 Software Version 2023h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2023h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2023h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2023h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	Correct handling of large displacements on limit switch still active
Bugfix	Running homing is untroubled by a position marker occurrence
Bugfix	CAN receives PDOs with more then one objects with byte length correct
Bugfix	CAN SDO expedited write with bad length code will be rejected
Bugfix	CAN SDO write to byte objects works with overlong data also
Bugfix	maximal speed in current mode within object Motor data rejects zero value
Bugfix	Current mode setting value will be evaluated at writing of new value
Bugfix	Hallsensor pattern will be updated in diagnostic mode for motor type 11 also
Bugfix	Following error disables correct when position window is defined and motor is blocked also
Replaced	New order code #317270 replaces #280938 (new EPOS 24/1 for EC6)

15.11 Software Version 2024h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2024h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2024h_6210h_0000h_0000h.bin
EPOS 70/10	Epos_2024h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	Speedlimit in Current Mode works for motor types 0x11 and 0x01 also
Bugfix	Homingmodes 0x11 and 0x27 (Home Switch Negative Speed w/wo Index) works again

15.12 Software Version 2030h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2030h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2030h_6210h_0000h_0000h.bin Epos_2030h_6211h_0000h_0000h.bin
EPOS 70/10	Epos_2030h_6410h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	The Software position limits take effect to the actual position (additional to the desired position)
Bugfix	The quickstop in PVM works now
Bugfix	Device type has access type RO in eds-file
Bugfix	Master Encoder mode and Step/Direction mode are shown in Supported drive modes also
PDO	The valid bit of the PDO COB-ID objects (0x1400sub1 to 0x1403sub1 and 0x1800sub1 to 0x1803sub1) will be evaluated. The default values for the PDO parameter objects are adapted.
Documentation	The documentation and help files will be delivered in a special file. (The bin-file does no longer include the documentation files which slashes the file-size)

Description New Features

New Feature	Description
Verify configuration	New object Verify Configuration to check configuration consistence
Heartbeat Consumer	Two Consumer Heartbeat Time can be setup to guarding two separate nodes
CAN Error Code	The new error code 0x8150 signals a CAN transmit COB-ID problem
Digital Inputs	A dummy value for Configuration of digital inputs simplifies the configuration.

15.13 Software Version 2031h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2031h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2031h_6210h_0000h_0000h.bin Epos_2031h_6211h_0000h_0000h.bin
EPOS 70/10	Epos_2031h_6410h_0000h_0000h.bin
MCD EPOS 60 W	Epos_2031h_6610h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	Heartbeat consumer 2 (Consumer Heartbeat Time)
Bugfix	Step/Direction Mode direction corrected
Bugfix	Set motor windings to high-impedance in all power disabled states
Bugfix	Influence of data recorder to speed controller reduced
Bugfix	Current peak at first enabling of block-commutated motor (motor type 0x11) removed
Hall Angle Detection Error	Improvement of Rotor angle initialisation algorithm reduces “Hall Angle detection” errors (Hall Angle Detection Error)
Current Mode Speed Limit	Improvement of speed limit algorithm (Motor data maximal speed in current mode) in Current Mode (speed controller should be still well-tuned!)

Description New Features

New Feature	Description
MCD EPOS 60 W	Support of new Product
LSS	Node ID detection with LSS (only MCD EPOS 60 W)

15.14 Software Version 2032h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2032h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2032h_6210h_0000h_0000h.bin Epos_2032h_6211h_0000h_0000h.bin
EPOS 70/10	Epos_2032h_6410h_0000h_0000h.bin
MCD EPOS 60 W	Epos_2032h_6610h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	Profile Velocity Mode direction change trajectory corrected
Bugfix	The quickstop deceleration is also used on fault in Homing Mode
Bugfix	Maximal profile velocity access corrected
Bugfix	Event triggered PDOs will be sent first time at changing to Operational
Bugfix	Accessory errors will be already handled during fault reaction state
Bugfix	A Emergency Message Frame with Error Code 0 will be sent if all Error getting cleared

Bugfix	dummy PDO COB-IDs (not valid and value 0) can be written now
Bugfix	Verify Configuration depends on configuration parameter objects only
Bugfix	Restore default parameters retains Node ID value if LSS is supported
Bugfix	Homing and Position Marker functionalities on DigIn 2 & 3 corrected for MCD EPOS 60 W
Bugfix	Changing of motor parameters is blocked on MCD EPOS 60 W
Bugfix	minor LSS adaption on MCD EPOS 60 W (on leaving LSS state machine after saving valid Node ID)
Statusword	Internal limit active flag (bit 11) in Statusword implemented
Data Recorder	Data Recorder entries in object dictionary are invisible now
Electronic datasheet	minor changes / bugfixes in the eds-file

15.15 Software Version 2033h

Binary Files

Hardware	Firmware Filename
EPOS 24/1	Epos_2033h_6010h_0000h_0000h.bin
EPOS 24/5	Epos_2033h_6210h_0000h_0000h.bin Epos_2033h_6211h_0000h_0000h.bin
EPOS 70/10	Epos_2033h_6410h_0000h_0000h.bin
MCD EPOS 60 W	Epos_2033h_6610h_0000h_0000h.bin

Description Changes

Change	Description
Bugfix	CAN communication at higher busload: sporadic losing of TxSDO, RxPDO or TxPDO solved
Bugfix	Restore Default Parameters does not reset Node ID
Bugfix	Encoder index processing improved (bounce immunity for bad index pulses)
Bugfix	CAN recovery from bus off state adapted
Bugfix	Changing of all fixed motor parameters is blocked (MCD EPOS 60 W only)
Bugfix	Encoder resolution of 500 is allowed additionally (MCD EPOS 60 W only)
Electronic datasheet	Minor changes / bugfixes in the eds-file