

# AKD®

## EtherCAT Communication



Edition: U, October 2020

Valid for firmware version 1.20

Part Number 903-200005-00

Original Documentation

# EtherCAT®



For safe and proper use, follow these instructions. Keep for future use.

**KOLLMORGEN**®

*Because Motion Matters™*

## Record of Document Revisions

| Revision   | Remarks  |
|------------|--|
| ...        | Table with lifecycle information of this document see "Record of Document Revisions" (→ p. 176)  |
| R, 11/2018 | Updated warning symbols.   |
| T, 11/2019 | Updated Emergency Service Changes, RX PDO size limitation and FBUS.PARAM05. Added Objects 2080h and 2081h, and example for Flexible PDO Mapping. |
| U, 10/2020 | Added objects 34D1h, 547Ah, 547Bh and edited to data type for objects 2001h and 2012   |

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## Current patents

- US Patent 8,154,228 (Dynamic Braking For Electric Motors)
- US Patent 8,214,063 (Auto-tune of a Control System Based on Frequency Response)

### **Technical changes which improve the performance of the device may be made without prior notice!**

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## 2 General

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## 2.1 About this Manual

This manual, *AKD EtherCAT Communication*, describes the installation, setup, range of functions, and software protocol for the EtherCAT AKD product series. All AKD EtherCAT drives have built-in EtherCAT functionality; therefore, an additional option card is not required.

A digital version of this manual (pdf format) is available on the DVD included with your drive. Manual updates can be downloaded from the Kollmorgen website.

Related documents for the AKD series include:

- *AKD Installation Manual* This manual provides instructions for installation and drive setup.
- *AKD WorkBench Online Help*. This manual describes how to use your drive in common applications. It also provides tips for maximizing your system performance with the AKD. It includes the *Parameter and Command Reference Guide* which provides documentation for the parameters and commands used to program the AKD.
- *AKD EtherCAT Communications Manual*. This manual describes the CAN communication and delivers a lot of information for CAN over EtherCAT communication.
- *Accessories Manual*. This manual provides documentation for accessories like cables and regen resistors used with AKD. Regional versions of this manual exist.

Additionally, an EtherCAT XML file, entitled *AKD EtherCAT Device Description*, describes the drive SDO and PDO. This file is available on the Kollmorgen website (part of the firmware zip archive).

## 2.2 Target Group









This manual addresses personnel with the following qualifications:

- Installation: only by electrically qualified personnel.
- Setup: only by qualified personnel with extensive knowledge of electrical engineering and drive technology.
- Programming: software developers, project-planners.

The qualified personnel must know and observe the following standards:

- ISO 12100, IEC 60364 and IEC 60664
- National accident prevention regulations

## 2.3 Symbols Used

| Symbol   | Indication   |
|--|--|
|  <b>DANGER</b>  | Indicates a hazardous situation which, if not avoided, will result in death or serious injury.   |
|  <b>WARNING</b> | Indicates a hazardous situation which, if not avoided, could result in death or serious injury.  |
|  <b>CAUTION</b> | Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
| <b>NOTICE</b>  | Indicates situations which, if not avoided, could result in property damage.                     |
| <b>NOTE</b>  | This symbol indicates important notes.   |
|                 | Warning of a danger (general). The type of danger is specified by the text next to the symbol.   |
|                 | Warning of danger from electricity and its effects.  |
|                 | Warning of danger from suspended loads.  |
|               | Warning of danger from high temperature.   |
|               | Warning of danger from automatic start.  |

## 2.4 Abbreviations Used

| Abbreviation | Meaning  |
|--------------|--|
| AL           | Application Layer: the protocol that directly used by the process entities.  |
| Cat          | Category – classification for cables that is also used in Ethernet.  |
| DC           | Distributed Clocks Mechanism to synchronize EtherCAT slaves and master   |
| DL           | Data Link(=Layer 2). EtherCAT uses standardized Ethernet (IEEE 802.3)  |
| ESC          | EtherCAT Slave Controller  |
| FPGA         | Field Programmable Gate Array  |
| FTP          | File Transfer Protocol   |
| HW           | Hardware   |
| ICMP         | Internet Control Message Protocol: Mechanisms for signaling IP errors.   |
| IEC          | International Electrotechnical Commission: The international standards   |
| IEEE         | Institute of Electrical and Electronics Engineers, Inc.  |
| LLDP         | Link Layer Discovery Protocol  |
| MAC          | Media Access Control   |
| MII          | Media Independent Interface: Standardized interface Ethernet controller <-> routing equipment.   |
| MDI          | Media Dependant Interface: Use of connector Pins and Signaling.  |
| MDI-X        | Media Dependant Interface (crossed): Use of connector Pins and Signaling with crossed lines.   |
| OSI          | Open System Interconnect   |
| OUI          | Organizationally Unique Identifier – the first 3 Bytes of an Ethernet-Address, that will be assign to companies or organizations and can be used for protocoll identifiers as well (e.g. LLDP) |
| PDI          | Physical Device Interface: set of elements that allows access to ESC from the process side.  |
| PDO          | Process Data Object  |
| PDU          | Protocol Data Unit: Contains protocol information transferred from a protocol instance of transparent data to a subordinate level  |
| PHY          | Physical interface that converts data from the Ethernet controller to electric or optical signals.   |
| PLL          | Phase Locked Loop  |
| PTP          | Precision Time Protocol in accordance with IEEE 1588   |
| RSTP         | Rapid Spanning Tree Protocol   |
| RT           | Real-time, can be run in Ethernet controllers without special support.   |
| RX           | Receive  |
| RXPDO        | Receive PDO  |
| SNMP         | Simple Network Management Protocol   |
| SPI          | Serial Peripheral Interface  |
| Src Addr     | Source Address: Source address of a message.   |
| STP          | Shielded Twisted Pair  |
| TCP          | Transmission Control Protocol  |
| TX           | Transmit   |
| TXPDO        | Transmit PDO   |
| UDP          | User Datagram Protocol: Non-secure multicast/broadcast frame.  |
| UTP          | Unshielded Twisted Pair  |
| ZA ECAT      | Access mode EtherCAT   |
| ZA Drive     | Acces mode drive   |

## 3 Installation and Setup

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### 3.1 Important Instructions



#### **⚠ DANGER** High Voltage up to 900 V!

There is a danger of serious personal injury or death by electrical shock or electrical arcing. Capacitors can still have dangerous voltages present up to 7 minutes after switching off the supply power. Control and power connections can still be live, even if the motor is not rotating.

- Never remove electrical connections to the drive while it is live.
- Wait at least seven minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (e.g. contacts) or undoing any connections.
- To be sure, measure the voltage in the DC bus link and wait until it has fallen below 50 V.



#### **⚠ WARNING** Automatic Restart!

Risk of death or serious injury for humans working in the machine. Drives with EtherCAT are remote-controlled machines. They can start to move at any time without previous warning. The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting.

- Place a warning sign ("WARNING: Possible Automatic Start" or similar) to the machine.
- Ensure, that power on is not possible, while humans are in a dangerous zone of the machine.

#### **NOTICE**

Install the drive as described in the *Installation Manual*. The wiring for the analog setpoint input and the positioning interface, as shown in the wiring diagram in the *Installation Manual*, is not required. Never break any of the electrical connections to the drive while it is live. This action can result in destruction of the electronics.

#### **NOTICE**

The drive's status must be monitored by the PLC to acknowledge critical situations. Wire the FAULT contact in series into the emergency stop circuit of the installation. The emergency stop circuit must operate the supply contactor.

#### **NOTE**

It is permissible to use the setup software to alter the settings of the drive. Any other alterations will invalidate the warranty. Because of the internal representation of the position-control parameters, the position controller can only be operated if the final limit speed of the drive does not exceed:

#### **rotary**

at sinusoidal<sup>2</sup> commutation: 7500 rpm

at trapezoidal commutation: 12000 rpm.

#### **linear**

at sinusoidal<sup>2</sup> commutation: 4 m/s

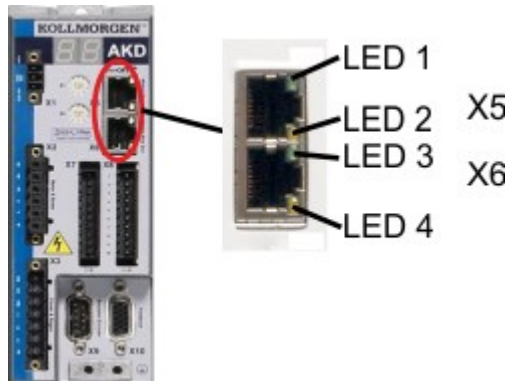
at trapezoidal commutation: 6.25 m/s

#### **NOTE**

All the data on resolution, step size, positioning accuracy etc. refer to calculatory values. Non-linearities in the mechanism (backlash, flexing, etc.) are not taken into account. If the final limit speed of the motor must be altered, then all the parameters that were previously entered for position control and motion blocks must be adapted.

### 3.2 EtherCAT Onboard

Connection to the EtherCAT Network via X5 (in port) and X6 (out port).



#### 3.2.1 LED functions

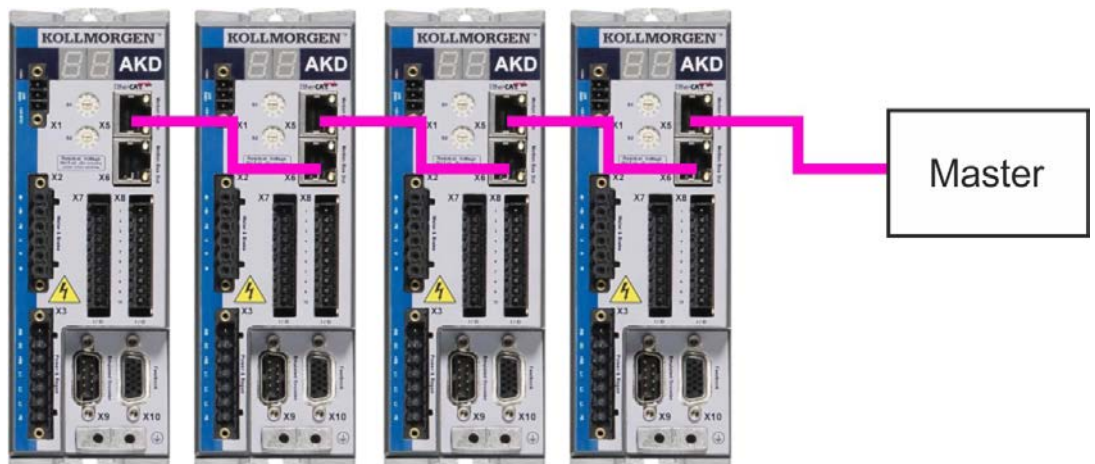
The communication status is indicated by the built-in LEDs.

| Connector | LED# | Name          | Function                          |
|-----------|------|---------------|-----------------------------------|
| X5        | LED1 | IN port Link  | ON = active<br>OFF = not active   |
|           | LED2 | RUN           | ON = running<br>OFF = not running |
| X6        | LED3 | OUT port Link | ON = active<br>OFF = not active   |
|           | LED4 | -             | -                                 |

#### 3.2.2 Connection technology

You can connect to the EtherCAT network using RJ-45 connectors.

#### 3.2.3 Network Connection Example



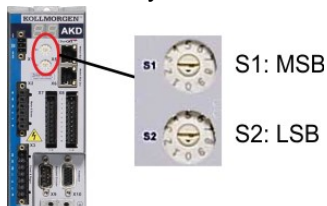
### 3.3 EtherCAT activation with AKD-CC models

AKD-CC drive models are Drives, which support EtherCAT and CAN fieldbus types within one common software. CC drive models are delivered with EtherCAT set active. If you must change a drive from CANopen to EtherCAT, the DRV.TYPE parameter must be changed

1. by software: connect the PC to the AKD and change the parameter DRV.TYPE in the WorkBench terminal screen (see DRV.TYPE parameter documentation) or
2. by hardware: with the rotary switches S1 & S2 at the front and the button B1 on the top side of the Drive.

The following steps are needed for changing the fieldbus type from CAN to EtherCAT with the rotary switches.

1. Set the rotary switches on the front side of the AKD to the value of 89.



*Set S1 to 8 and S2 to 9*

2. Press the button B1 for about 3 seconds (starts DRV.NVSAVE).  
Press B1 for 3 seconds.



The display shows **En** during the process of changing DRV.TYPE to EtherCAT.  
**Do not switch off the 24[V] power supply while the seven segment shows En!**

3. Wait until the display returns to the original state.
4. Power cycle the drive by switching the 24 V power supply **off** and then **on** again.

#### NOTE

The seven segment display shows Er (Error) in case that the DRV.TYPE instruction failed. In this case please power cycle the drive and contact the Kollmorgen customer support for further help.



### 3.4 Guide to Setup

#### NOTICE

Only professional personnel with extensive knowledge of control and drive technology are allowed to setup the drive.



#### **WARNING** Automatic Restart!

Risk of death or serious injury for humans working in the machine. Drives with EtherCAT are remote-controlled machines. They can start to move at any time without previous warning. The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting.

- Place a warning sign ("WARNING: Possible Automatic Start" or similar) to the machine.
- Ensure, that power on is not possible, while humans are in a dangerous zone of the machine.

#### NOTE

Refer to chapter "Important Configuration Parameters" (→ p. 18) for fieldbus parameter setting (FBUS.PARAMx).

1. Check assembly/installation. Check that all the safety instructions in the product manual for the drive and this manual have been observed and implemented. Check the setting for the station address and baud rate.
2. Connect PC, start WorkBench. Use the setup software WorkBench to set the parameters for the drive.
3. Setup basic functions. Start up the basic functions of the drive and optimize the current, speed and position controllers. This section of the setup is described in the in the online help of the setup software.
4. Save parameters. When the parameters have been optimized, save them in the drive.

### 3.5 Important Configuration Parameters

The AKD holds several fieldbus-specific, general purpose parameters. Some of them contain the following relevant data:

**FBUS.PARAM01:**

Sets the baud rate for the CANbus. Supported baud rates are 125, 250, 500 and 1000 kBaud. On AKD-C, FBUS.PARAM01 sets and stores the EtherCAT station alias for the ESC (EtherCAT slave controller) of string 2.

**FBUS.PARAM02:**

This parameter activates the synchronization feature of the AKD. The DC feature must be activated in order to allow the AKD to get synchronized with the master. Only works when FBUS.TYPE = 3 (CANopen).

Drive internal PLL (phase locked loop) functionality: enabled (1),

Drive internal PLL functionality: disabled (0).

**FBUS.PARAM03:**

This parameter contains the Configured Station Alias address of the AKD. An EEPROM emulation write access to the Configured Station Alias address forces the AKD to store the drive parameters automatically using the DRV.NVSAVE command. On AKD-C, FBUS.PARAM03 sets and stores the EtherCAT station alias for the ESC (EtherCAT slave controller) of string 1.

**FBUS.PARAM04:**

This parameter enables (1) or disables (0) the synchronization supervision of the CANOpen or EtherCAT fieldbus.

Default values for this parameter are as follows:

CANopen drive: disabled (0)

EtherCAT drive: enabled (1)

Synchronization supervision is active when FBUS.PARAM 04 = 1 and the first CANOpen Sync message or first EtherCAT frame is received. When more than three CANOpen sync messages or seven EtherCAT frames have not been received and the drive is enabled, fault F125 (“Synchronization lost“), occurs.

**FBUS.PARAM05:**

|       |   |  |
|-------|---|--|
| Bit 0 | 1 | Faults can only be reset using DS402 controlword bit 7.  |
|       | 0 | The reset can also be done using Telnet or digital input and the DS402 state machine reflects this condition.  |
| Bit 1 | 1 | The state of the hardware enable does not change the state machine to state Operation enable.  |
|       | 0 | If the state Operation enable or Switched on is active, it falls back to the state Switch on disabled, if the Hardware enable goes to 0.   |
| Bit 2 | 1 | WorkBench/Telnet cannot software enable the drive when CANopen/EtherCAT are operational.   |
|       | 0 | WorkBench/Telnet can software enable the drive.<br><br><b>NOTE</b> During commissioning this bit should be set to 1 to avoid influences to DS402 power stage state machine. The fieldbus should not be in operation to avoid influence to test functions of WorkBench. |
| Bit 3 | 1 | DS402 - state machine is not influenced if the software enable is taken away using Telnet.   |
|       | 0 | DS402 - state machine is influenced if the software enable is taken away using Telnet.   |

|  |   |  |
|--|---|--|
| Bit 4  | 1 | Scaling is done using special DS402 - objects (independent on units)   |
|  | 0 | Scaling for position, velocity and acceleration objects is done using UNIT parameters.   |
| Bit 5<br>(EtherCAT only)                           | 1 | FBUS.PARAM03 defines the station alias address if not 0. If FBUS.PARAM03 is set to 0, the address will be taken from rotary switches if they are not 0. The EtherCAT master has the ability to use the alias address selected by the drive or issue its own. |
|  | 0 | The rotary switches define the station alias address if not 0. If the rotary switches are set to 0, the address is taken from FBUS.PARAM03 instead, if it is not 0.  |
| Bit 6  | 1 | Bit 0 of parameter MT.CNTL (object 35B9 sub 0) can be accessed.  |
|  | 0 | Bit 0 of parameter MT.CNTL (object 35B9 sub 0) is exclusively used for DS402 controlword.  |
| Bit 7  | 1 | All capture objects (0x20A0-0x20A3, 0x20A6, 0x20A7, 0x60BA to 0x60BD) are scaled as object 0x6063.   |
|  | 0 | All capture objects (0x20A0-0x20A3, 0x20A6, 0x20A7, 0x60BA to 0x60BD) are scaled as object 0x6064.   |
| Bit 8  | 1 | DS402 - state Switched on means power stage disabled.  |
|  | 0 | DS402 - state Switched on means power stage enabled.   |
| Bit 9  | 1 | SDO content of object 0x6063 is the same as PDO content.   |
|  | 0 | SDO content of object 0x6063 depends on AKD unit parameters.   |
| Bit 10<br>(Bit 10 is active only, if Bit 8 is set) | 1 | State Switched on can be reached without the high-level voltage being active.  |
|  | 0 | State Switched on can only be reached when the high-level voltage is active; otherwise the drive stays in Ready to switch on.  |
| Bit 11   | 1 | No emergency messages over CANopen are triggered when a drive warning occurs.  |
|  | 0 | Emergency messages over CANopen are triggered when a drive warning occurs.   |
| Bit 12   |   | reserved   |
| Bit 13<br>(EtherCAT only)                          | 1 | Downloaded parameter file is stored automatically to nonvolatile memory.   |
|  | 0 | Downloaded parameter file is not stored automatically to nonvolatile memory.   |
| Bit 14   | 1 | If a warning occurs which limits a movement of the motor bit 11 in the DS402 statusword is additionally set to bit 7.  |
|  | 0 | Only bit 7 is set when any warning occurs.   |
| Bit 15   | 1 | The bit 10 of the statusword (target reached) is also set as a reaction to the halt bit (bit 8) of the controlword when the motor velocity is below CS.VTHRESH.  |
|  | 0 | Bit 10 of the statusword is only set when the external setpoint value of a movement is reached, e.g., target position in profile position mode.  |
| Bit 16   | 1 | The hardware enable input decides if the transitions between Switch on disabled and Ready to switch on are taken.  |
|  | 0 | The decision relies on the DS402 controlword.  |

**FBUS.PARAM06 to FBUS.PARAM10:**

Reserved.

### 3.6 Setting up Ethernet over EtherCAT (EoE)

If you are using firmware version 1.16 or later and your EtherCAT master supports Ethernet over EtherCAT (EoE), a WorkBench connection to your drive can be established without connecting to the drive's service port.

**NOTE**

If the service port and EoE network interface are used in parallel, the service port network interface shall be configured to be in a different subnet than the EoE network interface. Running both network interface in the same subnet is NOT supported.

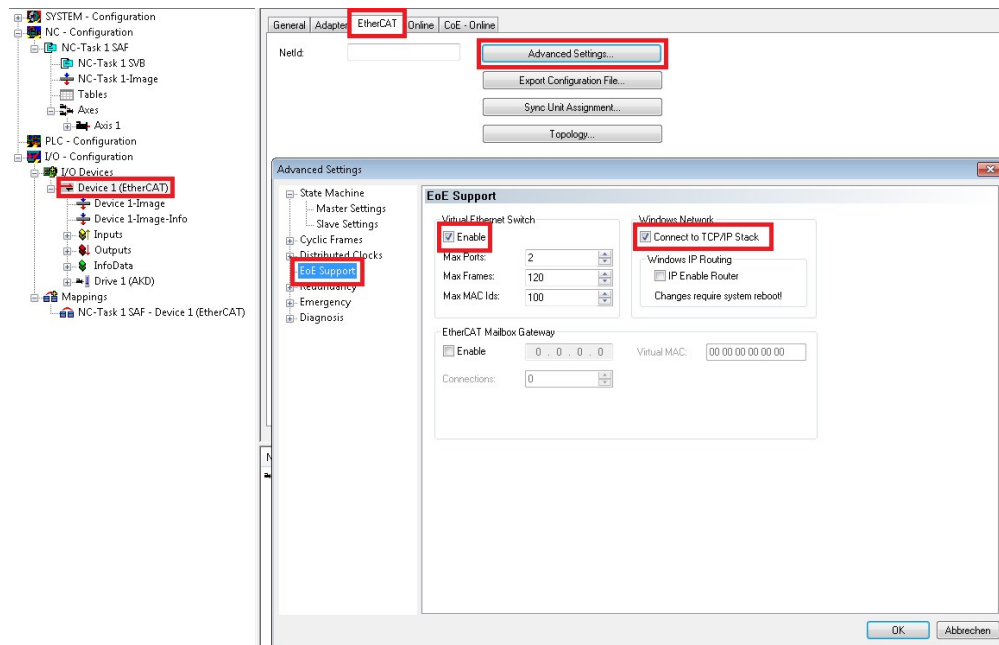
The master will use the EtherCAT mailbox to forward the Ethernet traffic from your PC to the drive, allowing you to access the drive as if it was connected over Ethernet.

The following walk through uses a TwinCAT master as an example.

#### 3.6.1 EtherCAT Device Settings

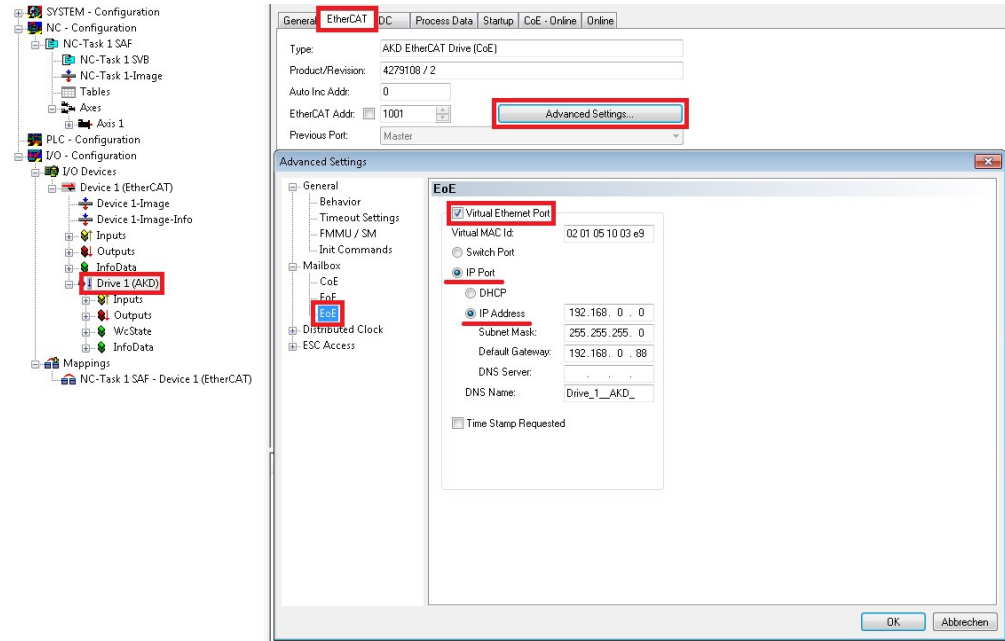
The first step is to make sure your EtherCAT device has EoE enabled. TwinCAT has a dedicated "EoE Support" page inside the EtherCAT device's settings.

Enable "Virtual Ethernet Switch." Check the box "Connect to TCP/IP Stack."



### 3.6.2 Drive Settings

After setting up the EtherCAT device, you must enable EoE for the drive. In TwinCAT there is an EoE page within the Drive's Mailbox settings. If the EoE page is not displayed, add the drive to the EtherCAT network again, using the latest device description.

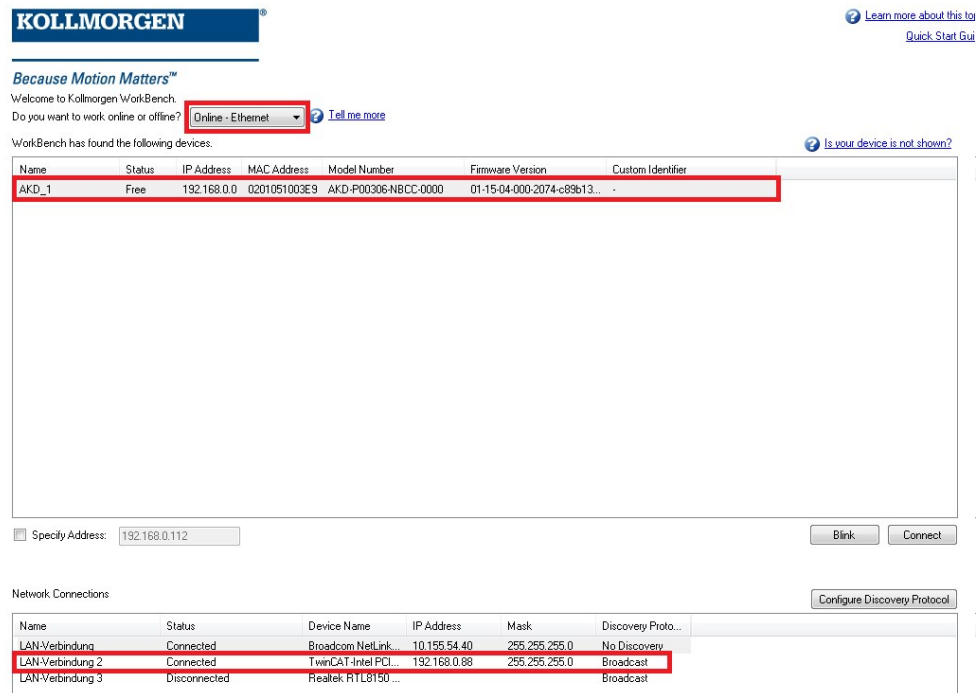


To enable EoE on your drive, check the “Virtual Ethernet Port” box, select “IP Port” and “IP Address” and enter at least a valid IP address and subnet mask.

### 3.6.3 Connecting to the Drive

You should now be able to access your drive over WorkBench using EoE.

Open WorkBench and make sure the discovery protocol is enabled for the network interface that is in the subnet configured for your drive in the previous step. You can now connect to your drive as if it were connected over the service port.



### 3.6.4 Performance Concerns

Since EoE is very demanding on EtherCAT Mailbox communication, all measures to improve Mailbox performance should be taken.

When releasing the EoE feature, the biggest allowed mailbox size has been increased from 512 to 1024 byte. A larger mailbox means fewer Mailbox transfers, resulting in a performance increase.

Furthermore an additional Fieldbus Memory Management Unit (FMMU) has been added. This allows the master to be notified of new data in the mailbox input without the need to poll the mailbox, leading to a decrease in reaction time, thus improving performance. If your master does not support this, you should at least try to decrease the period in which the master polls the drive's mailbox.

### 3.6.5 Restrictions

- Since a firmware download restarts the drive in the resident firmware, which does not support Ethernet over EtherCAT, downloading firmware via EoE is not possible. To update your drive's firmware use FoE instead.
- If your EtherCAT master uses the device description provided in the esi-file and you want to automatically detect your drives, set the keyword ECAT.LEGACYREV to 0. The drive will then report a different revision number and will be recognized by the master as a device capable of Ethernet over Ethercat.

## 3.7 Setup via TwinCAT NC/PTP System Manager

Before you set up the drive, make sure the following have been completed:

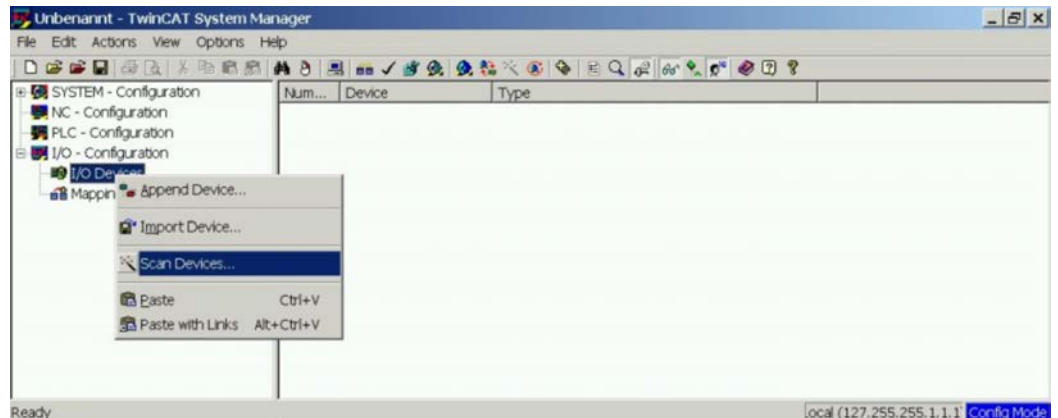
- The AKD is configured with WorkBench and the servomotor is able to move
- A correctly configured EtherCAT card is present in the master.
- TwinCAT software from Beckhoff (NC/PTP-Mode setup) is installed. Install first the TwinCAT System Manager, restart your PC, then install the option package NC/PTP-Mode.
- The XML description of the drive is available (the XML file on the DVD or on the Kollmorgen website).
- An AKD EtherCAT slave is connected to the EtherCAT master PC.
- The TwinCAT system manager resides in Config-Mode. The current mode of the system manager is displayed of the bottom right side of the TwinCAT main-screen window.

Copy the XML description of the drive to the TwinCAT system (usually to the folder `c:\TwinCAT\IO\EtherCAT`) and restart the TwinCAT system since TwinCAT analyzes all device description files during start-up.

The following example explains the automatic EtherCAT network setup. The network setup can also be done manually; please refer to the TwinCAT manual for more details.

### 3.7.1 Scan devices

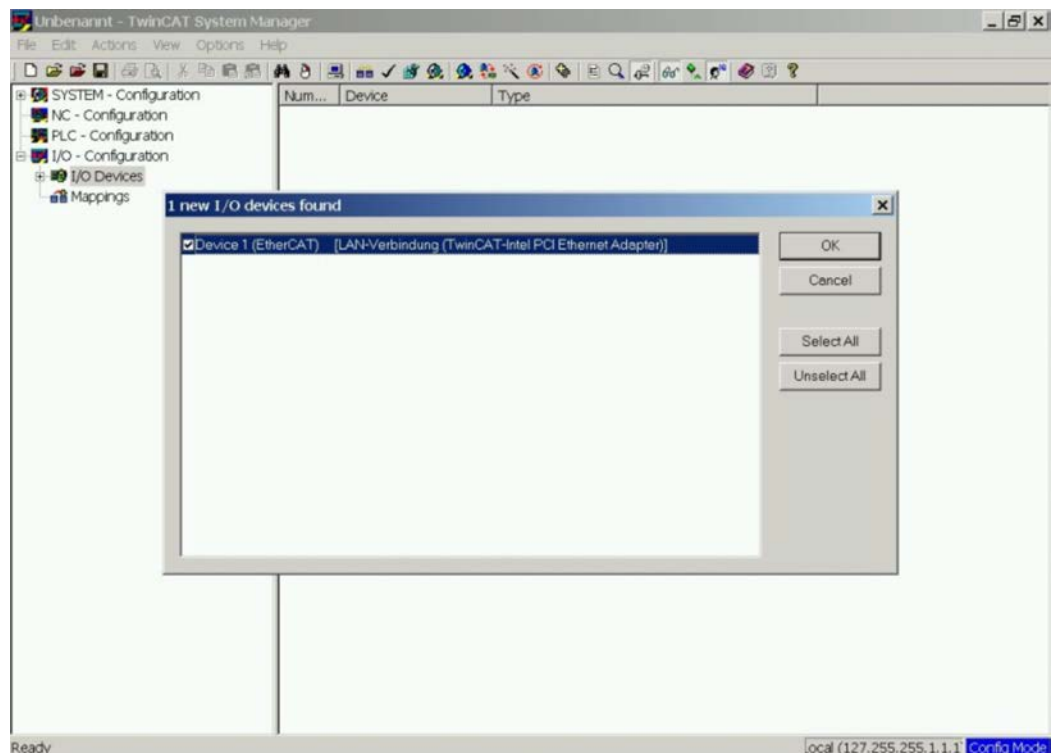
First ensure that the EtherCAT master is physically connected to the EtherCAT AKD. Create a new (empty) project. Right click I/O Devices and scan for the devices. An example is included in the EtherCAT network card, which is plugged into the PC.



A pop-up window informs you that not all devices can be detected by the TwinCAT software. Click **OK** to continue.

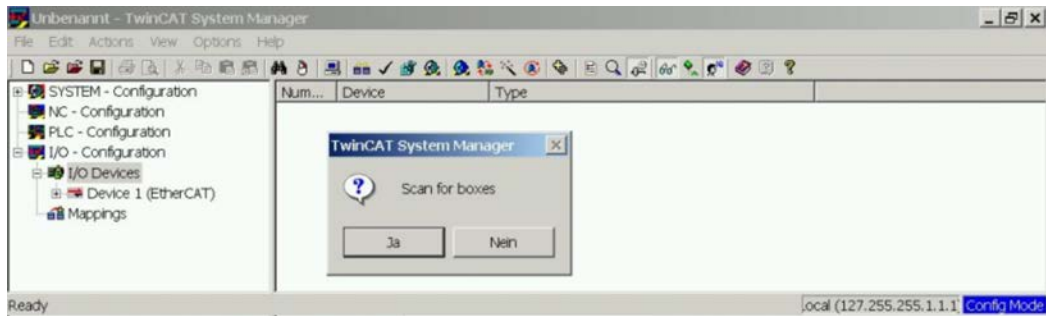
### 3.7.2 Select the device

TwinCAT must be able to find the EtherCAT network card. An EtherCAT slave must be connected to the network card; otherwise TwinCAT will find a real-time EtherNET card instead of the EtherCAT card. Press the **OK** button.



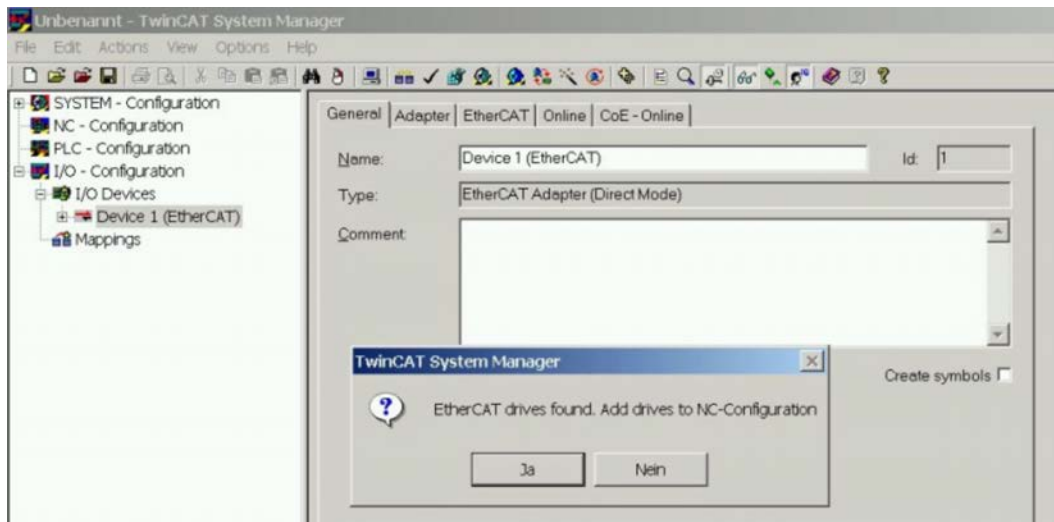
### 3.7.3 Scan for boxes

Click **Yes** to allow TwinCAT to scan for boxes. A *box* is an alias for a slave device and is always used in Beckhoff software products.






### 3.7.4 Add Slaves to NC tasks

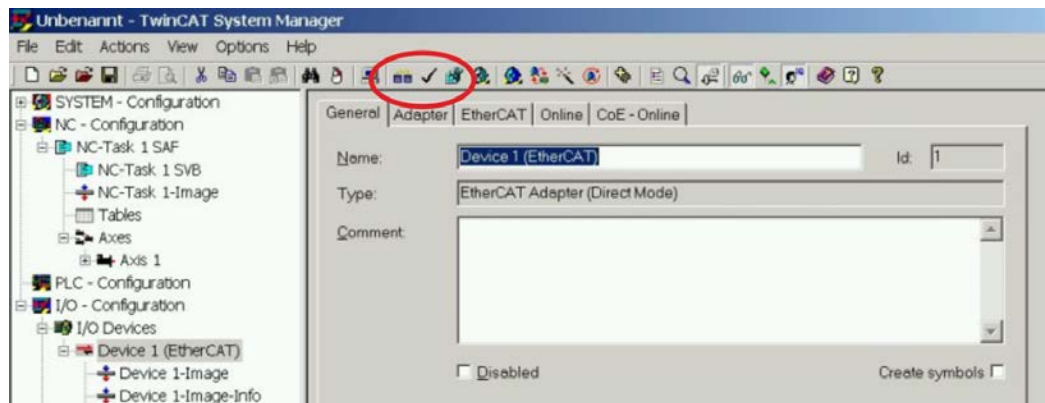
TwinCAT should now have identified the AKD according to the Device Description file. TwinCAT next asks if the slaves should be connected to NC tasks. Click **Yes** to continue. An NC task can, for example, contain a PLC program, which can be programmed by the user.



### 3.7.5 Enable the network configuration

Confirm that the AKD appears in the device tree. Next, enable the network configuration.

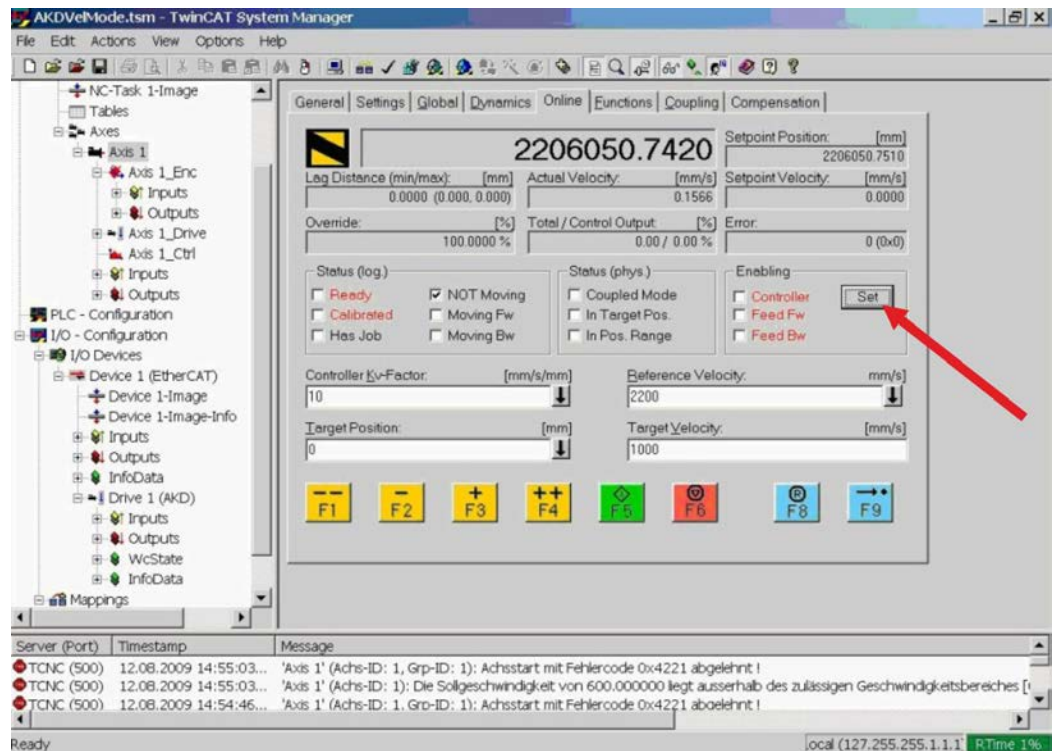
First press the  button in order to generate the mappings, then press the  button in order to let TwinCAT check the configuration and use finally the  button in order to step into run-mode. Confirm afterwards that TwinCAT is allowed to jump into run-mode.





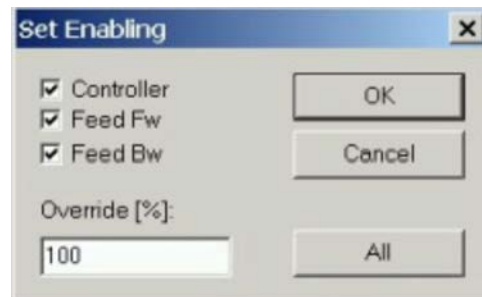
### 3.7.6 Enable the axis and move the axis

The Axis can be enabled by a mouse-click on the Set button within the Online window inside of each Axis, see also the next picture.



Afterwards a pop-up window appears.

The following setting enables the drive and allows command values in both directions.



Afterwards the motor should move in positive or negative direction as soon as the clicks on the following yellow buttons within the Online window:



### 3.8 Setup WorkBench over TwinCAT

This chapter describes a quick start guide to setup a WorkBench over TwinCAT system and make a motor spin under that system.

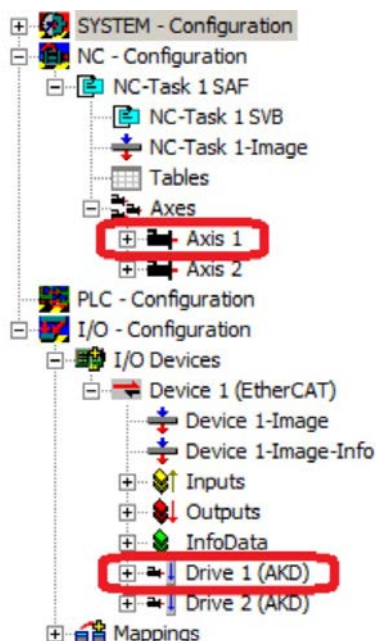
This chapter does not give specific details on TwinCAT system or WorkBench alone but is giving guidelines and information on how TwinCAT master and WorkBench works together.

Main steps in configuring a WorkBench over TwinCAT system are:

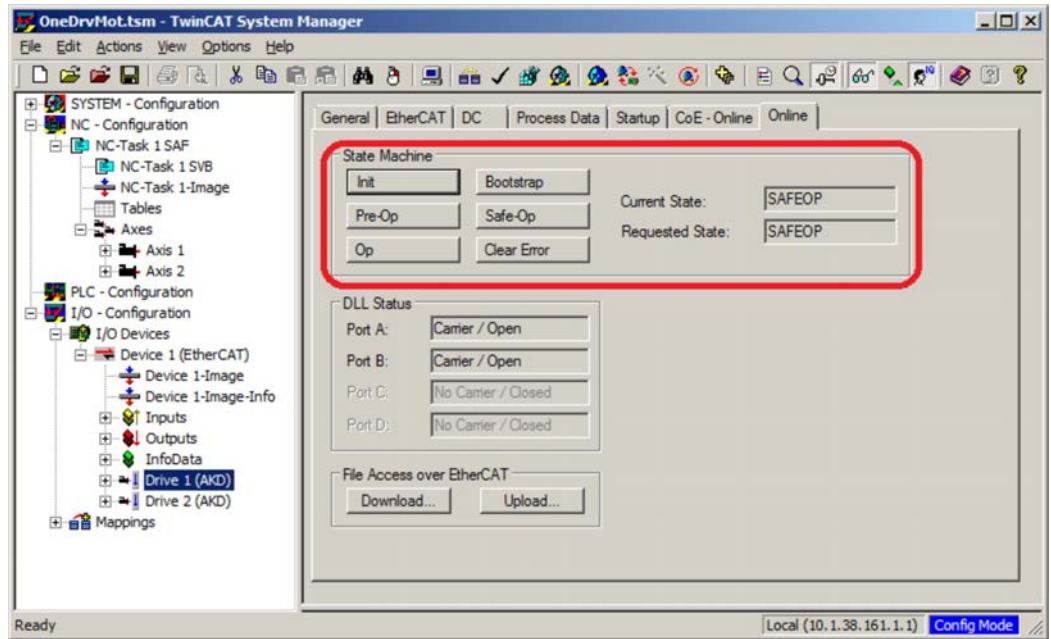
- TwinCAT and WorkBench configuration
- Connecting to a drive using WorkBench
- Configuring and enabling a drive

#### 3.8.1 TwinCAT and WorkBench Configuration

The EtherCAT network must be setup and managed using TwinCAT System Manager. To be able to connect to a drive and enable it, the drive must be loaded under the I/O Devices node in TwinCAT System Manager and axis must be added to NC - Configuration as shown → p. 22 "Setup via TwinCAT NC/PTP System Manager" in the EtherCAT Manual.



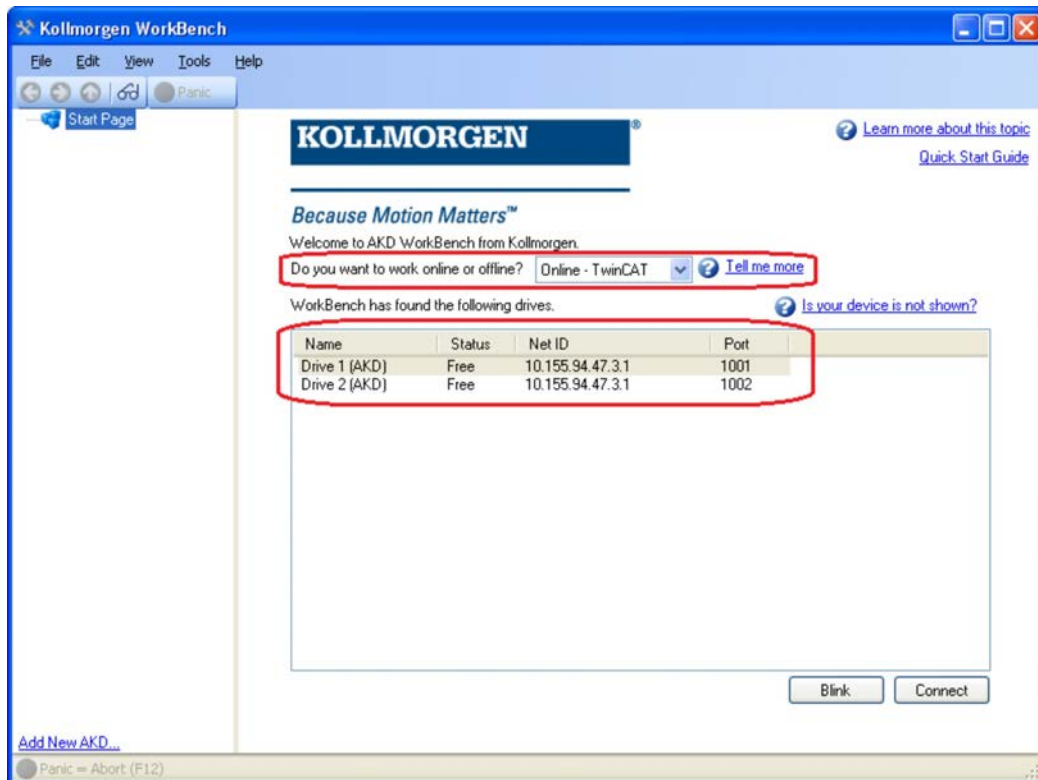
In order to connect to the drives using WorkBench, the drives must be either in Pre-Op, Safe-Op or Op state. State machine for a drive can be accessed from the Online tab for the corresponding drive under the I/O Configuration → I/O Devices → Device [x] → Drive [x] node (see screenshot below).



Installation process for WorkBench is the same process as normal, except that it must be installed on the same machine as TwinCAT. Communication to the drive is done thru TwinCAT master and it's not possible to connect WorkBench to the master remotely.

### 3.8.2 Connecting to a Drive Using WorkBench

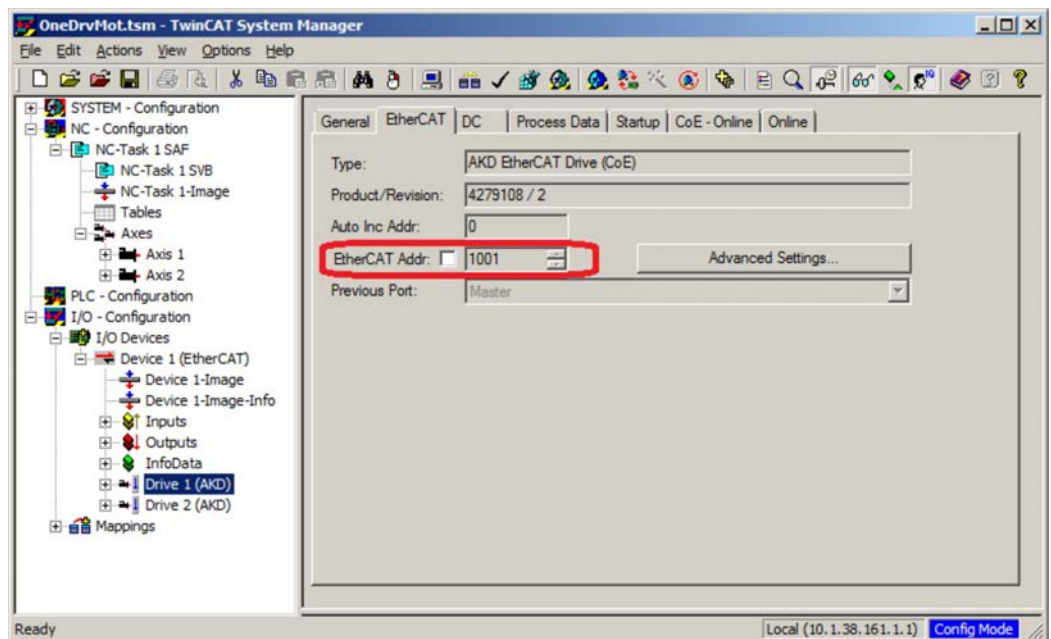
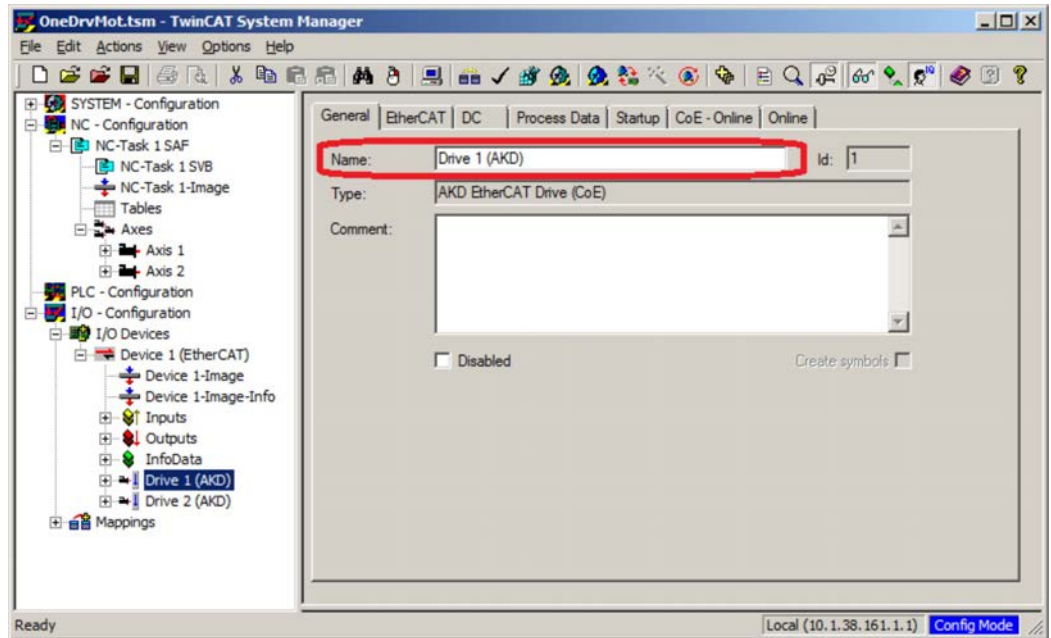
In order to connect to a drive, a TwinCAT device must be added in WorkBench. The start page of WorkBench can be used to do this. First, the type of drive (Online - TwinCAT) must be specified. Then, a list of available drives will be provided.



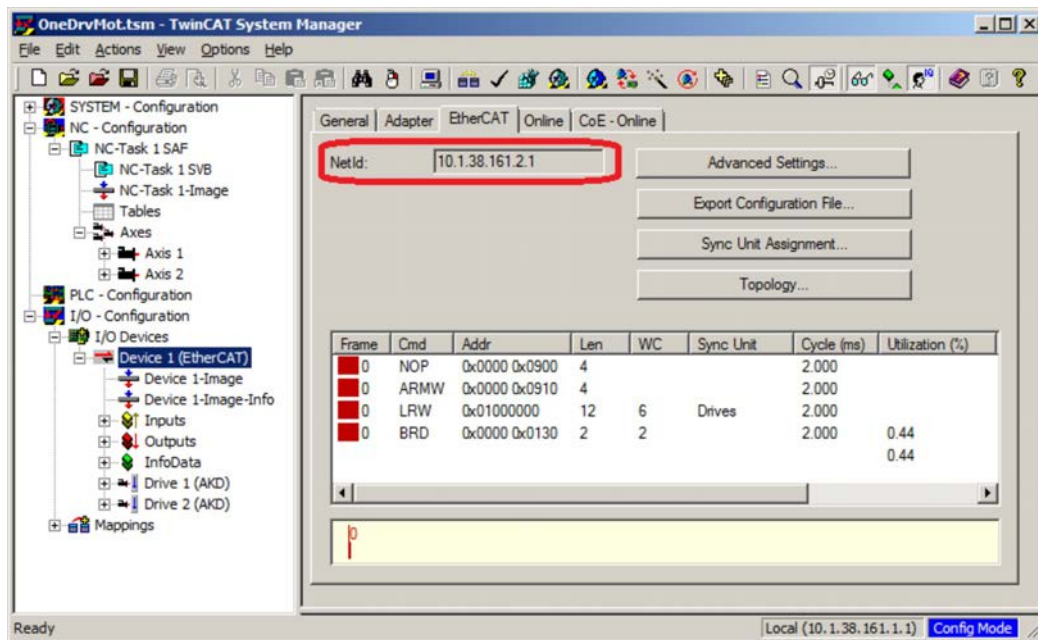
The information provided for a drive are its name, status, Net ID and Port number. After selecting a drive from the list, clicking on the "Connect" button will create a device in the left frame of WorkBench and connect the device.

The name, Net ID and port number are information coming from the TwinCAT master configuration file (the name may be different than the drive name returned by the *DRV.NAME* command). While the status is an indicator that tells if there is already a device created within WorkBench which is already connected to that particular drive.

Using TwinCAT System Manager, the drive name and port number can be found in the General and EtherCAT tab respectively for the corresponding drive under the I/O Configuration → I/O Devices → Device [x] → Drive [x] node.



The Net ID can be found in the EtherCAT tab in the I/O Configuration → I/O Devices → Device [x] node.



It is important to understand that this information is coming from the TwinCAT master and its configuration file but not from the drive itself. Thus, if the TwinCAT configuration is not reflecting the actual network configuration, you may have a drive listed in WorkBench which is not powered up or even connected in the EtherCAT network, or you have a drive powered up and connected to the TwinCAT network but not shown in the WorkBench list.



### 3.8.3 Configuring and Enabling a Drive

Once connected with WorkBench, a drive can be configured using all normal functionality of WorkBench.

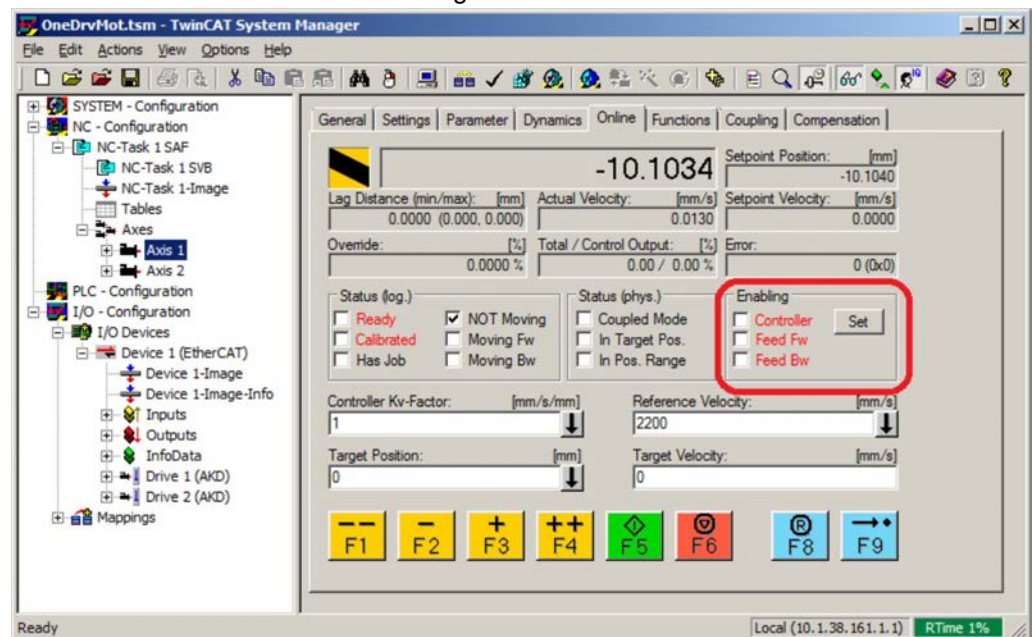
The only operation that is not possible to do using WorkBench over TwinCAT is the download of a new firmware in the drive. Downloading a new firmware in the drive must be performed using File over EtherCAT (FoE) feature of TwinCAT server.

#### NOTICE

If the cyclic communication of the TwinCAT master is enabled, it is possible that some commands sent by WorkBench using the ASCII channel are overwritten by the TwinCAT master. Typically, the drive enable command will have no effect if sent from WorkBench because the control word is usually mapped.

Using TwinCAT, enabling the drive can be done with the following procedure:

1. Under NC Configuration → Axes → Axis [x] node, choose the Online tab.
2. Press the Set button within the Enabling section.

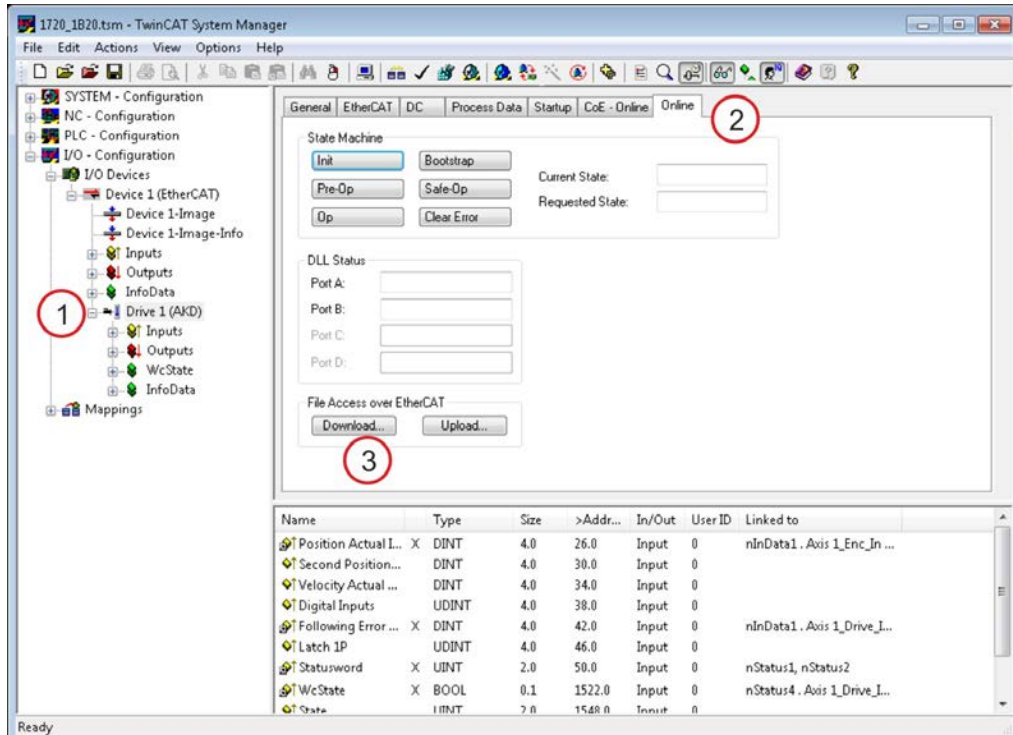


3. In the pop-up dialog box, check the Controller checkbox to enable the drive (or un-check to disable the drive) and press on the OK button.

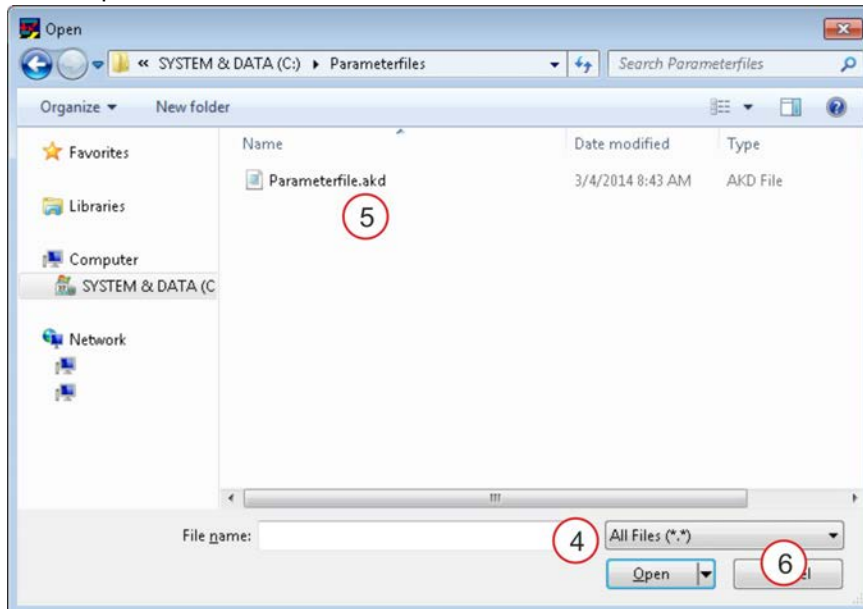
### 3.8.4 Download a Parameter File over TwinCAT

You can download a parameter file to the drive over EtherCAT. Before you start, make sure that the drive is in INIT, PREOP, or SAFEOP state before trying to download the file.

1. First select the drive where you want to perform the download.
2. Change to the Online tab.



3. Press the Download button.
4. Choose "All Files (\*.\*)" as file type to see the parameter files ending with ".akd".
5. Select the file.
6. Press Open to start the download.



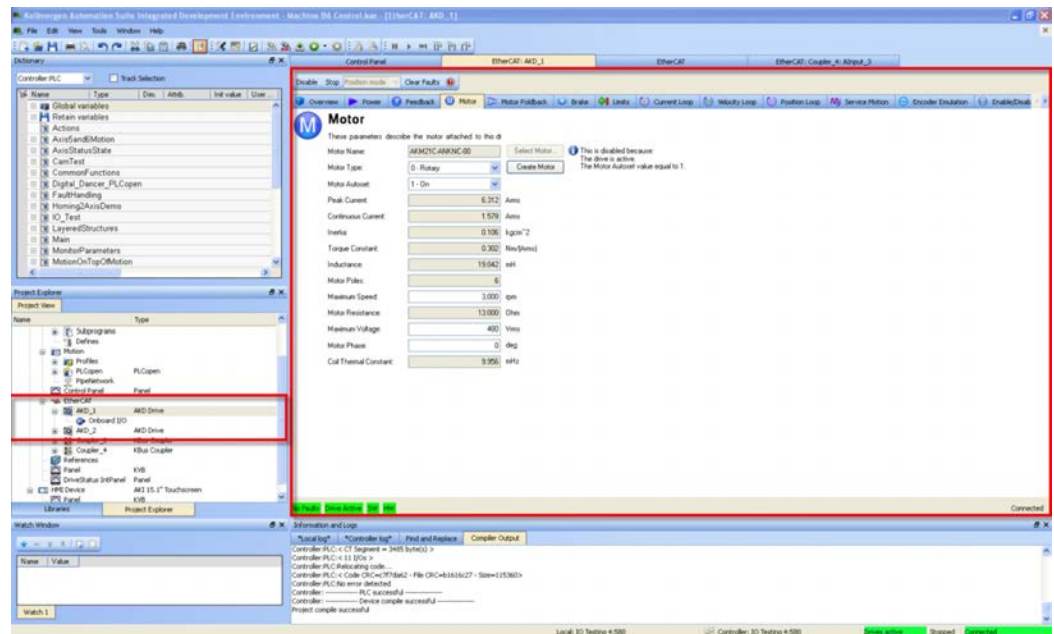
**NOTE**

Downloading a parameter file over TwinCAT is supported by all drives from firmware 01.12.000.



### 3.9 Setup via KAS IDE

If you are using a Kollmorgen Automation Suite (KAS) system, the AKD setup is completely integrated into the KAS Integrated Development Environment (IDE), as shown below:



For further information on the setup for a KAS system, see the following sections in the KAS documentation:

- **KAS IDE User Manual:** See section 4.2.3 Add and Configure Drive.
- **KAS Online Help:** See **Using the KAS IDE> Creating a Project> Step 3 - Add and Configure Drive.**

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## 4 EtherCAT Profile

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|   |           |
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## 4.1 Slave Register

The table below gives the addresses of individual registers in the FPGA memory. The data is provided in little-endian format, with the 'least significant byte' occupying the lowest address. A detailed description of all registers and FPGA memory locations is available in the "EtherCAT Slave Controller" description of the EtherCAT user organization ([www.EtherCAT.org](http://www.EtherCAT.org)).

| Address | Length (Byte)               | Description   | ZA ECAT* | ZA Drive* |
|---------|-----------------------------|---|----------|-----------|
| 0x0120  | 2                           | AL Control  | R/W      | R/O       |
| 0x0130  | 2                           | AL Status   | R/O      | R/W       |
| 0x0134  | 2                           | AL Status Code  | R/O      | R/W       |
| 0x0204  | 2                           | Interrupt Enable Register   | R/O      | R/W       |
| 0x0220  | 2                           | AL Event (IRQ Event)  | R/W      | R/O       |
| 0x0800  | 8                           | Sync Manager 0 (Mail Out Control Register)  | R/W      | R/O       |
| 0x0808  | 8                           | Sync Manager 1 (Mail In Control Register)   | R/W      | R/O       |
| 0x0810  | 8                           | Sync Manager 2 (Process data Output Control Register)   | R/W      | R/O       |
| 0x0818  | 8                           | Sync Manager 3 (Process data Input Control Register)  | R/W      | R/O       |
| 0x0820  | 8                           | Sync Manager 4  | R/W      | R/O       |
| 0x0828  | 8                           | Sync Manager 5  | R/W      | R/O       |
| 0x0830  | 8                           | Sync Manager 6  | R/W      | R/O       |
| 0x0838  | 8                           | Sync Manager 7  | R/W      | R/O       |
| 0x0840  | 8                           | Sync Manager 8  | R/W      | R/O       |
| 0x1100  | Max. 64                     | ProOut Buffer (Process data Output, set-points ECAT)  | R/W      | R/O       |
| 0x1140  | Max. 64                     | ProIn (Process data Input, act. values ECAT)  | R/O      | R/W       |
| 0x1800  | up to 512**<br>up to 1024** | Mail Out Buffer (Object Channel Buffer ECAT, byte-length is specified in the device description file) | R/W      | R/O       |
| 0x1C00  | up to 512**<br>up to 1024** | Mail In Buffer (Object Channel Buffer Drive, byte-length is specified in the device description file) | R/O      | R/W       |

\* ZA ECAT = Access mode EtherCAT

\* ZA Drive = Access mode drive

\*\* depends on firmware version and revision number

## 4.2 AL Event (Interrupt Event) and Interrupt Enable

Communication between the drive and the EtherCAT FPGA can be interrupt-driven. The interrupt enable register and the AL event register are responsible for the EtherCAT interface interrupt functionality.

There are two events which lead also to a HW interrupt within the drive, the EEPROM emulation event and the SyncManager 2 event. The actual values of the drive (SyncManager 3 data) are written without any AL event request during each HW IRQ, e.g. triggered by a SyncManager 2 event. The Mailbox exchange between the master and the AKD is completely handled by polling the AL event register within the background task of the drive.

The drive activates individual EtherCAT interface events when the corresponding bit of the interrupt enable register is set to 1. When it is set to 0, the hardware interrupts for the specific events are deactivated.

### 4.2.1 Interrupt Enable Register (Address 0x0204:0x0205)

| Parameter                              | Address | Bit    | ZA Drive | ZA ECAT | Description   |
|--|---------|--------|----------|---------|---|
| AL Control Event                       | 0x204   | 0      | R/W      | R/O     | Activation of AL control event for phase run-up                                 |
| -                                      | 0x204   | 1      | R/W      | R/O     | Reserved  |
| Sync0 DC Distributed Clock             | 0x204   | 2      | R/W      | R/O     | Activation of distributed clock (DC) sync 0 interrupts for entire communication |
| Sync1 DC Distributed Clock             | 0x204   | 3      | R/W      | R/O     | Activation of distributed clock (DC) sync 1 interrupts for entire communication |
| SyncManager activation register change | 0x204   | 4      | R/W      | R/O     | Activation of 'SyncManager activation register change' IRQ.                     |
| EEPROM emulation event                 | 0x204   | 5      | R/W      | R/O     | Activation of the EEPROM emulation interrupts.                                  |
| -                                      | 0x204   | 3 to 7 | R/W      | R/O     | Reserved  |
| Sync Manager 0 Event (Mail Out Event)  | 0x205   | 0      | R/W      | R/O     | Activation of output event mailbox (SDO, Sync Manager 0) for object channel.    |
| Sync Manager 1 Event (Mail In Event)   | 0x205   | 1      | R/W      | R/O     | Activation of input event mailbox (SDO, Sync Manager 1) for object channel.     |
| Sync Manager 2 Event (Pro Out Event)   | 0x205   | 2      | R/W      | R/O     | Activation of output event process data (PDO, card's cyclical setpoints)        |
| Sync Manager 3 Event (Pro In Event)    | 0x205   | 3      | R/W      | R/O     | Activation of input event process data (PDO, drive's cyclical actual values)    |
| -                                      | 0x205   | 4 to 7 | R/W      | R/O     | Reserved  |

#### 4.2.2 AL Event Request (Address 0x0220:0x0221)

When the relevant bit of the AL event request register is set to 1, the EtherCAT interface tells the drive which event it should process by the AKD.

| Parameter                              | Address | Bit    | ZA Drive | ZA ECAT | Description  |
|--|---------|--------|----------|---------|--|
| AL Control Event                       | 0x220   | 0      | R/O      | R/W     | Processing of AL control event for phase run-up  |
| Sync0 Distributed Clock (DC) Event     | 0x220   | 2      | R/O      | R/W     | Processing of a distributed clock (DC) event   |
| Sync1 Distributed Clock (DC) Event     | 0x220   | 3      | R/O      | R/W     | Processing of a distributed clock (DC) event   |
| SyncManager activation register change | 0x220   | 4      | R/O      | R/W     | The content of the SyncManager activation register has been changed.                     |
| EEPROM emulation event                 | 0x220   | 5      | R/O      | R/W     | Processing of an EEPROM emulation event in order to identify the AKD within the network. |
| -                                      | 0x220   | 6 to 7 | R/O      | R/W     | Reserved   |
| Sync Manager 0 Event                   | 0x221   | 0      | R/O      | R/W     | Mailbox request (SDO, Sync Manager 0) for object channel.                                |
| Sync Manager 1 Event                   | 0x221   | 1      | R/O      | R/W     | Mailbox response (SDO, Sync Manager 1) for object channel.                               |
| Sync Manager 2 Event                   | 0x201   | 2      | R/O      | R/W     | Process data output (PDO, card's cyclical setpoints)                                     |
| Sync Manager 3 Event                   | 0x201   | 3      | R/O      | R/W     | Process data input (PDO, drive's cyclical actual values)                                 |
| Sync Manager 4 –                       |         |        |          |         |  |
| Sync Manager 7 Event                   | 0x221   | 4 to 7 | R/O      | R/W     | Reserved   |
| Sync Manager 8 –                       |         |        |          |         |  |
| Sync Manager 15 Event                  | 0x222   | 0 to 7 | R/O      | R/W     | Reserved   |

### 4.3 Phase Run-Up

The AL control, AL status and AL status code registers are responsible for communication phase run-up (also referred to as EtherCAT status change), for current status display and for any fault messages. The drive responds to every EtherCAT interface transition request made by the AL control register via the AL Status and AL Status Code registers. Any fault messages are displayed in the AL status code register.

A status change within the AL control register is polled within the AKD, which means that an AL control event does not lead to a HW interrupt within the drive.

#### 4.3.1 AL Control (Address 0x0120:0x0121)

| Parameter                      | Address | Bit     | ZA Drive | ZA ECAT | Description   |
|--------------------------------|---------|---------|----------|---------|---|
| Status                         | 0x120   | 3 to 0  | R/O      | W/O     | 0x01: Init Request  |
| 0x02: PreOperational Request   |         |         |          |         |   |
| 0x03: Bootstrap Mode Request   |         |         |          |         |   |
| 0x04: Safe Operational Request |         |         |          |         |   |
| 0x08: Operational Request      |         |         |          |         |   |
| Acknowledgement                | 0x120   | 4       | R/O      | W/O     | 0x00: No fault acknowledgement<br>0x01: Fault acknowledgement (positive edge) |
| Reserved                       | 0x120   | 7 to 5  | R/O      | W/O     | -   |
| Applic. specific               | 0x120   | 15 to 8 | R/O      | W/O     | -   |

#### 4.3.2 AL Status (Address 0x0130:0x0131)

| Parameter              | Address | Bit     | ZA Drive | ZA ECAT | Description   |
|------------------------|---------|---------|----------|---------|---|
| Status                 | 0x130   | 3 to 0  | W/O      | R/O     | 0x01: Init  |
| 0x02: PreOperational   |         |         |          |         |   |
| 0x03: Bootstrap Mode   |         |         |          |         |   |
| 0x04: Safe Operational |         |         |          |         |   |
| 0x08: Operational      |         |         |          |         |   |
| Status change          | 0x130   | 4       | W/O      | R/O     | 0x00: Acknowledgement<br>0x01: Error, e.g. forbidden transition |
| Reserved               | 0x130   | 7 to 5  | W/O      | R/O     | -   |
| Applic. specific       | 0x130   | 15 to 8 | W/O      | R/O     | -   |

### 4.3.3 AL Status Code (Address 0x0134:0x0135)

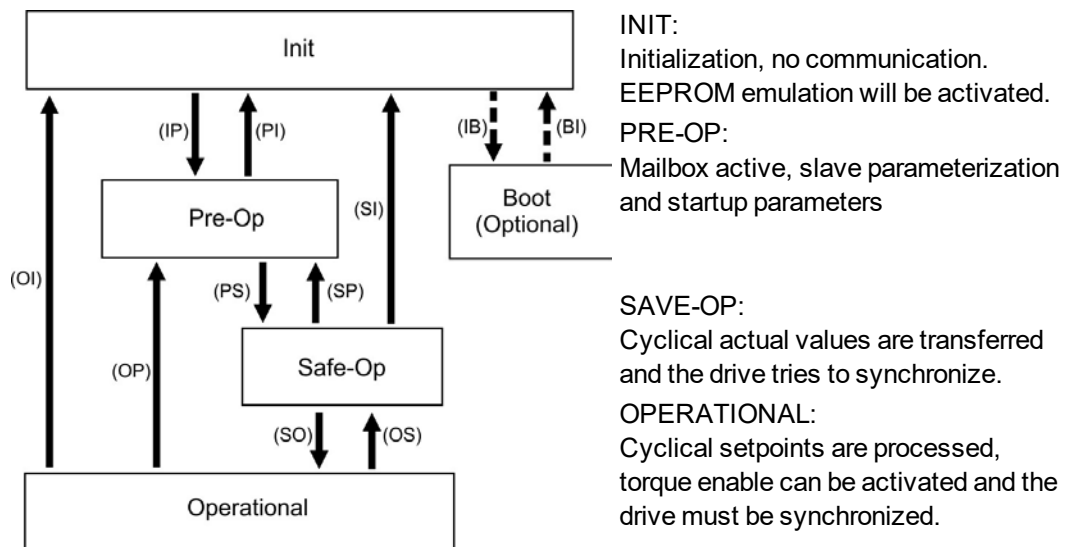
| Parameter | Address | Bit    | ZA Drive | ZA ECAT | Description     |
|-----------|---------|--------|----------|---------|-----------------|
| Status    | 0x134   | 7 to 0 | W/O      | R/O     | See table below |
| Status    | 0x135   | 7 to 0 | W/O      | R/O     | See table below |

| Code   | Description                        | Current Status (Status change)                    | Resulting Status   |
|--------|------------------------------------|---|--------------------|
| 0x0000 | No error                           | All   | Current Status     |
| 0x0011 | Invalid requested state change     | I -> S, I -> O, P -> O,<br>O -> B, S -> B, P -> B | Current Status + E |
| 0x0017 | Invalid sync manager configuration | I -> P, P -> S                                    | Current Status + E |

No other codes are supported.

### 4.3.4 EtherCAT communication phases

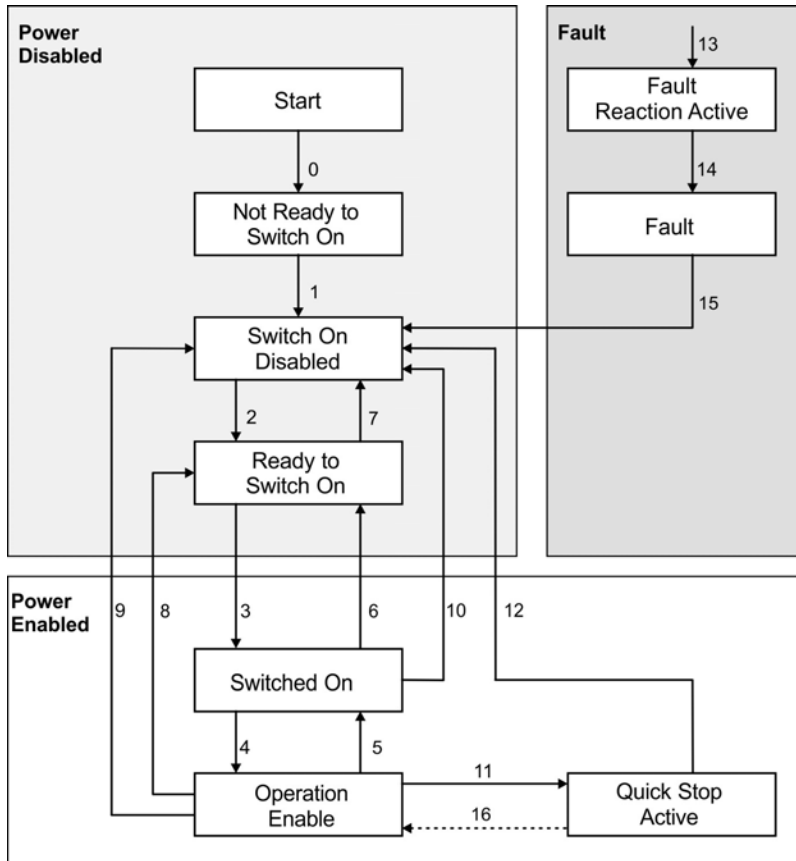


#### Individual communication transitions

| Transition | AL Control (Bit 3 to 0) | Description  |
|------------|-------------------------|--|
| (IB)       | 0x03                    | -  |
| (BI)       | -                       | -  |
| (IP)       | 0x02                    | AKD reads the SyncManager 0 & 1 configuration and verifies the value of the start-address and the length. The AKD prepares itself for handling SyncManager 0 events. |
| (PI)       | 0x01                    | -  |
| (PS)       | 0x04                    | AKD reads the SyncManager 2 & 3 configuration and verifies the value of the start-address and the length.  |
| (SP)       | 0x02                    | -  |
| (SI)       | 0x01                    | -  |
| (SO)       | 0x08                    | The SsyncManager 2 hardware interrupt will be enabled by the drive.  |
| (OS)       | 0x04                    | Deactivation of SyncManager 2 hardware interrupt.  |
| (OP)       | 0x02                    | Deactivation of SyncManager 2 hardware interrupt..   |
| (OI)       | 0x01                    | Deactivation of SyncManager 2 hardware interrupt.  |



## 4.4 CANopen over EtherCAT (CoE) State Machine



The state machine for the control and status words corresponds to the CANopen state machine in accordance with DS402.

CANopen control and status words are captured in every instance of fixed PDO mapping (see chapter "Fixed PDO Mappings" (→ p. 43)).

### 4.4.1 Status Description

| Status                 | Description  |
|------------------------|--|
| Not Ready to Switch On | The drive is not ready to switch on; the controller has not indicated readiness for service. The drive is still in the boot phase or in fault status.  |
| Switch On Disable      | In 'Switch On Disable' status, the amplifier cannot be enabled via the EtherCAT interface, because (for example) there is no connection to a power source.   |
| Ready to Switch On     | In 'Ready to Switch On' status, the drive can be enabled via the control word.   |
| Switched On            | In 'Switched On' status, the amplifier is enabled, but the setpoints of the EtherCAT-interface are not yet transferred. The amplifier is idle, and a positive edge in bit 3 of the control word activates setpoint transfer (transition to 'Operation Enable' status). |
| Operation Enable       | In this status, the drive is enabled and setpoints are transferred from the EtherCAT interface.  |
| Quick Stop Active      | The drive follows a quick stop ramp.   |
| Fault Reaction Active  | The drive responds to a fault with an emergency stop ramp.   |
| Fault                  | A fault is pending, the drive is stopped and disabled.   |

#### 4.4.2 Commands in the Control Word

##### Bit assignment in the control word

| Bit | Name                                    | Bit | Name                  |
|-----|---|-----|-----------------------|
| 0   | Switch on                               | 8   | Pause/halt            |
| 1   | Disable Voltage                         | 9   | reserved              |
| 2   | Quick Stop                              | 10  | reserved              |
| 3   | Enable Operation                        | 11  | reserved              |
| 4   | Operation mode specific                 | 12  | reserved              |
| 5   | Operation mode specific                 | 13  | Manufacturer-specific |
| 6   | Operation mode specific                 | 14  | Manufacturer-specific |
| 7   | Reset Fault (only effective for faults) | 15  | Manufacturer-specific |

##### Commands in the control word

| Command           | Bit 7<br>Fault<br>Reset | Bit 3<br>Enable Oper-<br>ation | Bit 2<br>Quick<br>Stop | Bit 1<br>Disable<br>Voltage | Bit 0<br>Switch<br>On | Transitions  |
|-------------------|-------------------------|--------------------------------|------------------------|-----------------------------|-----------------------|--------------|
| Shutdown          | X                       | X                              | 1                      | 1                           | 0                     | 2, 6, 8      |
| Switch on         | X                       | X                              | 1                      | 1                           | 1                     | 3            |
| Disable Voltage   | X                       | X                              | X                      | 0                           | X                     | 7, 9, 10, 12 |
| Quick Stop        | X                       | X                              | 0                      | 1                           | X                     | 7, 10, 11    |
| Disable Operation | X                       | 0                              | 1                      | 1                           | 1                     | 5            |
| Enable Operation  | X                       | 1                              | 1                      | 1                           | 1                     | 4, 16        |
| Fault Reset       | 1                       | X                              | X                      | X                           | X                     | 15           |

Bits labeled **X** are irrelevant. **0** and **1** indicate the status of individual bits.

##### Mode-dependent bits in the control word

The following table shows the mode-dependent bits in the control word. Only manufacturer-specific modes are supported at present. The individual modes are set by Object 6060h Modes of operation.

| Operation mode                   | No  | Bit 4                      | Bit 5                      | Bit 6             |
|----------------------------------|-----|----------------------------|----------------------------|-------------------|
| Profile Position Mode (pp)       | 01h | new_setpoint               | change_set_<br>immediately | absolute/relative |
| Profile Velocity Mode (pv)       | 03h | reserved                   | reserved                   | reserved          |
| Profile Torque Mode (tq)         | 04h | reserved                   | reserved                   | reserved          |
| Homing Mode (hm)                 | 06h | homing_operation_<br>start | reserved                   | reserved          |
| Interpolated Position Mode (ip)  | 07h |                            | reserved                   | reserved          |
| Cyclic synchronous position mode | 08h | reserved                   | reserved                   | reserved          |

##### Description of the remaining bits in the control word

**Bit 8:** (Pause) If Bit 8 is set, then the drive halts (pauses) in all modes. The setpoints (speed for homing or jogging, motion task number, setpoints for digital mode) for the individual modes are retained.

**Bit 9,10:** These bits are reserved for the drive profile (DS402).

**Bit 13, 14, 15:** These bits are manufacturer-specific, and reserved at present.

### 4.4.3 State Machine Bits (status word)

#### Bit assignment in the status word

| Bit | Name               | Bit | Name                               |
|-----|--------------------|-----|------------------------------------|
| 0   | Ready to switch on | 8   | Manufacturer-specific (reserved)   |
| 1   | Switched on        | 9   | Remote (always 1)                  |
| 2   | Operation enable   | 10  | Target reached                     |
| 3   | Fault              | 11  | Internal limit active              |
| 4   | Voltage enabled    | 12  | Operation mode specific (reserved) |
| 5   | Quick stop         | 13  | Operation mode specific (reserved) |
| 6   | Switch on disabled | 14  | Manufacturer-specific (reserved)   |
| 7   | Warning            | 15  | Manufacturer-specific (reserved)   |

#### States of the state machine

| State                  | Bit 6<br>switch on<br>disable | Bit 5<br>quick<br>stop | Bit 3<br>fault | Bit 2<br>operation<br>enable | Bit 1<br>switched<br>on | Bit 0<br>ready to<br>switch<br>on |
|------------------------|-------------------------------|------------------------|----------------|------------------------------|-------------------------|-----------------------------------|
| Not ready to switch on | 0                             | X                      | 0              | 0                            | 0                       | 0                                 |
| Switch on disabled     | 1                             | X                      | 0              | 0                            | 0                       | 0                                 |
| Ready to switch on     | 0                             | 1                      | 0              | 0                            | 0                       | 1                                 |
| Switched on            | 0                             | 1                      | 0              | 0                            | 1                       | 1                                 |
| Operation enabled      | 0                             | 1                      | 0              | 1                            | 1                       | 1                                 |
| Fault                  | 0                             | X                      | 1              | 0                            | 0                       | 0                                 |
| Fault reaction active  | 0                             | X                      | 1              | 1                            | 1                       | 1                                 |
| Quick stop active      | 0                             | 0                      | 0              | 1                            | 1                       | 1                                 |

Bits labeled **X** are irrelevant. **0** and **1** indicate the status of individual bits.

#### Description of the remaining bits in the status word

**Bit 4:** voltage\_enabled The DC-link voltage is present if this bit is set.

**Bit 7:** warning There are several possible reasons for Bit 7 being set and this warning being produced. The reason for this warning can be revealed by using the Object 2000h (system warnings).

**Bit 9:** remote is always set to 1, i.e. the drive can always communicate and be influenced via the RS232 - interface.

**Bit 10:** target\_reached This is set when the drive has reached the target position.

**Bit 11:** internal\_limit\_active This bit specifies that a movement was or is limited. In different modes, different warnings cause the bit to be set.

## 4.5 Fixed PDO Mappings

Various ready-to-use mappings can be selected for cyclic data exchange via SDO's of the object 0x1C12 and 0x1C13. Using object 0x1C12 subindex 1 (Sync Manager 2 assignment), a fixed mapping for the cyclic command values can be set with the values 0x1701, 0x1702, 0x1720 to 0x1725. Using object 0x1C13 subindex 1 (Sync Manager 3 assignment), a fixed mapping for the cyclic actual values can be set via the data 0x1B01, 0x1B20 to 0x1B26.

Use the sequence below to select the fixed command value mapping 0x1701 via SDO's:

1. SDO write access to object 0x1C12Sub0 Data:0x00
2. SDO write access to object 0x1C12Sub1 Data:0x1701
3. SDO write access to object 0x1C12Sub0 Data:0x01

**NOTE**

Up to firmware version 1.8.x.x AKD.XML file, fixed mapping 0x1701 called out 0x6062sub0 as the “Position Command”. From AKD firmware release 1.8.5.0, the AKD.XML will be changed to call out 0x60C1sub1 as the “Position Command” and an additional XML file called “AKD\_TwinCAT.XML” will be added to support TwinCat 2x and older. In reality, SDO 0x6062sub0 is not supported in the AKD firmware but was called in the fixed mapping to support a TwinCat issue.

**Position interface, supported fixed mappings:**

|        |   |
|--------|---|
| 0x1701 | Position command value (4 bytes), Control word (2 bytes), total (6 bytes)   |
| 0x1720 | Control Word (2 bytes), Interpolated position command value (4 bytes), Latch control word (2 bytes), Torque feed forward (2 bytes), Digital outputs (2 bytes)   |
| 0x1721 | Interpolated position command value (4 bytes), Control Word (2 bytes), Torque feed forward (2 bytes)  |
| 0x1722 | Control word (2 byte), Interpolated position command value (4 bytes), Latch control word (2 bytes), Torque feed forward (2 bytes), Digital outputs (2 bytes), max. torque (2 bytes)   |
| 0x1723 | Control word (2 bytes), Interpolated position command value (4 bytes), Latch control word (2 bytes), Torque feed forward (2 bytes), Digital outputs (2 bytes), Reset of changed input information (2 bytes)   |
| 0x1724 | Target position for cyclic synchronous position mode (4 bytes), Control word (2 byte), Torque feed forward (2 bytes)  |
| 0x1725 | Controlword (2 bytes), Target position for cyclic synchronous position mode (4 bytes), Digital outputs (4 bytes), Torque feed forward (2 bytes), Analog output value (2 bytes), Max torque (2 bytes)  |
| 0x1B01 | Position actual value (4 bytes), Status word (2 bytes), total (6 bytes)   |
| 0x1B20 | Position actual internal value (4 bytes), 2nd position feedback position (4 bytes), velocity actual value (4 bytes), digital inputs (4 bytes), following error (4 bytes), latch position positive (4 bytes), status word (2 bytes), torque actual value (2 bytes), latch status (2 bytes), analog input value (2 bytes)                             |
| 0x1B21 | Position Actual Internal Value (4 bytes), Status word (2 bytes)   |
| 0x1B22 | Position actual internal value (4 bytes), 2nd position feedback position (4 bytes), velocity actual value (4 bytes), digital inputs (4 bytes), following error (4 bytes), latch position negative (4 bytes), status word (2 bytes), torque actual value (2 bytes), latch status (2 bytes), analog input value (2 bytes)                             |
| 0x1B23 | Position actual internal value (4 bytes), 2nd position feedback position (4 bytes), velocity actual value (4 bytes), digital inputs (4 bytes), following error (4 bytes), latch position positive / negative (4 bytes), status word (2 bytes), torque actual value (2 bytes), latch status (2 bytes), analog input value (2 bytes)                  |
| 0x1B24 | Position actual value (4 bytes), status word (2 bytes)  |
| 0x1B25 | Position actual internal value (4 bytes), 2nd position feedback position (4 bytes), latch position 2 positive / negative (4 bytes), digital inputs (4 bytes), following error (4 bytes), latch position 1 positive / negative (4 bytes), status word (2 bytes), torque actual value (2 bytes), latch status (2 bytes), analog input value (2 bytes) |
| 0x1B26 | Statusword (2 bytes), Position actual value (4 bytes), Analog input value (2 bytes), Digital inputs (4 bytes), Following error actual value (4 bytes)   |

**Velocity interface, supported fixed mappings:**

|        |   |
|--------|---|
| 0x1702 | Velocity command value (4 bytes), Control word (2 bytes), total (6 bytes) |
|--------|---|

The objects, which are mapped into the fixed PDOs can be read via the subindices 1 to n of the above indices. The number of mapped entries is available by reading subindex 0 of the above indices.

Example:

A read access to object 1702 sub 0 gives a value of 2, a read on subindex 1 gives 0x60ff0020, on subindex 2 0x60400010. The meaning of these numbers can be seen in the CANopen manual or the flexible-mapping example (→ p. 48.).

## 4.6 Flexible PDO Mappings

In addition to the fixed PDO mapping the so-called flexible mapping of real-time objects is possible.

**NOTE**

Available objects for PDO mapping are listed in the object dictionaries ("Appendix" (→ p. 65)). All objects with the entry "yes" in column "PDO map." can be used.

Restrictions of flexible mapping:

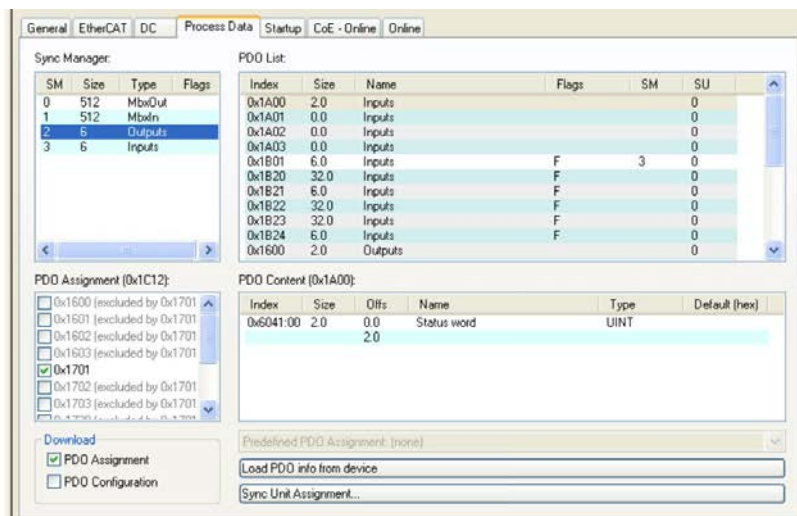
- An odd length PDO is not allowed.
  - In the Rx(=set-point)-direction the dummy-object 0x0002 sub 0 with a length of 8 bits can be used to make the PDO-length even.
  - In the Tx(=actual value)-direction one sub-index of the manufacturer status object 0x2002 sub 1..4 can be used to guarantee the even length of the Tx-PDO.
  - These special mappings may be used if the objects 0x6060 and 0x6061 have to be used in the mapping.
- The allowed PDOs have up to 32 bytes (Tx), 20 bytes for RX (FW version < 1.16) or 20 bytes for RX (FW > = 1.17). They are built from smaller PDO modules with a maximum length of 8 bytes. These are built by using the mapping objects 0x1600 to 0x1603 and 0x1a00 to 0x1a03.

The configuration is similar to the described sequence for the fixed mappings:

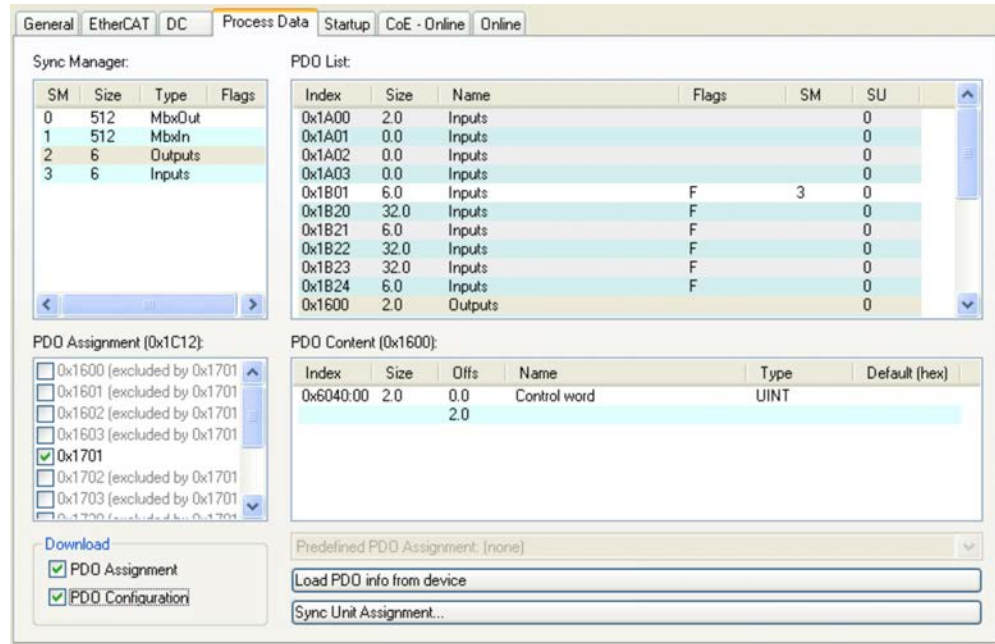
1. The mapping selection is cleared (write 0 to object 0x1C12 sub 0 and 1C13 sub 0)
2. As the AKD - implementation is based on CANopen the real-time data are build from up to 4 PDOs with 8 bytes in both directions. These PDOs are built in the same way as in a CAN-drive with the objects 0x1600 - 0x1603 and 0x1A00 - 0x1A03. Unused PDOs must be cleared with writing 0 to the subindex 0.
3. SDO write access to object 0x1C12 sub 1 .. 4 with the PDOs (0x1600 .. 0x1603), that should be used in receive direction of the AKD (set point values).
4. SDO write access to object 0x1C13 sub 1 .. 4 with the PDOs (0x1A00 .. 0x1A03), that should be used in transmit direction of the AKD (actual values).
5. SDO write access to the objects 0x1C12 sub 0 and 0x1C13 sub 0 with the number of mapped PDOs in this direction.

See an example in chapter "Flexible PDO Mappings" (→ p. 46) .

The cyclically used data are visible in the PDO-assignment window for the Inputs and Outputs of the Sync Managers. Default setting are the fixed PDOs 0x1701 and 0x1B01 (visible contents when selected in the PDO list).



If the flexible mapping is required, the PDO configuration check box must be changed.

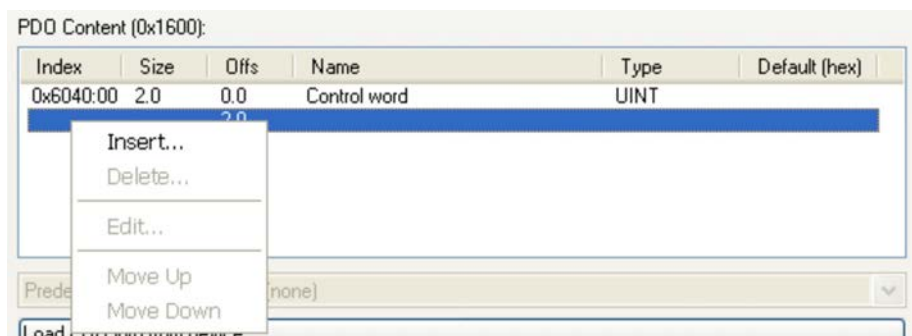


#### 4.6.1 Example: Flexible PDO Mapping

For the flexible mapping of the Outputs the fixed mapping 0x1701 has to be switched off and up to 4 free-mappable PDOs (0x1600-0x1603) can be used instead. The maximum number of bytes for each of these PDOs is 8.

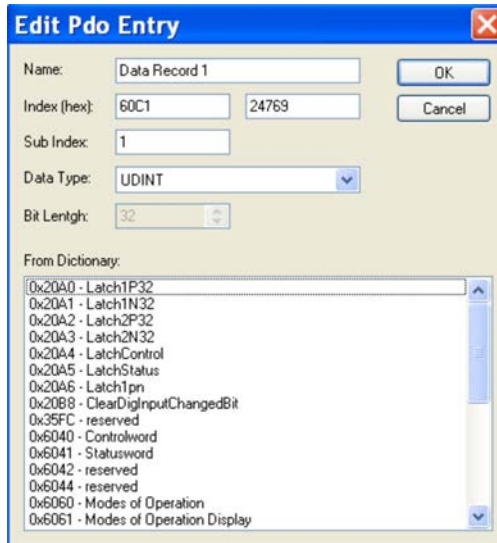


After that the default mapping of e.g. the PDO 0x1600 can be extended:

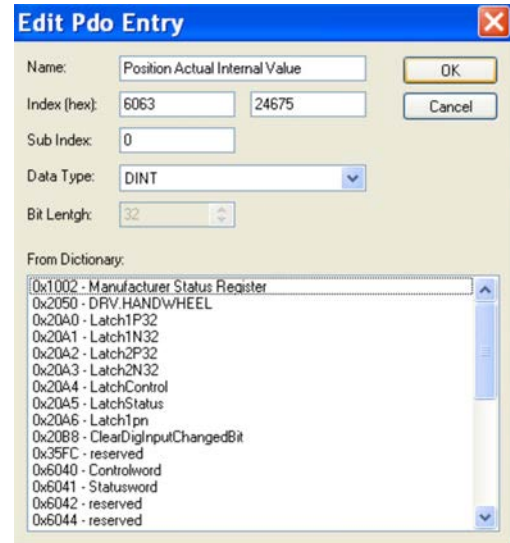




A list of possible objects for the mapping will be shown and a new entry can be chosen.



In this case the setpoint for the interpolated position mode is selected.



The same is valid for the Tx-PDO-direction. Here the value of the actual internal position is selected.

This results in the startup-SDO-list for this sample free-mapped-configuration.

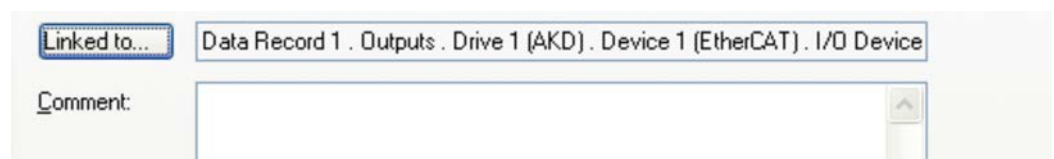
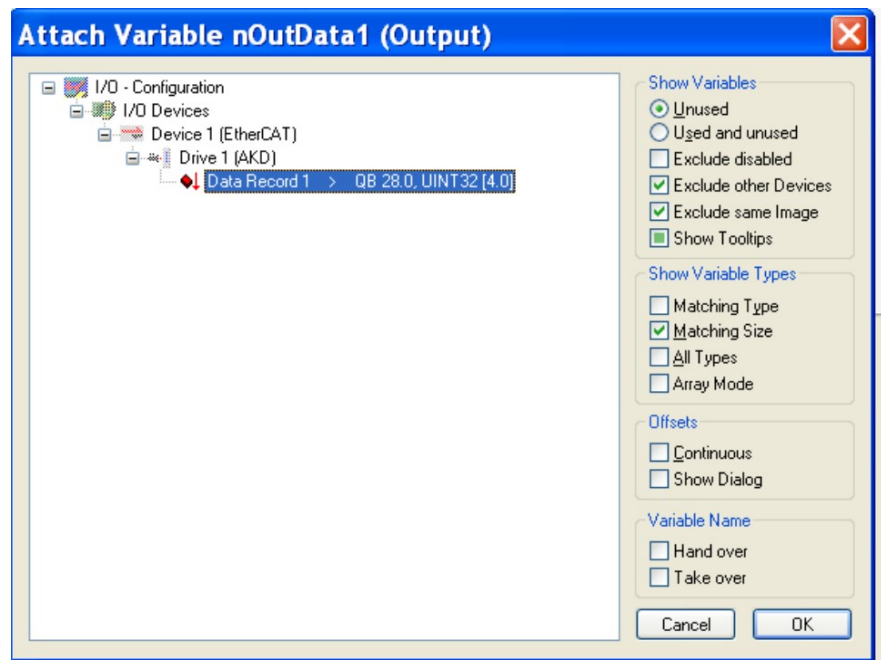
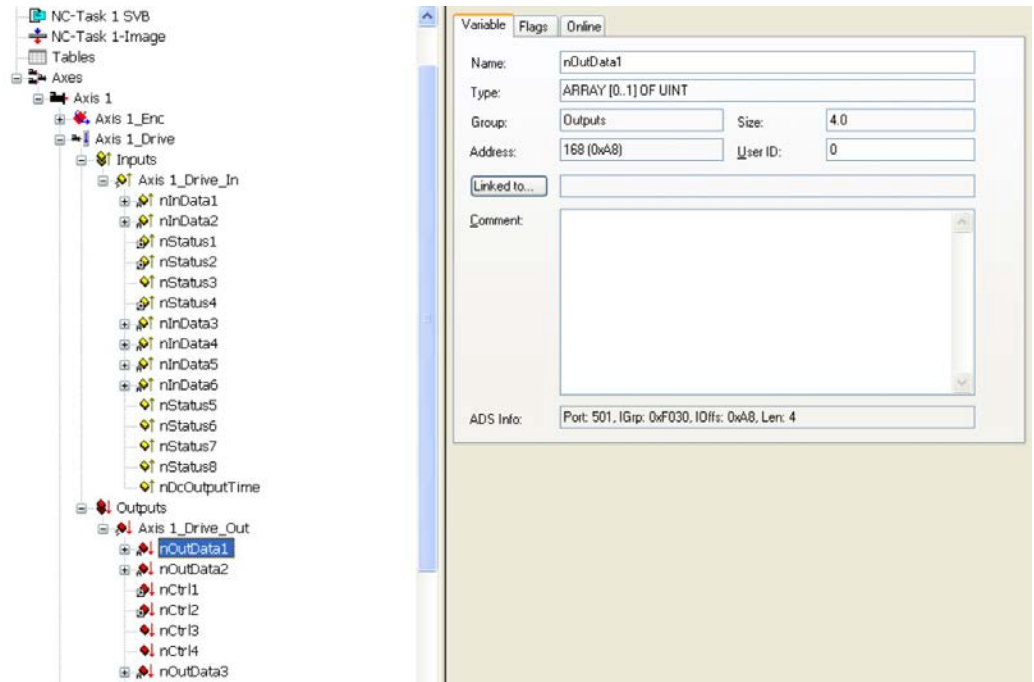
| Transition | Protocol | Index     | Data                    | Comment                     |
|------------|----------|-----------|-------------------------|-----------------------------|
| C <PS>     | CoE      | 0x1C12:00 | 0x00 (0)                | clear sm pdos (0x1C12)      |
| C <PS>     | CoE      | 0x1C13:00 | 0x00 (0)                | clear sm pdos (0x1C13)      |
| C <PS>     | CoE      | 0x1A00:00 | 0x00 (0)                | clear pdo 0x1A00 entries    |
| C <PS>     | CoE      | 0x1A00:01 | 0x60410010 (1614872592) | download pdo 0x1A00 entry   |
| C <PS>     | CoE      | 0x1A00:02 | 0x60630020 (1617100832) | download pdo 0x1A00 entry   |
| C <PS>     | CoE      | 0x1A00:00 | 0x02 (2)                | download pdo 0x1A00 entr... |
| C <PS>     | CoE      | 0x1A01:00 | 0x00 (0)                | clear pdo 0x1A01 entries    |
| C <PS>     | CoE      | 0x1A02:00 | 0x00 (0)                | clear pdo 0x1A02 entries    |
| C <PS>     | CoE      | 0x1A03:00 | 0x00 (0)                | clear pdo 0x1A03 entries    |
| C <PS>     | CoE      | 0x1600:00 | 0x00 (0)                | clear pdo 0x1600 entries    |
| C <PS>     | CoE      | 0x1600:01 | 0x60400010 (1614807056) | download pdo 0x1600 entry   |
| C <PS>     | CoE      | 0x1600:02 | 0x60C10120 (1623261472) | download pdo 0x1600 entry   |
| C <PS>     | CoE      | 0x1600:00 | 0x02 (2)                | download pdo 0x1600 entr... |
| C <PS>     | CoE      | 0x1601:00 | 0x00 (0)                | clear pdo 0x1601 entries    |
| C <PS>     | CoE      | 0x1602:00 | 0x00 (0)                | clear pdo 0x1602 entries    |
| C <PS>     | CoE      | 0x1603:00 | 0x00 (0)                | clear pdo 0x1603 entries    |
| C <PS>     | CoE      | 0x1C12:01 | 0x1600 (5632)           | download pdo 0x1C12:01 i... |
| C <PS>     | CoE      | 0x1C12:00 | 0x01 (1)                | download pdo 0x1C12 count   |
| C <PS>     | CoE      | 0x1C13:01 | 0x1B01 (6913)           | download pdo 0x1C13:01 i... |
| C <PS>     | CoE      | 0x1C13:00 | 0x01 (1)                | download pdo 0x1C13 count   |
| C PS       | CoE      | 0x6060:00 | 0x07 (7)                | Opmode                      |
| C PS       | CoE      | 0x60C2:01 | 0x02 (2)                | Cycle time                  |
| C PS       | CoE      | 0x60C2:02 | 0xFD (253)              | Cycle exp                   |

The meaning of the data (for example 0x60410010 in the mapping of 0x1A00 sub 1) is as follows:

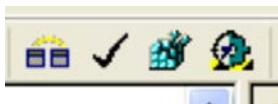
- 0x6041 is the index of the DS402 status word
- 0x00 is the subindex of the DS402 status word
- 0x10 is the number of bits for this entry, i. e. 16 bits or 2 bytes.



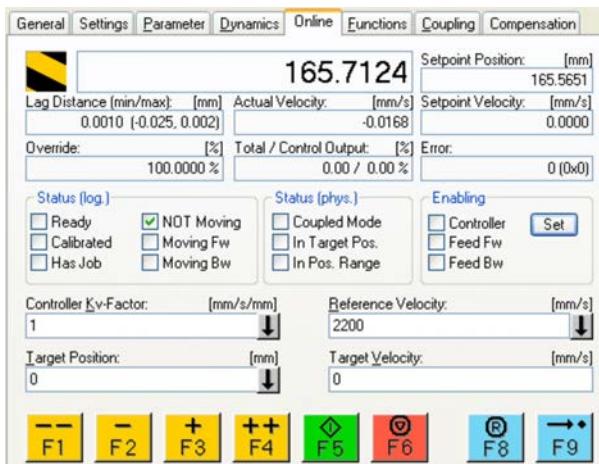
If this shall be used in the NC, the interpolation set point position has to be linked from the axis to the NC-axis.



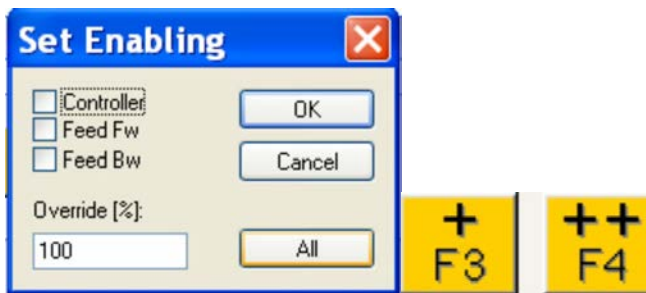
After doing this configuration the mapping can be activated as seen before in this document:



Now the NC-screen should show a position in the online window, which changes a bit in the last digits.



After enabling the power stage with the All-button, the drive can be moved via the jog-buttons or via the functions in the function menu.



### 4.6.2 Example: Flexible PDO Mapping with one byte gap in Rx-PDO

The AKD needs an even number of bytes in a PDO so it can be necessary to fill a gap if a one byte object like object 6060h sub 0 (mode of operation) is mapped to the Rx-PDO. This can be done in the following sequence:

- Rx-PDO Mapping with Controlword and 1st set-point.

Sync Manager:

| SM | Size | Type    | Flags |
|----|------|---------|-------|
| 0  | 1024 | MbxOut  |       |
| 1  | 1024 | MbxIn   |       |
| 2  | 6    | Outputs |       |
| 3  | 2    | Inputs  |       |

PDO List:

| Index  | Size | Name   | Flags | SM | SU |
|--------|------|--------|-------|----|----|
| 0x1A00 | 2.0  | Inputs |       | 3  | 0  |
| 0x1A01 | 0.0  | Inputs |       | 3  | 0  |
| 0x1A02 | 0.0  | Inputs |       | 3  | 0  |
| 0x1A03 | 0.0  | Inputs |       | 3  | 0  |
| 0x1B01 | 6.0  | Inputs | F     |    | 0  |
| 0x1B20 | 32.0 | Inputs | F     |    | 0  |
| 0x1B21 | 6.0  | Inputs | F     |    | 0  |
| 0x1B22 | 32.0 | Inputs | F     |    | 0  |
| 0x1B23 | 32.0 | Inputs | F     |    | 0  |
| 0x1B24 | 6.0  | Inputs | F     |    | 0  |

PDO Assignment (0x1C13):

- 0x1A00
- 0x1A01
- 0x1A02
- 0x1A03
- 0x1B01 (excluded by 0x1A03)
- 0x1B20 (excluded by 0x1A03)
- 0x1B21 (excluded by 0x1A03)
- 0x1B22 (excluded by 0x1A03)
- 0x1B23 (excluded by 0x1A03)
- 0x1B24 (excluded by 0x1A03)

PDO Content (0x1600):

| Index     | Size | Offs | Name          | Type | Default (hex) |
|-----------|------|------|---------------|------|---------------|
| 0x6040:00 | 2.0  | 0.0  | Controlword   | UINT |               |
| 0x60C1:01 | 4.0  | 2.0  | 1st set-point | DINT |               |
|           |      | 6.0  |               |      |               |

- Insert a one byte gap.

PDO Content (0x1600):

| Index     | Size | Offs | Name          | Type | Default (hex) |
|-----------|------|------|---------------|------|---------------|
| 0x6040:00 | 2.0  | 0.0  | Controlword   | UINT |               |
| 0x60C1:01 | 4.0  | 2.0  | 1st set-point | DINT |               |
|           |      | 6.0  |               |      |               |

0x1B20 32.0 Inputs F 0  
 0x1B21 6.0 Inputs F 0  
 0x1B22 32.0  
 0x1B23 32.0  
 0x1B24 6.0

PDO Content (0x1600):

| Index     | Size |
|-----------|------|
| 0x6040:00 | 2.0  |
| 0x60C1:01 | 4.0  |

Predefined PDO Assignment: (n)  
 Load PDO info from device  
 Sync Unit Assignment

**Edit Pdo Entry**

Name:

Index (hex):

Sub Index:

Data Type:

Bit Length:

From Dictionary:

- 0x1026:01 - StdIn
- 0x2071 - Target current
- 0x207F - Maximum velocity
- 0x2080 - Motion Task Select
- 0x20A4 - Latch controlword
- 0x20B8 - ClearDigInInputChangedBit
- 0x3450 - MOTOR BRAKERLS
- 0x345A:01 - Brake Control Command
- 0x3470:03 - ADUT.VALUE write
- 0x3497 - External feedback position
- 0x3499 - DRV.EMUESTEPCMD
- 0x34C0:01 - CMP0.ARMing
- 0x34C1:01 - CMP1.ARMing
- 0x6040 - Controlword

Type  
 UINT  
 BIT  
 BIT  
 UINT

In CANopen over EtherCAT, a gap is programmed using index 0 sub 0 with the size of the gap with one byte in the example.

- Insert additional object 6060h sub 0 (mode of operation).

PDO Content (0x1600):

| Index     | Size | Offs | Name          | Type | Default (hex) |
|-----------|------|------|---------------|------|---------------|
| 0x6040:00 | 2.0  | 0.0  | Controlword   | UINT |               |
| 0x60C1:01 | 4.0  | 2.0  | 1st set-point | DINT |               |
| ---       | 1.0  | 6.0  | ---           |      |               |
|           |      | 7.0  |               |      |               |

240.3.1... Edit Pdo Entry

Name: Modes of operation

Index (hex): 6060 24672

Sub Index: 0

Data Type: SINT

Bit Length: 8

From Dictionary:

- 0x20A4 - Latch controlword
- 0x20B8 - ClearDigInpuChangedBit
- 0x3450 - MOTOR.BRAKERLS
- 0x345A:01 - Brake Control Command
- 0x3470:03 - ADUT.VALUE write
- 0x3497 - External feedback position
- 0x3499 - DRV.EMUESTEPCMD
- 0x34C0:01 - CMP0.ARMing
- 0x34C1:01 - CMP1.ARMing
- 0x6040 - Controlword
- 0x6060 - Modes of operation
- 0x606D - Velocity window
- 0x606E - Velocity window time
- 0x6071 - Target torque

Result:

| Index  | Size | Offs | Name    | Type | Default (hex) |
|--------|------|------|---------|------|---------------|
| 0x1B26 | 18.0 |      | Inputs  | F    | 0             |
| 0x1600 | 8.0  |      | Outputs | 2    | 0             |
| 0x1601 | 0.0  |      | Outputs | 2    | 0             |

PDO Content (0x1600):

| Index     | Size | Offs | Name               | Type | Default (hex) |
|-----------|------|------|--------------------|------|---------------|
| 0x6040:00 | 2.0  | 0.0  | Controlword        | UINT |               |
| 0x60C1:01 | 4.0  | 2.0  | 1st set-point      | DINT |               |
| ---       | 1.0  | 6.0  | ---                |      |               |
| 0x6060:00 | 1.0  | 7.0  | Modes of operation | SINT |               |

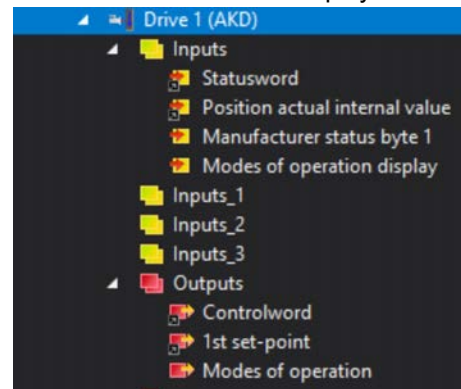
PDO List:

| Index  | Size | Name   | Flags | SM | SU |
|--------|------|--------|-------|----|----|
| 0x1A00 | 8.0  | Inputs |       | 3  | 0  |
| 0x1A01 | 0.0  | Inputs |       | 3  | 0  |
| 0x1A02 | 0.0  | Inputs |       | 3  | 0  |
| 0x1A03 | 0.0  | Inputs |       | 3  | 0  |
| 0x1B01 | 6.0  | Inputs | F     |    | 0  |
| 0x1B20 | 32.0 | Inputs | F     |    | 0  |
| 0x1B21 | 6.0  | Inputs | F     |    | 0  |
| 0x1B22 | 32.0 | Inputs | F     |    | 0  |
| 0x1B23 | 32.0 | Inputs | F     |    | 0  |
| 0x1B24 | 6.0  | Inputs | F     |    | 0  |

PDO Content (0x1A00):

| Index     | Size | Offs | Name                           | Type  | Default (hex) |
|-----------|------|------|--------------------------------|-------|---------------|
| 0x6041:00 | 2.0  | 0.0  | Statusword                     | UINT  |               |
| 0x6063:00 | 4.0  | 2.0  | Position actual internal value | DINT  |               |
| 0x2002:01 | 1.0  | 6.0  | Manufacturer status byte 1     | USINT |               |
| 0x6061:00 | 1.0  | 7.0  | Modes of operation display     | SINT  |               |
|           |      | 8.0  |                                |       |               |

View in the TwinCat I/O display.



**NOTE**

For Tx-PDOs, an even number of bytes is required. To fill a gap in the Tx-PDO mapping, existing one byte objects like 2002h sub 1 (Manufacturer status byte 1) can be used.

## 4.7 Supported Cyclical Setpoint and Actual Values

### Supported cyclical setpoint values

| Name                             | CANopen object | Data type | Description  |
|----------------------------------|----------------|-----------|--|
| Target current                   | 0x2071 sub 0   | 32 bit    | scaled in mA   |
| Latch Control word               | 0x20A4 sub 0   | UINT16    |  |
| Clear digital Input Change Bit   | 0x20B8         | 16 bit    |  |
| Analog output value              | 0x3470 sub 3   | 16 bit    |  |
| External feedback position       | 0x3497 sub 0   | 32 bit    |  |
| CANopen control-word             | 0x6040 sub 0   | UINT16    | CANopen control word.  |
| Modes of Operation               | 0x6060 sub 0   | 8 bit     | DS402 opmode setpoint  |
| Velocity Window                  | 0x606D sub 0   | 16 bit    |  |
| Velocity Window Time             | 0x606E sub 0   | 16 bit    |  |
| Target Torque                    | 0x6071 sub 0   | 16 bit    | 0.1% resolution  |
| Maximum Torque                   | 0x6072 sub 0   | 16 bit    |  |
| Target position                  | 0x607A sub 0   | INT32     | Used in profile position mode / cyclic synchronous position mode |
| Profile position target velocity | 0x6081 sub 0   | 32 bit    | related to MT.V  |
| Profile position target acc      | 0x6083 sub 0   | 32 bit    | related to MT.ACC  |
| Profile position target dec      | 0x6084 sub 0   | 32 bit    | related to MT.DEC  |
| Velocity feed forward            | 0x60B1 sub 0   | 32 bit    |  |
| Torque feed forward              | 0x60B2 sub 0   | INT16     |  |
| Touch probe function             | 0x60B8         | 16 bit    |  |
| Position command value           | 0x60C1 sub 1   | INT32     | Interpolation data record in IP-mode                             |
| Digital outputs                  | 0x60FE sub 1   | UINT32    |  |
| Velocity command value           | 0x60FF sub 0   | INT32     |  |

**Supported cyclical actual values**

| Name                            | CANopen object | Data type | Description           |
|---------------------------------|----------------|-----------|-----------------------|
| Position actual internal value  | 0x6063 sub 0   | INT32     |                       |
| Velocity actual value           | 0x606C sub 0   | INT32     |                       |
| CANopen status-word             | 0x6041 sub 0   | UINT16    | CANopen status word   |
| Second position feedback        | 0x2050 sub 0   | INT32     |                       |
| Digital inputs                  | 0x60FD sub 0   | UINT32    |                       |
| Following error actual value    | 0x60F4 sub 0   | INT32     |                       |
| Latch position positive edge    | 0x20A0 sub 0   | INT32     |                       |
| Torque actual value             | 0x6077 sub 0   | INT16     |                       |
| Latch status                    | 0x20A5 sub 0   | UINT16    |                       |
| Actual Current                  | 0x2077 sub 0   | 32 bit    | scaled in mA          |
| Latch1 negative edge            | 0x20A1 sub 0   | 32 bit    |                       |
| Latch2 Positive                 | 0x20A2 sub 0   | 32 bit    |                       |
| Latch2 Negative                 | 0x20A3 sub 0   | 32 bit    |                       |
| Latch1 positive/negative edge   | 0x20A6         | 32 bit    |                       |
| Latch 2 positive/negative edge  | 0x20A7         | 32 bit    |                       |
| Modes of Operation              | 0x6061         | 8 bit     | DS402 opmode status   |
| Position Actual Value           | 0x6064 sub 0   | 32 bit    | WB/ DS402 scale units |
| Touch probe status              | 0x60B9 sub 0   | 16 bit    |                       |
| Touch probe 1 positive edge pos | 0x60BA sub 0   | 32 bit    |                       |
| Touch probe 1 negative edge pos | 0x60BB sub 0   | 32 bit    |                       |
| Touch probe 2 positive edge pos | 0x60BC sub 0   | 32 bit    |                       |
| Touch probe 2 negative edge pos | 0x60BD sub 0   | 32 bit    |                       |
| Additional Pos actual value     | 0x60E4 sub 0   | 48 bit    |                       |
| Additional Pos actual value     | 0x60E4 sub 1   | 32 bit    |                       |
| Motor I2t                       | 0x3427 sub 3   | 32 bit    |                       |
| Analog output value             | 0x3470 sub 2   | 16 bit    |                       |
| Analog Input value              | 0x3470 sub 4   | 16 bit    |                       |
| Manufacturer status register    | 0x1002 sub 0   | 32 bit    |                       |



## 4.8 Supported Operation Modes

| CANopen mode of operation   | AKD mode of operation           | Description  |
|-----------------------------|---------------------------------|--|
| Profile velocity            | DRV.OPMODE 1<br>DRV.CMDSOURCE 1 | 0x6060Sub0 Data: 3<br>In this mode, the EtherCAT master sends cyclic velocity command values to the AKD.   |
| Interpolated position       | DRV.OPMODE 2<br>DRV.CMDSOURCE 1 | 0x6060Sub0 Data: 7<br>In this mode of operation the EtherCAT master sends cyclic position command values to the AKD. These command values are interpolated by the AKD according to the fieldbus sample rate. |
| Homing mode                 | DRV.OPMODE 2<br>DRV.CMDSOURCE 0 | 0x6060 sub 0 data : 6<br>In this mode an AKD-internal homing can be done.  |
| Profile Position            | DRV.OPMODE 2<br>DRV.CMDSOURCE 0 | 0x6060sub0 Data: 1<br>Uses motion task 0 to execute a point to point move  |
| Torque                      | DRV.OPMODE 0<br>DRV.CMDSOURCE 1 | 0x6060sub0 Data: 4<br>Commands torque in % of drive peak torque  |
| Cyclic Synchronous Position | DRV.OPMODE 2<br>DRV.CMDSOURCE 1 | 0x6060sub0 Data: 8<br>Master calculates move profile and commands motion with position points  |

## 4.9 Adjusting EtherCAT Cycle Time

The cycle time to be used in the drive for the cyclical setpoints and actual values can either be stored in the FBUS.SAMPLEPERIOD parameter in the amplifier or configured in the start-up phase. This happens via SDO mailbox access to objects 60C2 subindex 1 and 2.

Subindex 2, known as the interpolation time index, defines the power of ten of the time value (e.g. -3 means 10<sup>-3</sup> or milliseconds) while subindex 1, known as interpolation time units, gives the number of units (e.g. 4 means 4 units).

You can run a 2 ms cycle using various combinations. For example,

Index = -3, Units = 2 or

Index = -4, Units = 20 etc.

The FBUS.SAMPLEPERIOD parameter is counted in multiples of 62.5us microseconds within the device. This means, for example that 2 ms equates to FBUS.SAMPLEPERIOD value of 32.

## 4.10 Maximum Cycle Times depending on operation mode

The minimum cycle time for the drive is largely dependent on the drive configuration (second actual position value encoder latch functionality enabled and so on)

| Interface | Cycle time AKD       |
|-----------|----------------------|
| Position  | ≥ 0.25 ms (≥ 250 μs) |
| Velocity  | ≥ 0.25 ms (≥ 250 μs) |
| Torque    | ≥ 0.25 ms (≥ 250 μs) |



## 4.11 Synchronization

On all drives, the internal PLL is theoretically able to even out an average deviation of up to 4800 ppm in the cycle time provided by the master. The drive checks once per fieldbus cycle a counter within the drive internal FPGA, which is cleared by a Sync0 (Distributed clock) event. Depending of the counter value, the drive extends or decreases the 62.5  $\mu$ s MTS signal within the drive by a maximum of 300 ns.

The theoretical maximum allowed deviation can be calculated by using the following formula:

$$\max_{dev} = \frac{300[\text{ns}]}{62.5[\mu\text{s}]} \cdot 1,000,000 = 4800 \text{ [ppm]}$$

The synchronization functionality within the drive can be enabled via setting bit 0 of the FBUS.PARAM02 parameter to high. Therefore FBUS.PARAM02 must be set to the value of 1. Furthermore the distributed clock functionality must be enabled by the EtherCAT master in order to activate cyclic Sync0 events.

### 4.11.1 Synchronization behavior with distributed clocks (DC) enabled

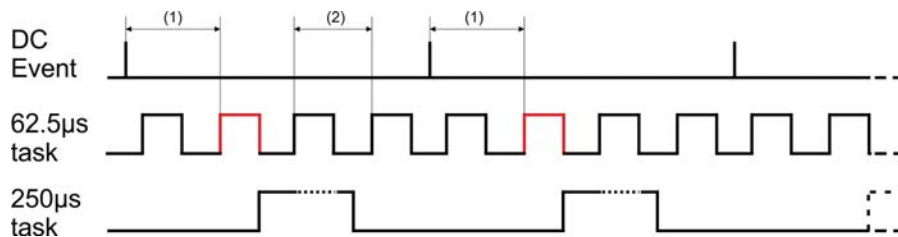
When the EtherCAT master enables distributed clocks, a distributed clock (DC) event is created in the AKD once per fieldbus cycle. An assigned 62.5  $\mu$ s real-time task in the AKD monitors the elapsed time between the DC events and the AKD System time and extends or reduces the 62.5  $\mu$ s strobe to the CPU as necessary.

The following fieldbus parameters are used for the synchronization feature:

1. FBUS.SYNCDIST = Expected time delay of the AKD PLL-code to the DC event.
2. FBUS.SYNCACT = Actual time delay of the AKD PLL-code to the DC event.
3. FBUS.PLLTHRESH = Number of consecutive successful synchronized PLL cycles of the AKD before the Drive is considered as synchronized.
4. FBUS.SYNCWND = Synchronization window in which the AKD is considered to be synchronized. The Drive is considered synchronized as long as the following statement is true is true for FBUS.PLLTHRESH consecutive cycles:  

$$\text{FBUS.SYNCDIST} - \text{FBUS.SYNCWND} < \text{FBUS.SYNCACT} < \text{FBUS.SYNCDIST} + \text{FBUS.SYNCWND}$$

Example with a 4kHz fieldbus sample rate:



Explanation: The red-marked 62.5[ $\mu$ s] real-time task displays the AKD 62.5  $\mu$ s real-time task within one fieldbus cycle which is responsible for calling the AKD PLL-code. The time delay (1) shows the actual delay to the previous DC event, which is ideally close to the adjusted FBUS.SYNCDIST parameter. Depending on (1) the AKD slightly extends or reduce the 62.5 [ $\mu$ s] IRQ generation of the high-priority real-time task in order to either increase or decrease the measured time delay to the DC event (1) for the next PLL cycle. The time distance (2) shows the 62.5[ $\mu$ s]  $\pm$  x[ms] realtime task of the AKD.

### 4.11.2 Synchronization behavior with distributed clocks (DC) disabled

The AKD fieldbus synchronization algorithm is similar to that used by Distributed Clocks. The difference is that the AKD synchronizes to a SyncManager2 event instead of the DC event. A SyncManager2 event is created when the EtherCAT Master sends a new package of command values to the drive while the network is in the Operational state. This occurs once per fieldbus cycle.

## 4.12 Latch Control Word and Latch Status Word

### Latch Control word (2 Byte)

| Bit   | Value (bin)       | Value (hex) | Description                           |
|-------|-------------------|-------------|---------------------------------------|
| 0     | 00000000 00000001 | zz01        | Enable extern latch 1 (positive rise) |
| 1     | 00000000 00000010 | zz02        | Enable extern latch 1 (negative rise) |
| 2     | 00000000 00000100 | zz04        | Enable extern latch 2 (positive rise) |
| 3     | 00000000 00001000 | zz08        | Enable extern latch 2 (negative rise) |
| 4     |                   |             |                                       |
| 5-7   |                   |             | Reserve                               |
| 8-12  | 00000001 00000000 | 01zz        | Read external latch 1 (positive rise) |
|       | 00000010 00000000 | 02zz        | Read external latch 1 (negative rise) |
|       | 00000011 00000000 | 03zz        | Read external latch 2 (positive rise) |
|       | 00000100 00000000 | 04zz        | Read external latch 2 (negative rise) |
| 13-15 |                   |             | Reserve                               |

### Latch Status word (2 Byte)

| Bit   | Value (bin)       | Value (hex) | Description  |
|-------|-------------------|-------------|--|
| 0     | 00000000 00000001 | zz01        | External latch 1 valid (positive rise)             |
| 1     | 00000000 00000010 | zz02        | External latch 1 valid (negative rise)             |
| 2     | 00000000 00000100 | zz04        | External latch 2 valid (positive rise)             |
| 3     | 00000000 00001000 | zz08        | External latch 2 valid (negative rise)             |
| 4     |                   |             |  |
| 5-7   |                   |             | Reserve  |
| 8-11  | 00000001 00000000 | z1zz        | Acknowledge value external latch 1 (positive rise) |
|       | 00000010 00000000 | z2zz        | Acknowledge value external latch 1 (negative rise) |
|       | 00000011 00000000 | z3zz        | Acknowledge value external latch 2 (positive rise) |
|       | 00000100 00000000 | z4zz        | Acknowledge value external latch 2 (negative rise) |
| 12-15 | 00010000 00000000 | 1zzz        | Digital Input State 4                              |
|       | 00100000 00000000 | 2zzz        | Digital Input State 3                              |
|       | 01000000 00000000 | 4zzz        | Digital Input State 2                              |
|       | 10000000 00000000 | 8zzz        | Digital Input State 1                              |

## 4.13 Mailbox Handling

With EtherCAT, acyclical data traffic (object channel or SDO channel) is called mailbox.

### NOTE

Available SDO objects are listed in the ("Appendix" (→ p. 65)).

This system is based around the master:

#### Mailbox Output:

The master (EtherCAT controller) sends data to the slave (drive). This is essentially a (read/write) request from the master. Mailbox output operates via Sync Manager 0.

#### Mailbox Input:

The slave (drive) sends data to the master (EtherCAT controller). The master reads the slave's response. Mailbox input operates via Sync Manager 1.

#### Timing diagram

The timing diagram illustrates the mailbox access process:



1. The EtherCAT master writes the mailbox request to the mail-out buffer.
2. On the next interrupt, the EtherCAT interface activates a Sync Manager 0 event (mailbox output event) in the AL event register.
3. The drive reads 16 bytes from the mail-out buffer and copies them to the internal mailbox output array.
4. The drive identifies new data in the internal mailbox output array and performs an SDO access to the object requested by the EtherCAT interface. The response from the drive is written to an internal mailbox input array.
5. The drive deletes all data in the internal mailbox output array so that a new mailbox access attempt can be made.
6. The drive copies the response telegram from the internal mailbox input array to the mail-in buffer of the EtherCAT interface.

### 4.13.1 Mailbox Output

An interrupt by the EtherCAT-interface with a Sync Manager 0 - Event starts a Mailbox Output Process. A 1 in the Mail Out Event-Bit of the AL Event register signals the drive, that the EtherCAT-interface wants to send a Mailbox message and that it has already stored the required data in the Mail Out Buffer. Now 16 Byte data are read by the drive with the IRQ process. The bytes are defined as follows

| Address 0x1800                                  |   |   |   |   |   |   |   | Address 0x180F                          |   |    |    |    |    |    |    |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
| 0   | 1   | 2 | 3   | 4   | 5 | 6 | 7 | 8                                       | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CAN over EtherCAT specific data<br>(CoE Header) |   |   |   |   |   |   |   | CAN specific data<br>(standard CAN SDO) |   |    |    |    |    |    |    |
| Byte 0  | Length of the data (Low Byte)   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 1  | Length of the data (High Byte)  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 2  | Address (Low Byte)  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 3  | Address (High Byte)   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 4  | Bit 0 to 5: Channel<br>Bit 6 to 7: Priority   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 5  | Bit 0 to 3: Type  |   |   | 1 = Reserved: ADS over EtherCAT<br>2 = Reserved: Ethernet over EtherCAT<br>3 = Can over EtherCAT... |   |   |   |   |   |    |    |    |    |    |    |
|   | Bit 4 to 7: Reserved  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 6  | PDO Number (with PDO transmissions only, Bit 0 = LSB of the PDO number, see Byte 7 for MSB) |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 7  | Bit 0: MSB of the PDO number, see Byte 6  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
|   | Bit 1 to 3: Reserved  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
|   | Bit 4 to 7: CoE specific type   |   |   | 0: Reserved   |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 1: Emergency message  |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 2: SDO request  |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 3: SDO answer   |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 4: TXPDO  |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 5: RxPDO  |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   |   | 6: Remote transmission request of a TxPDO   |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   | 7: Remote transmission request of a RxPDO |   |   |   |   |   |   |    |    |    |    |    |    |
|   |   |   | 8...15: reserved                          |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 8  | Control-Byte in the CAN telegram:   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
|   | write access:   |   |   | 0x23=4Byte, 0x27=3Byte, 0x2B=2Byte, 0x2F-F=1Byte  |   |   |   |   |   |    |    |    |    |    |    |
|   | read access:  |   |   | 0x40  |   |   |   |   |   |    |    |    |    |    |    |
| Byte 9  | Low Byte of the CAN object number (Index)   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 10   | High Byte of the CAN object number (Index)  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 11   | Subindex according to CANopen Specification for the drive                                   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 12   | Data with a write access (Low Byte)   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 13   | Data with a write access  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 14   | Data with a write access  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
| Byte 15   | Data with a write access (High Byte)  |   |   |   |   |   |   |   |   |    |    |    |    |    |    |

The drive answers every telegram with an answer in the Mailbox Input buffer.

### 4.13.2 Mailbox Input

The drive answers every CoE telegram with a 16 byte answer telegram in the Mailbox Input buffer. The bytes are defined as follows:

| Address 0x1C00                                  |   |   |   |   |   |   |   | Address 0x1C0F   |   |    |    |    |    |    |    |  |
|---|---|---|---|---|---|---|---|--|---|----|----|----|----|----|----|--|
| 0   | 1   | 2 | 3 | 4 | 5 | 6   | 7   | 8  | 9 | 10 | 11 | 12 | 13 | 14 | 15 |  |
| CAN over EtherCAT specific data<br>(CoE Header) |   |   |   |   |   |   |   | CAN specific data<br>(standard CAN SDO)                                      |   |    |    |    |    |    |    |  |
| Byte 0  | Length of the data (Low Byte)   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 1  | Length of the data (High Byte)  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 2  | Address (Low Byte)  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 3  | Address (High Byte)   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 4  | Bit 0 to 5: Channel<br>Bit 6 to 7: Priority   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 5  | Bit 0 to 3: Type  |   |   |   |   |   | 1 = Reserved: ADS over EtherCAT<br>2 = Reserved: Ethernet over EtherCAT<br>3 = Can over EtherCAT... |  |   |    |    |    |    |    |    |  |
|   | Bit 4 to 7: Reserved  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 6  | PDO Number (with PDO transmissions only, Bit 0 = LSB of the PDO number, see Byte 7 for MSB) |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 7  | Bit 0: MSB of the PDO number, see Byte 6  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
|   | Bit 1 to 3: Reserved  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
|   | Bit 4 to 7: CoE specific type   |   |   |   |   |   | 0: Reserved   |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 1: Emergency message  |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 2: SDO request  |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 3: SDO answer   |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 4: TXPDO  |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 5: RxPDO  |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   |   | 6: Remote transmission request of a TxPDO   |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   | 7: Remote transmission request of a RxPDO |   |  |   |    |    |    |    |    |    |  |
|   |   |   |   |   |   | 8...15: reserved                          |   |  |   |    |    |    |    |    |    |  |
| Byte 8  | Control-Byte in the CAN telegram:   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
|   | write access OK:  |   |   |   |   |   | 0x60  |  |   |    |    |    |    |    |    |  |
|   | read access OK + length of answer:  |   |   |   |   |   | 0x43 (4 Byte), 0x47 (3 Byte), 0x4B (2Byte), 0x4F (1Byte)  |  |   |    |    |    |    |    |    |  |
|   | error with read- or write access:   |   |   |   |   |   | 0x80  |  |   |    |    |    |    |    |    |  |
| Byte 9  | Low Byte of the CAN object number (Index)   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 10   | High Byte of the CAN object number (Index)  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 11   | Subindex according to CANopen Specification for Kollmorgen drive                            |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 12   | Data (Low Byte)   |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |
| Byte 13   | Data  |   |   |   |   |   |   | error code Fehlercode according to CANopen Specification in case of an error |   |    |    |    |    |    |    |  |
| Byte 14   | Data  |   |   |   |   |   |   | data value of the object in case of successfull read access                  |   |    |    |    |    |    |    |  |
| Byte 15   | Data (High Byte)  |   |   |   |   |   |   |  |   |    |    |    |    |    |    |  |

### 4.13.3 Example: Mailbox Access

In the example below, PDOs 0x1704 are mapped (see Chapter "Fixed PDO Mappings" (→ p. 43) "Fixed PDO Mappings"):

The master sends this mailbox output message:

|         |      |  |
|---------|------|--|
| Byte 0  | 0x0A | The next 10 Bytes contain data (Byte 2 to Byte 11) |
| Byte 1  | 0x00 | The next 10 Bytes contain data (Byte 2 to Byte 11) |
| Byte 2  | 0x00 | Address 0  |
| Byte 3  | 0x00 | Address 0  |
| Byte 4  | 0x00 | Channel 0 and Priority 0                           |
| Byte 5  | 0x03 | CoE Object   |
| Byte 6  | 0x00 | PDO Number 0                                       |
| Byte 7  | 0x20 | PDO Number 0 and SDO-Request                       |
| Byte 8  | 0x2B | 2 Byte write access                                |
| Byte 9  | 0x12 | SDO-Object 0x1C12                                  |
| Byte 10 | 0x1C | SDO-Object 0x1C12                                  |
| Byte 11 | 0x01 | Subindex 1   |
| Byte 12 | 0x04 | Data value 0x00001704                              |
| Byte 13 | 0x17 | Data value 0x00001704                              |
| Byte 14 | 0x00 | Data value 0x00001704                              |
| Byte 15 | 0x00 | Data value 0x00001704                              |

The drive returns the following message:

|         |      |  |
|---------|------|--|
| Byte 0  | 0x0E | The next 14 Bytes contain data (Byte 2 to Byte 15) |
| Byte 1  | 0x00 | The next 14 Bytes contain data (Byte 2 to Byte 15) |
| Byte 2  | 0x00 | Address 0  |
| Byte 3  | 0x00 | Address 0  |
| Byte 4  | 0x00 | Channel 0 and Priority 0                           |
| Byte 5  | 0x03 | CoE Object   |
| Byte 6  | 0x00 | PDO Number 0                                       |
| Byte 7  | 0x20 | PDO Number 0 and SDO-Answer                        |
| Byte 8  | 0x60 | Successful write access                            |
| Byte 9  | 0x12 | SDO-Object 0x1C12                                  |
| Byte 10 | 0x1C | SDO-Object 0x1C12                                  |
| Byte 11 | 0x01 | Subindex 1   |
| Byte 12 | 0x00 | Data value 0x00000000                              |
| Byte 13 | 0x00 | Data value 0x00000000                              |
| Byte 14 | 0x00 | Data value 0x00000000                              |
| Byte 15 | 0x00 | Data value 0x00000000                              |

#### 4.14 EEPROM Content

AKD has a built-in emulated EEPROM. This EEPROM can be read by the EtherCAT master to get some information about drive properties, like PDO-information, drive name, serial numbers and communication-specific attributes.

They are organized in categories. There are two manufacturer-specific categories implemented in the AKD:

- Category 0x0800: Holds a string with the model type
- 0x0801: Holds the firmware version in the format 0x\_xx-xx-yyy

#### 4.15 Emergency Service

Starting with firmware version 1-18-03-000, the drive can notify an EtherCAT master of a fault or warning via the emergency service. It will send a CoE frame with the CoE header's service field set to 1 (Emergency) and the data containing a Emergency Object (EMCY). A separate frame will be sent for every fault and warning that occurred. Additionally, a frame with emergency code 0 will be sent as an indication, that all faults and warnings have been cleared. This feature has to be manually enabled by setting the keyword ECAT.ENEMCYREQ to 1.

-- / --



## 5 Appendix

### 5.1 CANopen Emergency Messages and Error Codes

Emergency messages are triggered by internal equipment errors. They have a high ID-priority to ensure quick access to the bus. An emergency message contains an error field with pre-defined error/fault numbers (2 bytes), an error register (1byte), the error category (1 byte), and additional information. Error numbers 0000h to 7FFFh are defined in the communication or drive profile. Error numbers FF00h to FFFFh have manufacturer-specific definitions.

Starting with firmware version 1-18-03-000 the keyword CANOPEN.ADDMANUEMNCYCODE can be set to 1 to enable adding manufacturer specific information to the additional information field. When enabled, the additional information will contain the warning or fault number as ASCII characters.

| Error Code | Fault/Warning | Description                                    |
|------------|---------------|--|
| 0x0000     | 0             | Emergency error free.                          |
| 0x1080     | -             | General Warning.                               |
| 0x1081     | -             | General Error.                                 |
| 0x3110     | F523          | DC Bus link over voltage FPGA.                 |
| 0x3120     | F247          | DC Bus link voltage exceed allowed thresholds. |
| 0x3130     | F503          | DC Bus link capacitor overload.                |
| 0x3180     | n503          | Warning: DC Bus link capacitor overload.       |
| 0x3210     | F501          | DC Bus link over-voltage.                      |
| 0x3220     | F502          | DC Bus Link under-voltage.                     |
| 0x3280     | n502          | Warning: DC Bus Link under-voltage.            |
| 0x3281     | n521          | Warning: Dynamic Braking I <sup>2</sup> T.     |
| 0x3282     | F519          | Regen short circuit.                           |
| 0x3283     | n501          | Warning: DC Bus link over-voltage.             |
| 0x4210     | F234          | Excessive temperature, device (control board). |
| 0x4310     | F235          | Excessive temperature, drive (heat sink).      |
| 0x4380     | F236          | Power temperature sensor 2 high.               |
| 0x4381     | F237          | Power temperature sensor 3 high.               |
| 0x4382     | F535          | Power board overtemperature.                   |
| 0x4390     | n234          | Warning: Control temperature sensor 1 high.    |
| 0x4391     | n235          | Warning: Power temperature sensor 1 high.      |
| 0x4392     | n236          | Warning: Power temperature sensor 2 high.      |
| 0x4393     | n237          | Warning: Power temperature sensor 3 high.      |
| 0x4394     | n240          | Warning: Control temperature sensor 1 low.     |
| 0x4395     | n241          | Warning: Power temperature sensor 1 low.       |
| 0x4396     | n242          | Warning: Power temperature sensor 2 low.       |
| 0x4397     | n243          | Warning: Control temperature sensor 1 low.     |
| 0x4398     | F240          | Control temperature sensor 1 low.              |
| 0x4399     | F241          | Power temperature sensor 1 low.                |
| 0x439A     | F242          | Power temperature sensor 2 low.                |
| 0x439B     | F243          | Power temperature sensor 3 low.                |
| 0x5113     | F512          | 5V0 under voltage.                             |
| 0x5114     | F505          | 1V2 under voltage.                             |

| Error Code | Fault/Warning | Description   |
|------------|---------------|---|
| 0x5115     | F507          | 2V5 under voltage.  |
| 0x5116     | F509          | 3V3 under voltage.  |
| 0x5117     | F514          | +12V0 under voltage.  |
| 0x5118     | F516          | -12V0 under voltage.  |
| 0x5119     | F518          | Analog 3V3 under voltage.                                   |
| 0x5180     | F504          | 1V2 over voltage.   |
| 0x5181     | F506          | 2V5 over voltage.   |
| 0x5182     | F508          | 3V3 over voltage.   |
| 0x5183     | F510          | 5V0 over voltage.   |
| 0x5184     | F513          | +12V0 over voltage.   |
| 0x5185     | F515          | -12V0 over voltage.   |
| 0x5186     | F517          | Analog 3V3 over voltage.                                    |
| 0x5530     | F105          | Hardware memory, non-volatile memory stamp invalid.         |
| 0x5580     | F106          | Hardware memory, non-volatile memory data.                  |
| 0x5589     | F124          | Cogging compensation non volatile memory data error (CRC).  |
| 0x5590     | F204          | Control board EEPROM read failed.                           |
| 0x5591     | F205          | Control board EEPROM corrupted serial num stamp.            |
| 0x5592     | F206          | Control board EEPROM corrupted serial num data.             |
| 0x5593     | F207          | Control board EEPROM corrupted parameter stamp.             |
| 0x5594     | F208          | Control board EEPROM corrupted parameter data.              |
| 0x5595     | F219          | Control board EEPROM write failed.                          |
| 0x55A0     | F209          | Power board EEPROM read failed.                             |
| 0x55A1     | F210          | Power board EEPROM corrupted serial num stamp.              |
| 0x55A2     | F212          | Power board EEPROM corrupted serial num data.               |
| 0x55A3     | F213          | Power board EEPROM corrupted parameter stamp.               |
| 0x55A4     | F214          | Power board EEPROM corrupted parameter data.                |
| 0x55A5     | F230          | Power board EEPROM write failed.                            |
| 0x55A6     | F232          | Power board EEPROM invalid data.                            |
| 0x55B0     | F248          | Option board EEPROM corrupted.                              |
| 0x55B1     | F249          | Option board upstream checksum.                             |
| 0x55B2     | F250          | Option board upstream checksum.                             |
| 0x55B3     | F251          | Option board watchdog.                                      |
| 0x55B8     | F252          | Firmware and option board FPGA types are not compatible.    |
| 0x55B9     | F253          | Firmware and option board FPGA versions are not compatible. |
| 0x55C0     | F621          | Control Board CRC fault.                                    |
| 0x55C1     | F623          | Power Board CRC fault.                                      |
| 0x55C2     | F624          | Power Board Watchdog fault.                                 |
| 0x55C3     | F625          | Power Board Communication fault.                            |
| 0x55C4     | F626          | Power Board FPGA not configured.                            |
| 0x55C5     | F627          | Control Board Watchdog fault.                               |
| 0x55C6     | n103          | Warning: Resident FPGA .                                    |
| 0x55C7     | n104          | Warning: Operational FPGA .                                 |
| 0x6080     | F631          | Issue command timed out                                     |
| 0x6380     | F532          | Drive motor parameters setup incomplete.                    |
| 0x6381     | F120          | Failed to set default parameters.                           |

| Error Code | Fault/Warning | Description   |
|------------|---------------|---|
| 0x7180     | F301          | Motor overheat.   |
| 0x7182     | F305          | Motor Brake open circuit.                                       |
| 0x7183     | F306          | Motor Brake short circuit.                                      |
| 0x7184     | F307          | Motor Brake applied during enable state.                        |
| 0x7185     | F436          | EnDAT overheated.   |
| 0x7186     | n301          | Warning: Motor overheated.                                      |
| 0x7187     | F308          | Voltage exceeds motor rating.                                   |
| 0x7188     | F560          | Regen near capacity, could not prevent over voltage.            |
| 0x7189     | F312          | Brake released when it should be applied.                       |
| 0x7305     | F417          | Broken wire in primary feedback.                                |
| 0x7380     | F402          | Feedback 1 Analog signal amplitude default.                     |
| 0x7381     | F403          | Feedback 1 EnDat communication fault.                           |
| 0x7382     | F404          | Feedback 1 illegal hall state.                                  |
| 0x7383     | F405          | Feedback 1 BiSS watchdog.                                       |
| 0x7384     | F406          | Feedback 1 BiSS multi cycle.                                    |
| 0x7385     | F407          | Feedback 1 BiSS sensor.   |
| 0x7386     | F408          | Feedback 1 SFD configuration.                                   |
| 0x7387     | F409          | Feedback 1 SFD UART overrun.                                    |
| 0x7388     | F410          | Feedback 1 SFD UART frame.                                      |
| 0x7389     | F412          | Feedback 1 SFD UART parity.                                     |
| 0x738A     | F413          | Feedback 1 SFD transfer timeout.                                |
| 0x738C     | F415          | Feedback 1 SFD mult. corrupt position.                          |
| 0x738D     | F416          | Feedback 1 SFD Transfer incomplete.                             |
| 0x738E     | F418          | Feedback 1 power supply fault.                                  |
| 0x738F     | F401          | Feedback 1 failed to set feedback.                              |
| 0x7390     | n414          | Warning: SFD single corrupted position.                         |
| 0x7391     | F419          | Encoder init procedure failed.                                  |
| 0x7392     | F534          | Failed to read motor parameters from feedback device.           |
| 0x7393     | F421          | SFD position sensor fault.                                      |
| 0x7394     | F463          | Tamagawa encoder: overheat.                                     |
| 0x7395     | n451          | Warning: Tamagawa encoder battery.                              |
| 0x7396     | n423          | Warning: Non volatile memory error, multiturn overflow.         |
| 0x7397     | F471          | Operation in Position Mode with Halls Only feedback not allowed |
| 0x7398     | F135          | Homing is needed.   |
| 0x7399     | F468          | FB2.Source not set.   |
| 0x739A     | F469          | FB1.ENCREC is not power of two.                                 |
| 0x739B     | F423          | Non volatile memory error, multiturn overflow.                  |
| 0x739C     | F467          | Hiperface DSL fault.  |
| 0x739D     | F452          | Multiturn overflow not supported with this feedback.            |
| 0x739E     | F465          | Excessive shock detected by feedback device.                    |
| 0x73A0     | F453          | Tamagawa encoder: communication timeout.                        |
| 0x73A1     | F454          | Tamagawa encoder: communication transfer incomplete.            |
| 0x73A2     | F456          | Tamagawa encoder: communication CRC.                            |
| 0x73A3     | F457          | Tamagawa encoder: communication start timeout.                  |

| Error Code | Fault/Warning | Description   |
|------------|---------------|---|
| 0x73A4     | F458          | Tamagawa encoder: communication UART overrun.   |
| 0x73A5     | F459          | Tamagawa encoder: communication UART framing.   |
| 0x73A6     | F460          | Tamagawa encoder: over speed.   |
| 0x73A7     | F461          | Tamagawa encoder: contouring error.   |
| 0x73A8     | F462          | Tamagawa encoder: counting overflow.  |
| 0x73A9     | F464          | Tamagawa encoder: multiturn error.  |
| 0x73AA     | F451          | Tamagawa encoder: battery.  |
| 0x73B0     | F486          | Motor velocity exceeds emulated encoder maximum speed.                                    |
| 0x73B8     | F420          | FB3 EnDat communication fault.  |
| 0x73C0     | F473          | Wake and Shake. Insufficient movement.  |
| 0x73C1     | F475          | Wake and Shake. Excessive movement.   |
| 0x73C2     | F476          | Wake and Shake. Fine-coarse delta too large.  |
| 0x73C3     | F478          | Wake and Shake. Overspeed.  |
| 0x73C4     | F479          | Wake and Shake. Loop angle delta too large.   |
| 0x73C5     | F482          | Commutation not initialized.  |
| 0x73C6     | F483          | Motor U phase missing.  |
| 0x73C7     | F484          | Motor V phase missing.  |
| 0x73C8     | F485          | Motor W phase missing.  |
| 0x73C9     | n478          | Warning: Wake and Shake. Overspeed.   |
| 0x73D0     | F487          | Wake and Shake. Validating positive movement failed.                                      |
| 0x73D1     | F489          | Wake and Shake. Validating negative movement failed.                                      |
| 0x73D2     | F490          | Wake and Shake. Validating commutation angle time out.                                    |
| 0x73D3     | F491          | Wake and Shake. Validating commutation angle moved too far.                               |
| 0x73D4     | F492          | Wake and Shake. Validating commutation angle required more than MOTOR.ICONT.              |
| 0x73D5     | F493          | Invalid commutation detected, motor accelerates in wrong direction.                       |
| 0x8130     | F129          | Life Guard Error or Heartbeat Error.  |
| 0x8180     | n702          | Warning: Fieldbus communication lost.   |
| 0x8280     | n601          | Warning: Modbus data rate is too high.  |
| 0x8311     | F304          | Motor foldback.   |
| 0x8331     | F524          | Drive foldback.   |
| 0x8380     | n524          | Warning: Drive foldback.  |
| 0x8381     | n304          | Warning: Motor foldback.  |
| 0x8382     | n309          | Warning: Motor I <sup>2</sup> t load.   |
| 0x8383     | n580          | Warning: Using derivate of position when using sensorless feedback type in position mode. |
| 0x8384     | n581          | Warning: Zero velocity when using induction sensorless feedback type in position mode.    |
| 0x8385     | n495          | Warning: Failed to process recorder cogging compensation table.                           |
| 0x8480     | F302          | Over speed.   |
| 0x8481     | F703          | Emergency timeout occurred while axis should disable.                                     |
| 0x8482     | F480          | Fieldbus command velocity too high.   |
| 0x8483     | F481          | Fieldbus command velocity too low.  |
| 0x8582     | n107          | Warning: Positive software position limit is exceeded.                                    |
| 0x8583     | n108          | Warning: Negative software position limit is exceeded.                                    |
| 0x8611     | F439          | Following error (user).   |
| 0x8685     | F138          | Instability during autotune.  |

| Error Code | Fault/Warning | Description   |
|------------|---------------|---|
| 0x8686     | n151          | Warning: Not enough distance to move; Motion Exception.           |
| 0x8687     | n152          | Warning: Not enough distance to move; Following Motion Exception. |
| 0x8688     | n153          | Warning: Velocity Limit Violation, Exceeding Max Limit.           |
| 0x8689     | n154          | Warning: Following Motion Failed; Check Motion Parameters.        |
| 0x868A     | n156          | Warning: Target Position crossed due to Stop command.             |
| 0x86A0     | n157          | Warning: Homing Index pulse not found.                            |
| 0x86A1     | n158          | Warning: Homing Reference Switch not found.                       |
| 0x86A2     | n159          | Warning: Failed to set motion task parameters.                    |
| 0x86A3     | n160          | Warning: Motion Task Activation Failed.                           |
| 0x86A4     | n161          | Warning: Homing Procedure Failed.                                 |
| 0x86A5     | F139          | Target Position Over Short due to invalid Motion task activation. |
| 0x86A6     | n163          | Warning: MT.NUM exceeds limit.                                    |
| 0x86A7     | n164          | Warning: Motion task is not initialized.                          |
| 0x86A8     | n165          | Warning: Motion task target position is out.                      |
| 0x86A9     | n167          | Warning: Software limit switch traversed.                         |
| 0x86AA     | n168          | Warning: Invalid bit combination in the motion task control word. |
| 0x86AB     | n169          | Warning: 1:1 profile cannot be triggered on the fly.              |
| 0x86AC     | n170          | Warning: Customer profile table is not initialized.               |
| 0x86AD     | n171          | Warning: Motion task activation is currently pending              |
| 0x86AE     | n135          | Warning: Homing is needed.  |
| 0x86AF     | n174          | Warning: Homing maximum distance exceeded                         |
| 0x86B0     | F438          | Following error (numeric).  |
| 0x86B6     | n179          | Teaching of Cogging compensation stopped before finishing         |
| 0x86B7     | n180          | Cogging compensation not active. Axis needs to be homed first.    |
| 0x8780     | F125          | Fieldbus synchronization lost.                                    |
| 0x8781     | n125          | Warning: Fieldbus synchronization lost.                           |
| 0x8AF0     | n137          | Warning: Homing and feedback mismatch.                            |
| 0xFF00     | F701          | Fieldbus runtime.   |
| 0xFF01     | F702          | Fieldbus communication lost.                                      |
| 0xFF02     | F529          | Iu current offset limit exceeded.                                 |
| 0xFF03     | F530          | Iv current offset limit exceeded.                                 |
| 0xFF04     | F521          | Regen over power.   |
| 0xFF07     | F525          | Output over current.  |
| 0xFF08     | F526          | Current sensor short circuit.                                     |
| 0xFF09     | F128          | MPOLES/FPOLES not an integer.                                     |
| 0xFF0A     | F531          | Power stage fault.  |
| 0xFF0B     | F602          | Safe torque off.  |
| 0xFF0C     | F131          | Secondary feedback A/B line break.                                |
| 0xFF0D     | F130          | Secondary feedback supply over current.                           |
| 0xFF0E     | F134          | Secondary feedback illegal state.                                 |
| 0xFF0F     | F245          | External fault.   |
| 0xFF10     | F136          | Firmware and FPGA versions are not compatible.                    |
| 0xFF11     | F101          | Firmware type mismatch.   |
| 0xFF12     | n439          | Warning: Following error (user).                                  |
| 0xFF13     | n438          | Warning: Following error (numeric).                               |

| Error Code | Fault/Warning | Description   |
|------------|---------------|---|
| 0xFF14     | n102          | Warning: Operational FPGA is not a default FPGA.      |
| 0xFF15     | n101          | Warning: The FPGA is a laboratory FPGA.               |
| 0xFF16     | n602          | Warning: Safe torque off.                             |
| 0xFF17     | F132          | Secondary feedback Z line break.                      |
| 0xFF18     | n603          | Warning: OPMODE incompatible with CMDSOURCE.          |
| 0xFF19     | n604          | Warning: EMUEMODE incompatible with DRV.HANDWHEELSRC. |

## 5.2 CANopen Object Dictionary

The following tables describe all objects reachable via SDO or PDO. (i.p. = in preparation).

### Abbreviations:

|        |                  |       |                  |
|--------|------------------|-------|------------------|
| U      | = UNSIGNED       | RO    | = Read only      |
| INT    | = INTEGER        | RW    | = Read and Write |
| VisStr | = Visible String | WO    | = Write only     |
|        |                  | const | = Constant       |

### 5.2.1 Float Scaling

The scaling applied to objects which match floating-point parameters in WorkBench/Telnet are listed in the column "Float Scaling."

For example, index 607Ah is listed as 1:1 - this means that commanding a value of 1000 in SDO 607Ah is equivalent to entering MT.P 1000.000 in WorkBench. On the other hand, index 3598h is listed as 1000:1 - this means that commanding a value of 1000 in SDO 3598h is equivalent to entering IL.KP 1.000 in WorkBench.

A few parameters are listed as variable (var), because the scaling depends on other settings.

### 5.2.2 Effectiveness of PDO set-points

Some objects are having effect only in the state machine state "Operation Enabled", which is controlled by the DS402 control word. They are marked with an asterisk (\*) at the PDO mapping.

### 5.2.3 Communication SDOs

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                           | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|---------------------------------------|--------------|
| 1000h | 0         | U32       |             | RO     | no       | Device type                           | —            |
| 1001h | 0         | U8        |             | RO     | no       | Error register                        | —            |
| 1002h | 0         | U32       |             | RO     | yes      | Manufacturer-specific status register | —            |
| 1003h |           | Array     |             |        |          | Pre-defined error field               | —            |
| 1003h | 0         | U8        |             | RW     | no       | Number of errors                      | —            |
| 1003h | 1 to 10   | U32       |             | RO     | no       | standard error field                  | —            |
| 1005h | 0         | U32       |             | RW     | no       | COB-ID SYNC message                   | —            |
| 1006h | 0         | U32       |             | RW     | no       | Communication cycle period            | —            |
| 1008h | 0         | VisStr    |             | const  | no       | Manufacturer device name              | —            |
| 1009h | 0         | VisStr    |             | const  | no       | Manufacturer hardware version         | —            |
| 100Ah | 0         | VisStr    |             | const  | no       | Manufacturer software version         | —            |
| 100Ch | 0         | U16       |             | RW     | no       | Guard time                            | —            |
| 100Dh | 0         | U8        |             | RW     | no       | Lifetime factor                       | —            |
| 1010h |           | Array     |             |        |          | Save parameters                       | —            |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|--|--------------|
| 1010h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1010h | 1         | U32       |             | RW     | no       | Saves the drive parameters from the RAM to the NV. | DRV.NVSAVE   |
| 1011h |           | Array     |             |        |          | Load parameters                                    | —            |
| 1011h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1011h | 1         | U32       |             | RW     | no       | Loads default parameters to the RAM.               | DRV.RSTVAR   |
| 1012h | 0         | U32       |             | RW     | no       | COB—ID for the Time Stamp                          | —            |
| 1014h | 0         | U32       |             | RW     | no       | COB—ID for the Emergency Object                    | —            |
| 1016h |           | Record    |             |        |          | Consumer heartbeat time                            | —            |
| 1016h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1016h | 1         | U32       |             | RW     | no       | Consumer heartbeat time                            | —            |
| 1017h | 0         | U16       |             | RW     | no       | Producer heartbeat time                            | —            |
| 1018h |           | Record    |             |        |          | Identity Object                                    | —            |
| 1018h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1018h | 1         | U32       |             | RO     | no       | Vendor ID  | —            |
| 1018h | 2         | U32       |             | RO     | no       | Product Code                                       | —            |
| 1018h | 3         | U32       |             | RO     | no       | Revision number                                    | —            |
| 1018h | 4         | U32       |             | RO     | no       | Serial number                                      | —            |
| 1026h |           | Array     |             |        |          | OS prompt  | —            |
| 1026h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1026h | 1         | U8        |             | WO     | no       | StdIn  | —            |
| 1026h | 2         | U8        |             | RO     | no       | StdOut   | —            |
| 1400h |           | Record    |             |        |          | RXPDO1 communication parameter                     | —            |
| 1400h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1400h | 1         | U32       |             | RW     | no       | RXPDO1 COB — ID                                    | —            |
| 1400h | 2         | U8        |             | RW     | no       | Transmission type RXPDO1                           | —            |
| 1401h |           | Record    |             |        |          | RXPDO2 communication parameter                     | —            |
| 1401h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1401h | 1         | U32       |             | RW     | no       | RXPDO2 COB—ID                                      | —            |
| 1401h | 2         | U8        |             | RW     | no       | Transmission type RXPDO2                           | —            |
| 1402h |           | Record    |             |        |          | RXPDO3 communication parameter                     | —            |
| 1402h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1402h | 1         | U32       |             | RW     | no       | RXPDO3 COB—ID                                      | —            |
| 1402h | 2         | U8        |             | RW     | no       | Transmission type RXPDO3                           | —            |
| 1403h |           | Record    |             |        |          | RXPDO4 communication parameter                     | —            |
| 1403h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1403h | 1         | U32       |             | RW     | no       | RXPDO4 COB—ID                                      | —            |
| 1403h | 2         | U8        |             | RW     | no       | Transmission type RXPDO4                           | —            |
| 1600h |           | Record    |             |        |          | RXPDO1 mapping parameter                           | —            |
| 1600h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1600h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object                | —            |
| 1601h |           | Record    |             |        |          | RXPDO2 mapping parameter                           | —            |
| 1601h | 0         | U8        |             | RO     | no       | highest sub-index                                  | —            |
| 1601h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object                | —            |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                         | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|-------------------------------------|--------------|
| 1602h |           | Record    |             |        |          | RXPDO3 mapping parameter            | —            |
| 1602h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1602h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object | —            |
| 1603h |           | Record    |             |        |          | RXPDO4 mapping parameter            | —            |
| 1603h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1603h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object | —            |
| 1800h |           | Record    |             |        |          | TXPDO1 communication parameter      | —            |
| 1800h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1800h | 1         | U32       |             | RW     | no       | TXPDO1 COB—ID                       | —            |
| 1800h | 2         | U8        |             | RW     | no       | Transmission type TXPDO1            | —            |
| 1800h | 3         | U16       |             | RW     | no       | Inhibit time                        | —            |
| 1800h | 4         | U8        |             | const  | no       | reserved                            | —            |
| 1800h | 5         | U16       |             | RW     | no       | Event timer                         | —            |
| 1801h |           | Record    |             |        |          | TXPDO2 communication parameter      | —            |
| 1801h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1801h | 1         | U32       |             | RW     | no       | TXPDO2 COB—ID                       | —            |
| 1801h | 2         | U8        |             | RW     | no       | Transmission type TXPDO2            | —            |
| 1801h | 3         | U16       |             | RW     | no       | Inhibit time                        | —            |
| 1801h | 4         | U8        |             | const  | no       | reserved                            | —            |
| 1801h | 5         | U16       |             | RW     | no       | Event timer                         | —            |
| 1802h |           | Record    |             |        |          | TXPDO3 communication parameter      | —            |
| 1802h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1802h | 1         | U32       |             | RW     | no       | TXPDO3 COB—ID                       | —            |
| 1802h | 2         | U8        |             | RW     | no       | Transmission type TXPDO3            | —            |
| 1802h | 3         | U16       |             | RW     | no       | Inhibit time                        | —            |
| 1802h | 4         | U8        |             | const  | no       | reserved                            | —            |
| 1802h | 5         | U16       |             | RW     | no       | Event timer                         | —            |
| 1803h |           | Record    |             |        |          | TXPDO4 communication parameter      | —            |
| 1803h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1803h | 1         | U32       |             | RW     | no       | TXPDO4 COB—ID                       | —            |
| 1803h | 2         | U8        |             | RW     | no       | Transmission type TXPDO4            | —            |
| 1803h | 3         | U16       |             | RW     | no       | Inhibit time                        | —            |
| 1803h | 4         | U8        |             | const  | no       | reserved                            | —            |
| 1803h | 5         | U16       |             | RW     | no       | Event timer                         | —            |
| 1A00h |           | Record    |             |        |          | Mapping parameter TXPDO1            | —            |
| 1A00h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1A00h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object | —            |
| 1A01h |           | Record    |             |        |          | Mapping parameter TXPDO2            | —            |
| 1A01h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1A01h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object | —            |
| 1A02h |           | Record    |             |        |          | Mapping parameter TXPDO3            | —            |
| 1A02h | 0         | U8        |             | RO     | no       | highest sub-index                   | —            |
| 1A02h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—th application object | —            |
| 1A03h |           | Record    |             |        |          | Mapping parameter TXPDO4            | —            |



| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                          | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|--------------------------------------|--------------|
| 1A03h | 0         | U8        |             | RO     | no       | highest sub-index                    | —            |
| 1A03h | 1 to 8    | U32       |             | RW     | no       | Mapping for n—the application object | —            |
| 1C12h |           | Array     |             | RW     | no       | RxPDO assign                         | —            |
| 1C12h | 0         | U8        |             | RO     | no       | highest sub-index                    | —            |
| 1C13h | 1 to 4    | U8        |             | RW     | no       | Subindex 001..004                    | —            |
| 1C13h |           | Array     |             | RW     | no       | TxPDO assign                         | —            |
| 1C13h | 0         | U8        |             | RO     | no       | highest sub-index                    | —            |
| 1C13h | 1 to 4    | U8        |             | RW     | no       | Subindex 001..004                    | —            |

## 5.2.4 Manufacturer specific SDOs

### Objects 2000h to 3999h

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object  |
|-------|-----------|-----------|-------------|--------|----------|--|---------------|
| 2000h |           | Array     |             |        |          | System Warnings  | —             |
| 2000h | 0         | U8        |             | RO     | no       | highest sub-index  | —             |
| 2000h | 1         | U32       |             | RO     | no       | System Warning 1   | DRV.WARNING1  |
| 2000h | 2         | U32       |             | RO     | no       | System Warning 2   | DRV.WARNING2  |
| 2000h | 3         | U32       |             | RO     | no       | System Warning 3   | DRV.WARNING3  |
| 2001h |           | Array     |             |        |          | System Faults  | —             |
| 2001h | 0         | U8        |             | RO     | no       | highest sub-index  | —             |
| 2001h | 1         | U32       |             | RO     | no       | System Fault 1   | DRV.FAULT1    |
| 2001h | 2         | U32       |             | RO     | no       | System Fault 2   | DRV.FAULT2    |
| 2001h | 3         | U32       |             | RO     | no       | System Fault 3   | DRV.FAULT3    |
| 2001h | 4         | U32       |             | RO     | no       | System Fault 4   | DRV.FAULT4    |
| 2001h | 5         | U32       |             | RO     | no       | System Fault 5   | DRV.FAULT5    |
| 2001h | 6         | U32       |             | RO     | no       | System Fault 6   | DRV.FAULT6    |
| 2001h | 7         | U32       |             | RO     | no       | System Fault 7   | DRV.FAULT7    |
| 2001h | 8         | U32       |             | RO     | no       | System Fault 8   | DRV.FAULT8    |
| 2001h | 9         | U32       |             | RO     | no       | System Fault 9   | DRV.FAULT9    |
| 2001h | A         | U32       |             | RO     | no       | System Fault 10  | DRV.FAULT10   |
| 2002h |           | Array     |             |        |          | Manufacturer status bytes  | —             |
| 2002h | 0         | U8        |             | RO     | no       | highest sub-index  | —             |
| 2002h | 1         | U8        |             | RO     | yes      | Manufacturer status bytes 1                                      | —             |
| 2002h | 2         | U8        |             | RO     | yes      | Manufacturer status bytes 2                                      | —             |
| 2002h | 3         | U8        |             | RO     | yes      | Manufacturer status bytes 3                                      | —             |
| 2002h | 4         | U8        |             | RO     | yes      | Manufacturer status bytes 4                                      | —             |
| 2011h |           | VAR       |             | RO     |          | DRV.RUNTIME in seconds   | DRV.RUNTIME   |
| 2012h |           | Array     |             |        |          | Fault history: Fault numbers                                     | DRV.FAULTHIST |
| 2012h | 0         | U8        |             | RO     | no       | highest sub-index  | —             |
| 2012h | 1 to 20   | U32       |             | RO     | no       | Nth-latest entry in fault number list of fault history table     | —             |
| 2013h |           | Array     |             |        |          | Fault history: Time stamps                                       | DRV.FAULTHIST |
| 2013h | 0         | U8        |             | RO     | no       | highest sub-index  | —             |
| 2013h | 1 to 20   | U32       |             | RO     | no       | Nth-latest entry in fault time stamp list of fault history table | —             |
| 2014h |           | Array     |             |        |          | Mask TxPDO Channel 1   | —             |
| 2014h | 1         | U32       |             | RW     | no       | Mask (Byte 0..3)   | —             |
| 2014h | 2         | U32       |             | RW     | no       | Mask (Byte 4..7)   | —             |
| 2015h |           | Array     |             |        |          | Mask TxPDO Channel 2   | —             |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object         |
|-------|-----------|-----------|-------------|--------|----------|--|----------------------|
| 2015h | 1         | U32       |             | RW     | no       | Mask (Byte 0..3)   | —                    |
| 2015h | 2         | U32       |             | RW     | no       | Mask (Byte 4..7)   | —                    |
| 2016h |           | Array     |             |        |          | Mask TxPDO Channel 3   | —                    |
| 2016h | 1         | U32       |             | RW     | no       | Mask (Byte 0..3)   | —                    |
| 2016h | 2         | U32       |             | RW     | no       | Mask (Byte 4..7)   | —                    |
| 2017h |           | Array     |             |        |          | Mask TxPDO Channel 4   | —                    |
| 2017h | 1         | U32       |             | RW     | no       | Mask (Byte 0..3)   | —                    |
| 2017h | 2         | U32       |             | RW     | no       | Mask (Byte 4..7)   | —                    |
| 2018h |           | Array     |             |        |          | Firmware version   | —                    |
| 2018h | 0         | U16       |             | const  | no       | highest sub-index  | —                    |
| 2018h | 1         | U16       |             | const  | no       | Major version  | —                    |
| 2018h | 2         | U16       |             | const  | no       | Minor version  | —                    |
| 2018h | 3         | U16       |             | const  | no       | Revision   | —                    |
| 2018h | 4         | U16       |             | const  | no       | Branch version   | —                    |
| 2026h |           | Array     |             |        |          | ASCII Channel  | —                    |
| 2026h | 0         | U8        |             | RO     | no       | highest sub-index  | —                    |
| 2026h | 1         | VisStr    |             | WO     | no       | Command  | —                    |
| 2026h | 2         | VisStr    |             | RO     | no       | Response   | —                    |
| 2031h | 0         | VisStr    |             | RW     | no       | Drive Name, length 10 bits                                   | DRV.NAME             |
| 2032h | 0         | VisStr    |             | RW     | no       | Drive custom identifier string, length 32 byte               | DRV.CUSTOMIDENTIFIER |
| 2033h | 0         | VisStr    |             | RO     | no       | Drive model, 21 bytes  | —                    |
| 204Ch |           | Array     |             |        |          | pv scaling factor  | —                    |
| 204Ch | 0         | U8        |             | RO     | no       | highest sub-index  | —                    |
| 204Ch | 1         | INT32     |             | RW     | no       | pv scaling factor numerator                                  | —                    |
| 204Ch | 2         | INT32     |             | RW     | no       | pv scaling factor denominator                                | —                    |
| 2050h | 0         | INT32     | 1:1         | RO     | yes      | Position, secondary feedback                                 | DRV.HANDWHEEL        |
| 2071h | 0         | INT32     |             | RW     | yes*     | Target current   | -                    |
| 2077h | 0         | INT32     |             | RO     | yes      | Current actual value   | -                    |
| 207Fh | 0         | UINT32    |             | RW     | yes      | Maximum velocity in CST-mode & PT-mode                       | IL.VLIMIT            |
| 2080h | 0         | U16       |             | WO     | yes      | Selects motion task to be executed in profile position mode. | —                    |
| 2081h | 0         | U16       |             | RO     | yes      | Last active motion task.                                     | —                    |
| 20A0h | 0         | INT32     | var         | RO     | yes      | Latch position 1, positive edge                              | CAP0.PLFB , CAP0.T   |
| 20A1h | 0         | INT32     | var         | RO     | yes      | Latch position 1, negative edge                              | CAP0.PLFB , CAP0.T   |
| 20A2h | 0         | INT32     | var         | RO     | yes      | Latch position 2, positive edge                              | CAP1.PLFB , CAP1.T   |
| 20A3h | 0         | INT32     | var         | RO     | yes      | Latch position 2, negative edge                              | CAP1.PLFB , CAP1.T   |
| 20A4h | 0         | U16       |             | RW     | yes      | Latch control register                                       | —                    |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|---|--------------|
| 20A5h | 0         | U16       |             | RW     | yes      | Latch status register                                     | —            |
| 20A6h | 0         | INT32     | var         | RO     | yes      | Gets captured position value                              | CAP0.PLFB    |
| 20A7h | 0         | INT32     | var         | RO     | yes      | Gets captured position value                              | CAP1.PLFB    |
| 20B8h | 0         | U16       |             | RW     | yes      | Clear changed digital input information                   | —            |
| 3405h |           | Array     |             |        |          | VL.ARTYPE   | —            |
| 3405h | 0         | U8        |             | RO     | no       | highest sub-index   | —            |
| 3405h | 1         | U8        |             | RW     | no       | Calculation method for BiQuad filter 1                    | VL.ARTYPE1   |
| 3405h | 2         | U8        |             | RW     | no       | Calculation method for BiQuad filter 2                    | VL.ARTYPE2   |
| 3405h | 3         | U8        |             | RW     | no       | Calculation method for BiQuad filter 3                    | VL.ARTYPE3   |
| 3405h | 4         | U8        |             | RW     | no       | Calculation method for BiQuad filter 4                    | VL.ARTYPE4   |
| 3406h |           | Array     |             |        |          | VL BiQuad   | —            |
| 3406h | 0         | U8        |             | RO     | no       | highest sub-index   | —            |
| 3406h | 1         | U32       | 1000:1      | RW     | no       | Natural frequency of pole of anti-resonance (AR) filter 1 | VL.ARPF1     |
| 3406h | 2         | U32       | 1000:1      | RW     | no       | Natural frequency of pole of anti-resonance (AR) filter 2 | VL.ARPF2     |
| 3406h | 3         | U32       | 1000:1      | RW     | no       | Natural frequency of pole of anti-resonance (AR) filter 3 | VL.ARPF3     |
| 3406h | 4         | U32       | 1000:1      | RW     | no       | Natural frequency of pole of anti-resonance (AR) filter 4 | VL.ARPF4     |
| 3406h | 5         | U32       | 1000:1      | RW     | no       | Q of pole of anti-resonance (AR) filter 1                 | VL.ARPQ1     |
| 3406h | 6         | U32       | 1000:1      | RW     | no       | Q of pole of anti-resonance (AR) filter 2                 | VL.ARPQ2     |
| 3406h | 7         | U32       | 1000:1      | RW     | no       | Q of pole of anti-resonance (AR) filter 3                 | VL.ARPQ3     |
| 3406h | 8         | U32       | 1000:1      | RW     | no       | Q of pole of anti-resonance (AR) filter 4                 | VL.ARPQ4     |
| 3406h | 9         | U32       | 1000:1      | RW     | no       | Natural frequency of zero of anti-resonance (AR) filter 1 | VL.ARZF1     |
| 3406h | A         | U32       | 1000:1      | RW     | no       | Natural frequency of zero of anti-resonance (AR) filter 2 | VL.ARZF2     |
| 3406h | B         | U32       | 1000:1      | RW     | no       | Natural frequency of zero of anti-resonance (AR) filter 3 | VL.ARZF3     |
| 3406h | C         | U32       | 1000:1      | RW     | no       | Natural frequency of zero of anti-resonance (AR) filter 4 | VL.ARZF4     |
| 3406h | D         | U32       | 1000:1      | RW     | no       | Q of zero of anti-resonance filter 1                      | VL.ARZQ1     |
| 3406h | E         | U32       | 1000:1      | RW     | no       | Q of zero of anti-resonance filter 2                      | VL.ARZQ2     |

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|-------|-----------|-----------|-------------|--------|----------|--|-------------------------------|
| 3406h | F         | U32       | 1000:1      | RW     | no       | Q of zero of anti-resonance filter 3                         | VL.ARZQ3                      |
| 3406h | 10        | U32       | 1000:1      | RW     | no       | Q of zero of anti-resonance filter 4                         | VL.ARZQ4                      |
| 3407h |           | Struct    |             |        |          | Velocity Filter  | —                             |
| 3407h | 0         | U8        |             | RO     | no       | highest sub-index  | —                             |
| 3407h | 1         | INT32     | 1000:1      | RW     | no       | 10 Hz filtered VL.FB   | VL.FBFILTER                   |
| 3407h | 2         | U32       | 1000:1      | RW     | no       | Gain for the velocity feed-forward                           | VL.KVFF                       |
| 3407h | 3         | U32       |             | RW     | no       | Gain for the acceleration feedforward                        | VL.KBUSFF                     |
| 3407h | 4         | U32       | 1:1         | RW     | no       | Sets the velocity error                                      | VL.ERR                        |
| 3412h | 0         | INT8      |             | RW     | no       | Type of regen resistor                                       | REGEN.TYPE                    |
| 3414h | 0         | U8        |             | RW     |          | Returns and sets the regen resistor fault level temperature. | REGEN.WATTEXT                 |
| 3415h | 0         | U32       | 1000:1      | RO     | no       | Thermal regen resistor time constant                         | REGEN.TEXT                    |
| 3416h | 0         | U32       |             | RO     | no       | Gets regen resistor's calculated power                       | REGEN.POWER                   |
| 3417h | 0         | U32       |             | RO     | no       | Returns a filtered version of 3416h                          | REGEN.POWER-FILTERED          |
| 3420h | 0         | U16       | 1000:1      | RW     | no       | Sets the foldback fault level.                               | IL.FOLDFTHRESH                |
| 3421h | 0         | U32       | 1000:1      | RW     | no       | Sets the user value for the foldback fault level.            | IL.FOLDFTHRESHU               |
| 3422h | 0         | U32       | 1000:1      |        | no       | Sets friction compensation value.                            | IL.FRICTION                   |
| 3423h | 0         | INT32     | 1000:1      |        | no       | A constant current command added to compensate for gravity.  | IL.OFFSET                     |
| 3424h | 0         | U16       |             |        | no       | Enables/disables the integrator part of the PI loop.         | IL.INTEN (Password Protected) |
| 3425h | 0         | U32       | 1000:1      | RO     | no       | Reads the overall foldback current limit                     | IL.IFOLD                      |
| 3426h | 0         | U32       | 1000:1      | RW     | no       | Sets current loop acceleration feedforward gain value        | IL.KACCCFF                    |
| 3427h |           | Record    |             |        |          | Motor protection parameters                                  | —                             |
| 3427h | 0         | U8        |             | RO     | no       | highest sub-index  | —                             |
| 3427h | 1         | U8        |             | RW     | no       |  | IL.MIMODE                     |
| 3427h | 2         | U8        |             | RW     | no       |  | IL.MI2TWTHRESH                |
| 3427h | 3         | U32       |             | RW     | yes      |  | IL.MI2T                       |
| 3430h | 0         | U8        |             | RW     | no       | Sets the direction for absolute motion tasks.                | PL.MODPDIR                    |
| 3431h | 0         | U16       |             | RW     | no       | Sets the motion task in the drive                            | MT.SET                        |

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|-------|-----------|-----------|-------------|--------|----------|---|-----------------|
| 3432h | 0         | U16       |             | WO     | no       | Loads motion task for editing                                       | MT.LOAD         |
| 3440h |           | Array     |             |        |          | Controlled stop parameters  | —               |
| 3440h | 0         | U8        |             | RO     | no       | highest sub-index   | —               |
| 3440h | 1         | U32       | 1:1         | RW     | no       | Sets the deceleration value for a controlled stop.                  | CS.DEC          |
| 3440h | 2         | U32       | 1:1         | RW     | no       | Sets the velocity threshold for a controlled stop.                  | CS.VTHRESH      |
| 3440h | 3         | U32       |             | RW     | no       | Sets the time value for the drive velocity to be within CS.VTHRESH. | CS.TO           |
| 3441h | 0         | U8        |             | RO     | no       | Controlled stop state   | CS.STATE        |
| 3443h | 0         | U16       |             | RO     | no       | Returns the possible reason for a drive disable                     | DRV.DIS         |
| 3444h | 0         | U16       | 1000:1      | RO     | no       | Maximum current for dynamic braking                                 | DRV.DBILIMIT    |
| 3445h | 0         | U32       |             | RO     | no       | Emergency timeout for braking                                       | DRV.DISTO       |
| 3450h | 0         | U8        |             | RW     | yes      | Release or enable brake   | MOTOR.BRAKERLS  |
| 3451h | 0         | U8        |             | RO     | yes      | Determines which drive parameters are calculated automatically.     | MOTOR.AUTOSSET  |
| 3452h | 0         | U16       |             | RW     | no       | Sets the motor maximum voltage                                      | MOTOR.VOLTMAX   |
| 3453h | 0         | U32       |             | RW     | no       | Sets the motor temperature warning level                            | MOTOR.TEMPWARN  |
| 3454h | 0         | U32       | 1000:1      | RW     | no       | Sets the thermal constant of the motor coil                         | MOTOR.CTF0      |
| 3455h | 0         | U32       | 1000:1      | RW     | no       | Sets the line-to-line motor Lq                                      | MOTOR.LQLL      |
| 3456h | 0         | U32       | 1000:1      | RW     | no       | Sets the stator winding resistance phase-phase in ohms              | MOTOR.R         |
| 3457h |           | Record    |             |        |          | Induction Motor parameter   | —               |
| 3457h | 0         | U8        |             | RO     | no       | highest sub-index   | —               |
| 3457h | 1         | INT32     | 1000:1      | RW     | no       | Configuration of induction motor's rated velocity.                  | MOTOR.VRATED    |
| 3457h | 2         | U16       |             | RW     | no       | Configuration of induction motor's rated voltage.                   | MOTOR.VOLTRATED |
| 3457h | 3         | U16       |             | RW     | no       | Sets the minimum voltage for V/f Control.                           | MOTOR.VOLTMIN   |
| 3458h | 0         | U16       |             | RO     | yes      | Motor temperature for motors with sensor                            | MOTOR.TEMPC     |
| 345Ah |           | Array     |             |        |          | Brake Control   | —               |
| 345Ah | 0         | U8        |             | RO     | no       | highest sub-index   | —               |
| 345Ah | 1         | U16       |             | RW     | yes      | Brake Control Command   | —               |
| 345Ah | 2         | U16       |             | RO     | yes      | Brake Status Response   | —               |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object   |
|-------|-----------|-----------|-------------|--------|----------|--|----------------|
| 3460h |           | Record    |             |        |          | Capture engines parameters                             | —              |
| 3460h | 0         | U8        |             | RO     | no       | highest sub-index                                      | —              |
| 3460h | 1         | U8        |             | RW     | no       | Specifies the trigger source for the position capture. | CAP0.TRIGGER   |
| 3460h | 2         | U8        |             | RW     | no       | Specifies the trigger source for the position capture. | CAP1.TRIGGER   |
| 3460h | 3         | U8        |             | RW     | no       | Selects the captured value.                            | CAP0.MODE      |
| 3460h | 4         | U8        |             | RW     | no       | Selects the captured value.                            | CAP1.MODE      |
| 3460h | 5         | U8        |             | RW     | no       | Controls the precondition logic.                       | CAP0.EVENT     |
| 3460h | 6         | U8        |             | RW     | no       | Controls the precondition logic.                       | CAP1.EVENT     |
| 3460h | 7         | U8        |             | RW     | no       | Selects the capture precondition edge.                 | CAP0.PREEDGE   |
| 3460h | 8         | U8        |             | RW     | no       | Selects the capture precondition edge.                 | CAP1.PREEDGE   |
| 3460h | 9         | U8        |             | RW     | no       | Sets the precondition trigger.                         | CAP0.PRESELECT |
| 3460h | A         | U8        |             | RW     | no       | Sets the precondition trigger.                         | CAP1.PRESELECT |
| 3460h | B         | U8        |             | RW     | no       | Selects the feedback source for the capture engine 0.  | CAP0.FBSOURCE  |
| 3460h | C         | U8        |             | RW     | no       | Selects the feedback source for the capture engine 1.  | CAP1.FBSOURCE  |
| 3470h |           | Record    |             |        |          |  | —              |
| 3470h | 0         | U8        |             | RO     | no       | highest sub-index                                      | —              |
| 3470h | 1         | INT8      |             | RW     | no       | Sets the analog output mode.                           | AOUT.MODE      |
| 3470h | 2         | INT16     | 1000:1      | RW     | yes      | Reads the analog output value.                         | AOUT.VALUE     |
| 3470h | 3         | INT16     | 1000:1      | RW     | yes      | Reads and writes the analog output value.              | AOUT.VALUEU    |
| 3470h | 4         | INT16     | 1000:1      | RO     | yes      | Reads the value of the analog input signal.            | AIN.VALUE      |
| 3470h | 5         | U32       | 1000:1      | RW     | no       | Sets velocity scale factor for analog output           | AOUT.VSCALE    |
| 3471h | 0         | U32       | 1:1         | RW     | no       | Sets the analog position scale factor                  | AOUT.PSCALE    |
| 3472h | 0         | U32       | 1:1         | RW     | no       | Sets analog pscale factor                              | AIN.PSCALE     |
| 3474h |           | Array     |             |        |          | DINx.PARAM   | —              |
| 3474h | 0         | U8        |             | RO     | no       | highest sub-index                                      | —              |
| 3474h | 1         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 1                 | DIN1.PARAM     |
| 3474h | 2         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 2                 | DIN2.PARAM     |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object    |
|-------|-----------|-----------|-------------|--------|----------|--|-----------------|
| 3474h | 3         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 3                             | DIN3.PARAM      |
| 3474h | 4         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 4                             | DIN4.PARAM      |
| 3474h | 5         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 5                             | DIN5.PARAM      |
| 3474h | 6         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 6                             | DIN6.PARAM      |
| 3474h | 7         | U32       |             | RW     | no       | Lower 32-bit part of input parameter 7                             | DIN7.PARAM      |
| 3474h | 8         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 1                            | DIN1.PARAM      |
| 3474h | 9         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 2                            | DIN2.PARAM      |
| 3474h | A         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 3                            | DIN3.PARAM      |
| 3474h | B         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 4                            | DIN4.PARAM      |
| 3474h | C         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 5                            | DIN5.PARAM      |
| 3474h | D         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 6                            | DIN6.PARAM      |
| 3474h | E         | U32       |             | RW     | no       | Higher 32-bit part of input parameter 7                            | DIN7.PARAM      |
| 3475h |           | Array     |             |        |          | DOUtx.PARAM  | —               |
| 3475h | 0         | U8        |             | RO     | no       | highest sub-index  | —               |
| 3475h | 1         | U32       |             | RW     | no       | Lower 32-bit part of output parameter 1                            | DOU1.PARAM      |
| 3475h | 2         | U32       |             | RW     | no       | Lower 32-bit part of output parameter 2                            | DOU2.PARAM      |
| 3475h | 3         | U32       |             | RW     | no       | Higher 32-bit part of output parameter 1                           | DOU1.PARAM      |
| 3475h | 4         | U32       |             | RW     | no       | Higher 32-bit part of output parameter 2                           | DOU2.PARAM      |
| 3480h | 0         | U32       | 1000:1      | RW     | no       | Integral gain of position regulator PID loop                       | PL.KI           |
| 3481h |           | Array     |             |        |          | PL.INTMAX  | —               |
| 3481h | 0         | U8        |             | RO     | no       | highest sub-index  | —               |
| 3481h | 1         | U32       | 1:1         | RW     | no       | Input saturation   | PL.INTINMAX     |
| 3481h | 2         | U32       | 1:1         | RW     | no       | Output saturation  | PL.INTOUTMAX    |
| 3482h | 0         | INT32     | 1:1         | RO     | no       | Maximum value of following error in homing                         | HOME.PERRTHRESH |
| 3483h | 0         | INT32     | 1:1         | RW     | no       | Sets the position error warning level                              | PL.ERRWTHRESH   |
| 3484h | 0         | INT32     | 1:1         | RW     | no       | Specification of an additional movement after homing is completed. | HOME.DIST       |
| 3490h | 0         | INT32     | 1:1         | RW     | no       | Position feedback offset   | FB1.OFFSET      |



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|-------|-----------|-----------|-------------|--------|----------|---|-----------------|
| 3491h | 0         | U32       |             | RO     | no       | Location of index pulse on EEO  | DRV.EMUEMTURN   |
| 3492h | 0         | U32       |             | RO     | no       | Motion status of the drive  | DRV.MOTIONSTAT  |
| 3493h | 0         | U8        |             | RO     | no       | Direction of EEO (emulated encoder output)  | DRV.EMUEDIR     |
| 3494h |           | Record    |             |        |          | WS parameters   | —               |
| 3494h | 0         | U8        |             | RO     | no       | highest sub-index   | —               |
| 3494h | 1         | INT16     | 1000:1      | RW     | no       | Sets maximum current used for wake and shake  | WS.IMAX         |
| 3494h | 2         | INT32     | 1:1         | RW     | no       | Sets the maximum movement required for wake and shake                                     | WS.DISTMAX      |
| 3494h | 3         | U16       |             | RW     | no       | Sets the delay for wake and shake between loops in mode 0                                 | WS.TDELAY3      |
| 3494h | 4         | INT32     | 1:1         | RW     | no       | Defines the maximum allowed velocity for Wake & Shake                                     | WS.VTHRESH      |
| 3494h | 5         | U8        |             | RO     | no       | Reads wake and shake status   | WS.STATE        |
| 3494h | 6         | U8        |             | RW     | no       | Arm Wake and Shake to start   | WS.ARM          |
| 3495h | 0         | U16       | 1000:1      | RW     | no       | Voltage level for under-voltage warning.  | VBUS.UVWTHRESH  |
| 3496h |           | Array     |             |        |          | FBUS synchronization parameters   | —               |
| 3496h | 0         | U8        |             | RO     | no       | highest sub-index   | —               |
| 3496h | 1         | U32       |             | RW     | no       | expected time distance between clearing the PLL counter and calling the PLL function      | FBUS.SYNCDIST   |
| 3496h | 2         | U32       |             | RW     | no       | actual time distance between clearing the PLL counter and calling the PLL function        | FBUS.SYNCACT    |
| 3496h | 3         | U32       |             | RW     | no       | Time window, which is used in order to consider the drive as being synchronized           | FBUS.SYNCWND    |
| 3496h | 4         | U32       |             | RW     | no       | Time, which is used for extending or lowering the sample rate of the internal 16[kHz] IRQ | —               |
| 3498h | 0         | U8        |             | RW     | no       | Protection level of fieldbus against other communication channels (Telnet, Modbus..)      | FBUS.PROTECTION |

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|-------|-----------|-----------|-------------|--------|----------|--|--------------------|
| 3499h | 0         | INT32     |             | RW     | yes      | Set-point for stepper motor output through the emulated encoder output (EEO) | DRV.EMUESTEPCMD () |
| 34A0h |           | Array     |             |        |          | PLS Position   |                    |
| 34A0h | 0         | U8        |             | RO     | no       | highest sub-index  | —                  |
| 34A0h | 1         | INT32     | 1:1         | RW     | no       | Limit switch 1 compare value   | PLS.P1             |
| 34A0h | 2         | INT32     | 1:1         | RW     | no       | Limit switch 2 compare value   | PLS.P2             |
| 34A0h | 3         | INT32     | 1:1         | RW     | no       | Limit switch 3 compare value   | PLS.P3             |
| 34A0h | 4         | INT32     | 1:1         | RW     | no       | Limit switch 4 compare value   | PLS.P4             |
| 34A0h | 5         | INT32     | 1:1         | RW     | no       | Limit switch 5 compare value   | PLS.P5             |
| 34A0h | 6         | INT32     | 1:1         | RW     | no       | Limit switch 6 compare value   | PLS.P6             |
| 34A0h | 7         | INT32     | 1:1         | RW     | no       | Limit switch 7 compare value   | PLS.P7             |
| 34A0h | 8         | INT32     | 1:1         | RW     | no       | Limit switch 8 compare value   | PLS.P8             |
| 34A1h |           | Array     |             |        |          | PLS Width  | —                  |
| 34A1h | 0         | U8        |             | RO     | no       | highest sub-index  | —                  |
| 34A1h | 1         | INT32     | 1:1         | RW     | no       | Sets Limit Switch1 Width   | PLS.WIDTH1         |
| 34A1h | 2         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 2 Width  | PLS.WIDTH2         |
| 34A1h | 3         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 3 Width  | PLS.WIDTH3         |
| 34A1h | 4         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 4 Width  | PLS.WIDTH4         |
| 34A1h | 5         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 5 Width  | PLS.WIDTH5         |
| 34A1h | 6         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 6 Width  | PLS.WIDTH6         |
| 34A1h | 7         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 7 Width  | PLS.WIDTH7         |
| 34A1h | 8         | INT32     | 1:1         | RW     | no       | Sets Limit Switch 8 Width  | PLS.WIDTH8         |
| 34A2h |           | Array     |             |        |          | PLS Time   | —                  |
| 34A2h | 0         | U8        |             | RO     | no       | highest sub-index  | —                  |
| 34A2h | 1         | U16       |             | RW     | no       | Sets limit switch 1 time   | PLS.T1             |
| 34A2h | 2         | U16       |             | RW     | no       | Sets limit switch 2 time   | PLS.T2             |
| 34A2h | 3         | U16       |             | RW     | no       | Sets limit switch 3 time   | PLS.T3             |
| 34A2h | 4         | U16       |             | RW     | no       | Sets limit switch 4 time   | PLS.T4             |
| 34A2h | 5         | U16       |             | RW     | no       | Sets limit switch 5 time   | PLS.T5             |
| 34A2h | 6         | U16       |             | RW     | no       | Sets limit switch 6 time   | PLS.T6             |
| 34A2h | 7         | U16       |             | RW     | no       | Sets limit switch 7 time   | PLS.T7             |
| 34A2h | 8         | U16       |             | RW     | no       | Sets limit switch 8 time   | PLS.T8             |
| 34A3h |           | Array     |             |        |          | PLS Configuration  | —                  |
| 34A3h | 0         | U8        |             | RO     | no       | highest sub-index  | —                  |
| 34A3h | 1         | U16       |             | RW     | no       | Enables the limit switches   | PLS.EN             |
| 34A3h | 2         | U16       |             | RW     | no       | Resets limit switches  | PLS.RESET          |
| 34A3h | 3         | U16       |             | RW     | no       | Selects limit switch mode  | PLS.MODE           |

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|-------|-----------|-----------|-------------|--------|----------|---------------------------------|------------------|
| 34A3h | 4         | U16       |             | RW     | no       | Reads the limit switch state    | PLS.STATE        |
| 34A4h | 0         | U8        |             | RW     | no       | Sets limit switch units         | PLS.UNITS        |
| 34A8h | 0         | INT32     |             | RW     | no       | Sets the Compare 0 modulo value | CMP0.MODVALUE    |
| 34A9h |           | Array     |             |        |          | Compare0 modulo bounds          | —                |
| 34A9h | 0         | U8        |             | RO     | no       | highest sub-index               | —                |
| 34A9h | 1         | U8        |             | RW     | no       | Compare0 modulo bound 1         | CMP0.MODBOUND1   |
| 34A9h | 2         | U8        |             | RW     | no       | Compare0 modulo bound 2         | CMP0.MODBOUND2   |
| 34AAh |           | Array     |             |        |          | CMP0 setpoints                  | —                |
| 34AAh | 0         | U8        |             | RO     | no       | highest sub-index               | —                |
| 34AAh | 1         | INT32     |             | RW     | no       | Compare0 setpoint 0             | CMP0.SETPOINT 0  |
| 34AAh | 2         | INT32     |             | RW     | no       | Compare0 setpoint 1             | CMP0.SETPOINT 1  |
| 34AAh | 3         | INT32     |             | RW     | no       | Compare0 setpoint 2             | CMP0.SETPOINT 2  |
| 34AAh | 4         | INT32     |             | RW     | no       | Compare0 setpoint 3             | CMP0.SETPOINT 3  |
| 34AAh | 5         | INT32     |             | RW     | no       | Compare0 setpoint 4             | CMP0.SETPOINT 4  |
| 34AAh | 6         | INT32     |             | RW     | no       | Compare0 setpoint 5             | CMP0.SETPOINT 5  |
| 34AAh | 7         | INT32     |             | RW     | no       | Compare0 setpoint 6             | CMP0.SETPOINT 6  |
| 34AAh | 8         | INT32     |             | RW     | no       | Compare0 setpoint 7             | CMP0.SETPOINT 7  |
| 34ABh |           | Array     |             |        |          | CMP0 widths                     | —                |
| 34ABh | 0         | U8        |             | RO     | no       | highest sub-index               | —                |
| 34ABh | 1         | INT32     |             | RW     | no       | Compare0 width 0                | CMP0.WIDTH 0     |
| 34ABh | 2         | INT32     |             | RW     | no       | Compare0 width 1                | CMP0.WIDTH 1     |
| 34ABh | 3         | INT32     |             | RW     | no       | Compare0 width 2                | CMP0.WIDTH 2     |
| 34ABh | 4         | INT32     |             | RW     | no       | Compare0 width 3                | CMP0.WIDTH 3     |
| 34ABh | 5         | INT32     |             | RW     | no       | Compare0 width 4                | CMP0.WIDTH 4     |
| 34ABh | 6         | INT32     |             | RW     | no       | Compare0 width 5                | CMP0.WIDTH 5     |
| 34ABh | 7         | INT32     |             | RW     | no       | Compare0 width 6                | CMP0.WIDTH 6     |
| 34ABh | 8         | INT32     |             | RW     | no       | Compare0 width 7                | CMP0.WIDTH 7     |
| 34ACh |           | Array     |             |        |          | CMP0 widthtype                  | —                |
| 34ACh | 0         | U8        |             | RO     | no       | highest sub-index               | —                |
| 34ACh | 1         | U8        |             | RW     | no       | Compare0 widthtype 0            | CMP0.WIDTHTYPE 0 |
| 34ACh | 2         | U8        |             | RW     | no       | Compare0 widthtype 1            | CMP0.WIDTHTYPE 1 |
| 34ACh | 3         | U8        |             | RW     | no       | Compare0 widthtype 2            | CMP0.WIDTHTYPE 2 |
| 34ACh | 4         | U8        |             | RW     | no       | Compare0 widthtype 3            | CMP0.WIDTHTYPE 3 |
| 34ACh | 5         | U8        |             | RW     | no       | Compare0 widthtype 4            | CMP0.WIDTHTYPE 4 |
| 34ACh | 6         | U8        |             | RW     | no       | Compare0 widthtype 5            | CMP0.WIDTHTYPE 5 |
| 34ACh | 7         | U8        |             | RW     | no       | Compare0 widthtype 6            | CMP0.WIDTHTYPE 6 |
| 34ACh | 8         | U8        |             | RW     | no       | Compare0 widthtype 7            | CMP0.WIDTHTYPE 7 |
| 34ADh |           | Array     |             |        |          | CMP0 modes                      | —                |
| 34ADh | 0         | U8        |             | RO     | no       | highest sub-index               | —                |
| 34ADh | 1         | U8        |             | RW     | no       | Compare0 mode 0                 | CMP0.MODE 0      |
| 34ADh | 2         | U8        |             | RW     | no       | Compare0 mode 1                 | CMP0.MODE 1      |
| 34ADh | 3         | U8        |             | RW     | no       | Compare0 mode 2                 | CMP0.MODE 2      |
| 34ADh | 4         | U8        |             | RW     | no       | Compare0 mode 3                 | CMP0.MODE 3      |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                                | ASCII object    |
|-------|-----------|-----------|-------------|--------|----------|--|-----------------|
| 34ADh | 5         | U8        |             | RW     | no       | Compare0 mode 4                            | CMP0.MODE 4     |
| 34ADh | 6         | U8        |             | RW     | no       | Compare0 mode 5                            | CMP0.MODE 5     |
| 34ADh | 7         | U8        |             | RW     | no       | Compare0 mode 6                            | CMP0.MODE 6     |
| 34ADh | 8         | U8        |             | RW     | no       | Compare0 mode 7                            | CMP0.MODE 7     |
| 34B0h |           | Array     |             |        |          | USER.DWORDS for writing of feedback memory | —               |
| 34B0h | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |
| 34B0h | 1         | U32       |             | RW     | no       | FB1.USERDWORD1                             | FB1.USERDWORD1  |
| 34B0h | 2         | U32       |             | RW     | no       | FB1.USERDWORD2                             | FB1.USERDWORD2  |
| 34B1h |           | Array     |             |        |          | USER.WORDS for writing of feedback memory  | —               |
| 34B1h | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |
| 34B1h | 1         | U16       |             | RW     | no       | FB1.USERWORD1                              | FB1.USERWORD1   |
| 34B1h | 2         | U16       |             | RW     | no       | FB1.USERWORD2                              | FB1.USERWORD2   |
| 34B1h | 3         | U16       |             | RW     | no       | FB1.USERWORD3                              | FB1.USERWORD3   |
| 34B1h | 4         | U16       |             | RW     | no       | FB1.USERWORD4                              | FB1.USERWORD4   |
| 34B2h |           | Array     |             |        |          | USER.BYTES for writing of feedback memory  | —               |
| 34B2h | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |
| 34B2h | 1         | U8        |             | RW     | no       | FB1.USERBYTE1                              | FB1.USERBYTE1   |
| 34B2h | 2         | U8        |             | RW     | no       | FB1.USERBYTE2                              | FB1.USERBYTE2   |
| 34B2h | 3         | U8        |             | RW     | no       | FB1.USERBYTE3                              | FB1.USERBYTE3   |
| 34B2h | 4         | U8        |             | RW     | no       | FB1.USERBYTE4                              | FB1.USERBYTE4   |
| 34B2h | 5         | U8        |             | RW     | no       | FB1.USERBYTE5                              | FB1.USERBYTE5   |
| 34B2h | 6         | U8        |             | RW     | no       | FB1.USERBYTE6                              | FB1.USERBYTE6   |
| 34B2h | 7         | U8        |             | RW     | no       | FB1.USERBYTE7                              | FB1.USERBYTE7   |
| 34B2h | 8         | U8        |             | RW     | no       | FB1.USERBYTE8                              | FB1.USERBYTE8   |
| 34B8h | 0         | INT32     |             | RW     | no       | Sets the Compare 1 modulo value            | CMP1.MODVALUE   |
| 34B9h |           | Array     |             |        |          | Compare1 modulo bounds                     | —               |
| 34B9h | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |
| 34B9h | 1         | U8        |             | RW     | no       | Compare1 modulo bound 1                    | CMP1.MODBOUND1  |
| 34B9h | 2         | U8        |             | RW     | no       | Compare1 modulo bound 2                    | CMP1.MODBOUND2  |
| 34BAh |           | Array     |             |        |          | CMP1 setpoints                             | —               |
| 34BAh | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |
| 34BAh | 1         | INT32     |             | RW     | no       | Compare1 setpoint 0                        | CMP1.SETPOINT 0 |
| 34BAh | 2         | INT32     |             | RW     | no       | Compare1 setpoint 1                        | CMP1.SETPOINT 1 |
| 34BAh | 3         | INT32     |             | RW     | no       | Compare1 setpoint 2                        | CMP1.SETPOINT 2 |
| 34BAh | 4         | INT32     |             | RW     | no       | Compare1 setpoint 3                        | CMP1.SETPOINT 3 |
| 34BAh | 5         | INT32     |             | RW     | no       | Compare1 setpoint 4                        | CMP1.SETPOINT 4 |
| 34BAh | 6         | INT32     |             | RW     | no       | Compare1 setpoint 5                        | CMP1.SETPOINT 5 |
| 34BAh | 7         | INT32     |             | RW     | no       | Compare1 setpoint 6                        | CMP1.SETPOINT 6 |
| 34BAh | 8         | INT32     |             | RW     | no       | Compare1 setpoint 7                        | CMP1.SETPOINT 7 |
| 34BBh |           | Array     |             |        |          | CMP1 widths                                | —               |
| 34BBh | 0         | U8        |             | RO     | no       | highest sub-index                          | —               |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                            | ASCII object            |
|-------|-----------|-----------|-------------|--------|----------|--|-------------------------|
| 34BBh | 1         | INT32     |             | RW     | no       | Compare1 width 0                       | CMP1.WIDTH 0            |
| 34BBh | 2         | INT32     |             | RW     | no       | Compare1 width 1                       | CMP1.WIDTH 1            |
| 34BBh | 3         | INT32     |             | RW     | no       | Compare1 width 2                       | CMP1.WIDTH 2            |
| 34BBh | 4         | INT32     |             | RW     | no       | Compare1 width 3                       | CMP1.WIDTH 3            |
| 34BBh | 5         | INT32     |             | RW     | no       | Compare1 width 4                       | CMP1.WIDTH 4            |
| 34BBh | 6         | INT32     |             | RW     | no       | Compare1 width 5                       | CMP1.WIDTH 5            |
| 34BBh | 7         | INT32     |             | RW     | no       | Compare1 width 6                       | CMP1.WIDTH 6            |
| 34BBh | 8         | INT32     |             | RW     | no       | Compare1 width 7                       | CMP1.WIDTH 7            |
| 34BCh |           | Array     |             |        |          | CMP1 widthtype                         | —                       |
| 34BCh | 0         | U8        |             | RO     | no       | highest sub-index                      | —                       |
| 34BCh | 1         | U8        |             | RW     | no       | Compare1 widthtype 0                   | CMP1.WIDTHTYPE 0        |
| 34BCh | 2         | U8        |             | RW     | no       | Compare1 widthtype 1                   | CMP1.WIDTHTYPE 1        |
| 34BCh | 3         | U8        |             | RW     | no       | Compare1 widthtype 2                   | CMP1.WIDTHTYPE 2        |
| 34BCh | 4         | U8        |             | RW     | no       | Compare1 widthtype 3                   | CMP1.WIDTHTYPE 3        |
| 34BCh | 5         | U8        |             | RW     | no       | Compare1 widthtype 4                   | CMP1.WIDTHTYPE 4        |
| 34BCh | 6         | U8        |             | RW     | no       | Compare1 widthtype 5                   | CMP1.WIDTHTYPE 5        |
| 34BCh | 7         | U8        |             | RW     | no       | Compare1 widthtype 6                   | CMP1.WIDTHTYPE 6        |
| 34BCh | 8         | U8        |             | RW     | no       | Compare1 widthtype 7                   | CMP1.WIDTHTYPE 7        |
| 34BDh |           | Array     |             |        |          | CMP1 modes                             | —                       |
| 34BDh | 0         | U8        |             | RO     | no       | highest sub-index                      | —                       |
| 34BDh | 1         | U8        |             | RW     | no       | Compare1 mode 0                        | CMP1.MODE 0             |
| 34BDh | 2         | U8        |             | RW     | no       | Compare1 mode 1                        | CMP1.MODE 1             |
| 34BDh | 3         | U8        |             | RW     | no       | Compare1 mode 2                        | CMP1.MODE 2             |
| 34BDh | 4         | U8        |             | RW     | no       | Compare1 mode 3                        | CMP1.MODE 3             |
| 34BDh | 5         | U8        |             | RW     | no       | Compare1 mode 4                        | CMP1.MODE 4             |
| 34BDh | 6         | U8        |             | RW     | no       | Compare1 mode 5                        | CMP1.MODE 5             |
| 34BDh | 7         | U8        |             | RW     | no       | Compare1 mode 6                        | CMP1.MODE 6             |
| 34BDh | 8         | U8        |             | RW     | no       | Compare1 mode 7                        | CMP1.MODE 7             |
| 34C0h |           | Array     |             |        |          | Compare0 handling                      | —                       |
| 34C0h | 0         | U8        |             | RO     | no       | highest sub-index                      | —                       |
| 34C0h | 1         | U16       |             | RW     | no       | Compare0 arm setpoints                 | CMP0.ARM 0..7           |
| 34C0h | 2         | U16       |             | RW     | no       | Compare0 states                        | CMP0.STATE 0..7         |
| 34C1h |           | Array     |             |        |          | Compare1 handling                      | —                       |
| 34C1h | 0         | U8        |             | RO     | no       | highest sub-index                      | —                       |
| 34C1h | 1         | U16       |             | RW     | no       | Compare1 arm setpoints                 | CMP1.ARM 0..7           |
| 34C1h | 2         | U16       |             | RW     | no       | Compare1 states                        | CMP1.STATE 0..7         |
| 34D1h | 0         | U8        |             | RW     | no       | EtherCAT input handling                | ECAT.INPUTHANDLING      |
| 34D8h |           | Array     |             |        |          | PWM0 parameters                        |                         |
| 34D8h | 0         | U8        |             | RO     | no       | Highest sub-index                      |                         |
| 34D8h | 1         | U16       |             | RW     | yes      |  | PWM0.DUTYCYCLE          |
| 34D8h | 2         | U32       | 1000:1      | RW     | yes      |  | PWM0.PERIOD             |
| 3501h | 0         | INT32     | 1:1         | RW     | no       | Acceleration ramp                      | DRV.ACC, also see 6083h |
| 3502h | 0         | INT32     | 1:1         | RW     | no       | Acceleration ramp for homing/jog modes | HOME.ACC                |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object            |
|-------|-----------|-----------|-------------|--------|----------|---|-------------------------|
| 3506h | 0         | INT32     |             |        | no       | Action that hardware enable digital input will perform.                                     | DRV.HWENMODE            |
| 3509h | 0         | INT32     | 1000:1      | RO     | no       | Analog input voltage  | AIN.VALUE               |
| 3522h | 0         | INT32     | 1:1         | RW     | no       | Deceleration rate   | DRV.DEC, also see 6084h |
| 3524h | 0         | INT32     | 1:1         | RW     | no       | Deceleration ramp for homing/jog modes  | HOME.DEC                |
| 352Ah | 0         | INT32     |             | RW     | no       | Direction of movements  | DRV.DIR                 |
| 3533h | 0         | U32       |             | RO     | no       | Resolution of motor encoder   | FB1.ENCRES              |
| 3534h | 0         | U32       |             | RO     | no       | Mode of EEO connector   | DRV.EMUEMODE            |
| 3535h | 0         | U32       |             | RO     | no       | Resolution of EEO   | DRV.EMUERES             |
| 3537h | 0         | U32       |             | RO     | no       | Location of EEO index pulse   | DRV.EMUEZOFFSET         |
| 353Bh | 0         | INT32     |             | RO     | no       | Selection of the feedback type  | FB1.SELECT              |
| 3542h | 0         | U32       | 1000:1      | RW     | no       | Position Control Loop: Proportional Gain  | PL.KP                   |
| 3548h | 0         | U32       | 1000:1      | RW     | no       | Velocity Control Loop: Proportional Gain  | VL.KP                   |
| 354Bh | 0         | INT32     | 1000:1      | RW     | no       | Sets the velocity loop velocity feedforward gain value                                      | VL.KVFF                 |
| 354Dh | 0         | INT32     | 1000:1      | RW     | no       | Velocity Control Loop: I-Integration Time   | VL.KI                   |
| 3558h | 0         | INT32     | 1000:1      | RO     | no       | Current Monitor   | IL.FB                   |
| 3559h | 0         | INT32     | 1000:1      | RO     | no       | Drive Ifold   | IL.DIFOLD               |
| 355Ah | 0         | INT32     | 1000:1      | RW     | no       | I2T Warning   | IL.FOLDWTHRESH          |
| 3562h | 0         | INT32     |             | RW     | no       | Function of Digital Input 1   | DIN1.MODE               |
| 3565h | 0         | INT32     |             | RW     | no       | Function of Digital Input 2   | DIN2.MODE               |
| 3568h | 0         | INT32     |             | RW     | no       | Function of Digital Input 3   | DIN3.MODE               |
| 356Bh | 0         | INT32     |             | RW     | no       | Function of Digital Input 4   | DIN4.MODE               |
| 356Eh | 0         | INT32     | 1000:1      | RW     | no       | Application Peak Current, positive direction  | IL.LIMITP               |
| 356Fh | 0         | INT32     | 1000:1      | RW     | no       | Application Peak Current, negative direction  | IL.LIMITN               |
| 3586h | 0         | U32       |             | RW     | no       | Sets the motor temperature fault level  | MOTOR.TEMPFAULT         |
| 3587h | 0         | INT32     |             | RW     | no       | Select Motor Holding Brake  | MOTOR.BRAKE             |
| 358Eh | 0         | U32       | 1000:1      | RW     | no       | Motor Continuous Current Rating   | MOTOR.ICONT             |
| 358Fh | 0         | U32       | 1000:1      | RW     | no       | Motor Peak Current Rating   | MOTOR.IPEAK             |
| 3593h | 0         | U32       | 1000:1      | RW     | no       | Sets the torque constant of the motor   | MOTOR.KT                |
| 3596h | 0         | U32       | 1000:1      | RO     | no       | Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP | IL.KPDRATIO             |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object     |
|-------|-----------|-----------|-------------|--------|----------|---|------------------|
| 3598h | 0         | INT32     | 1000:1      | RW     | no       | Absolute Gain of Current Control loop                               | IL.KP            |
| 359Ch | 0         | U32       |             | RW     | no       | Sets the motor phase.   | MOTOR.PHASE      |
| 359Dh | 0         | U32       |             | RW     | no       | Sets the number of motor poles                                      | MOTOR.POLES      |
| 35A3h | 0         | U32       |             | RW     | no       | Sets the maximum motor speed  | MOTOR.VMAX       |
| 35A4h | 0         | INT32     | 1000:1      | RW     | no       | Maximum motor current   | IL.MIFOLD        |
| 35ABh | 0         | U32       | 1000:1      | RW     | no       | Sets the motor inertia  | MOTOR.INERTIA    |
| 35AFh | 0         | U32       |             | RW     | no       | Sets the digital output 1 mode                                      | DOUT1.MODE       |
| 35B2h | 0         | U32       |             | RW     | no       | Sets the digital output 2 mode                                      | DOUT2.MODE       |
| 35B4h | 0         | INT32     |             | RW     | no       | Operating Mode  | DRV.OPMODE       |
| 35B8h | 0         | U32       |             | RW     | no       | Table number for motion task  | MT.TNUM          |
| 35B9h | 0         | INT32     |             | RW     | no       | Control for Motion Task 0   | MT.CNTL          |
| 35BCh | 0         | INT32     |             | RW     | no       | Next Task Number for Motion Task 0                                  | MT.MTNEXT        |
| 35BDh | 0         | U32       |             | RW     | no       | Time to next motion task  | MT.TNEXT         |
| 35C2h | 0         | INT32     |             | RW     | no       | Select regen resistor   | REGEN.REXT       |
| 35C5h | 0         | INT32     | 1:1         | RO     | no       | Actual Following Error  | PL.ERR           |
| 35C6h | 0         | INT32     | 1:1         | RW     | no       | In-Position Window (profile position mode)                          | MT.TPOSWND       |
| 35C7h | 0         | INT32     | 1:1         | RW     | no       | Max. Following Error  | PL.ERRFTHRESH    |
| 35CAh | 0         | INT32     |             | RW     | no       | Position Resolution (Numerator)                                     | UNIT.PIN         |
| 35CBh | 0         | INT32     |             | RW     | no       | Position Resolution (Denominator)                                   | UNIT.POUT        |
| 35CFh | 0         | INT32     |             | RW     | no       | reserved  | PL.MODPEN        |
| 35D2h | 0         | U32       |             | RO     | no       | Mechanical Position   | FB1.MECHPOS      |
| 35E2h | 0         | U32       | 1:1         | RW     | no       | Sets the current limit during homing procedure to a mechanical stop | HOME.IPEAK       |
| 35EBh | 0         | INT32     |             | WO     | no       | Save Data in EEPROM   | DRV.NVSAVE       |
| 35F0h | 0         | INT32     |             | WO     | no       | Set Reference Point   | HOME.SET         |
| 35FEh | 0         | INT32     |             | WO     | no       | Stop Motion Task  | DRV.STOP         |
| 35FFh | 0         | U32       |             | RW     | no       | Selects between disable immediately or stop and then disable        | DRV.DISMODE      |
| 3610h | 0         | INT32     |             | RO     | no       | Ambient Temperature   | DRV.TEMPERATURES |
| 3611h | 0         | INT32     |             | RO     | no       | Heat Sink Temperature   | DRV.TEMPERATURES |
| 3612h | 0         | INT32     |             | RO     | no       | Motor Temperature   | MOTOR.TEMP       |
| 3617h | 0         | U32       | 1:1         | RW     | no       | Undervoltage mode   | VBUS.UVMODE      |
| 3618h | 0         | INT32     | 1:1         | RO     | no       | Actual Velocity   | VL.FB            |
| 361Ah | 0         | INT32     |             | RO     | no       | DC-bus voltage  | VBUS.VALUE       |



| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object    |
|-------|-----------|-----------|-------------|--------|----------|---|-----------------|
| 361Dh | 0         | U32       | 1000:1      | RW     | no       | Voltage level for under-voltage fault                 | VBUS.UVFTHRESH  |
| 3622h | 0         | INT32     | 1:1         | RW     | no       | Max. Velocity   | VL.LIMITP       |
| 3623h | 0         | INT32     | 1:1         | RW     | no       | Max. Negative Velocity                                | VL.LIMITN       |
| 3627h | 0         | INT32     | 1:1         | RW     | no       | Overspeed   | VL.THRESH       |
| 3629h | 0         | INT32     | 1000:1      | RW     | no       | SW1 Velocity Scaling Factor                           | AIN.VSCALE      |
| 3637h | 0         | INT32     | 1:1         | RW     | no       | reserved  | PL.MODP1        |
| 3638h | 0         | INT32     | 1:1         | RW     | no       | reserved  | PL.MODP2        |
| 3656h | 0         | U64       | 1:1         | RW     | no       | Initial feedback position                             | FB1.ORIGIN      |
| 3659h | 0         | INT32     |             | RW     | no       | Type of acceleration set-point for the system         | UNIT.ACCROTARY  |
| 365Bh | 0         | INT32     |             | RW     | no       | Presetting for motion task that is processed later    | MT.NUM          |
| 365Fh | 0         | INT32     |             | RW     | no       | Systemwide Definition of Velocity/Speed               | UNIT.VROTARY    |
| 3660h | 0         | INT32     |             | RW     | no       | Set Resolution of the Position                        | UNIT.PROTARY    |
| 366Eh | 0         | INT32     |             | RW     | no       | Disable Delaytime with Holding Brake                  | MOTOR.TBRAKEAPP |
| 366Fh | 0         | INT32     |             | RW     | no       | Enable Delaytime with Holding Brake                   | MOTOR.TBRAKERLS |
| 3683h | 0         | U16       |             | RW     | no       | Delay for wake and shake timing                       | WS.TDELAY1      |
| 3685h | 0         | U16       |             | RW     | no       | Sets delay for wake and shake timing                  | WS.TDELAY2      |
| 36A3h | 0         | VisStr    |             | RO     | no       |   | MOTOR.SERIALNUM |
| 36D0h | 0         | U16       |             | RW     | no       | Sets wake and shake current-vector appliance time     | WS.T            |
| 36D1h | 0         | U32       | 1:1         | RW     | no       | Sets the minimum movement required for wake and shake | WS.DISTMIN      |
| 36D7h | 0         | U32       | 1000:1      | RW     | no       | Sets homing auto move flag                            | HOME.AUTOMOVE   |
| 36E2h | 0         | U8        |             | RW     | no       | Sets the number of repetitions for wake and shake     | WS.NUMLOOPS     |
| 36E5h | 0         | U32       |             | RW     | no       | CAN baud rate selection                               | FBUS.PARAM01    |
| 36E6h | 0         | U32       |             | RW     | no       | pII synchronization                                   | FBUS.PARAM02    |
| 36E7h | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM03    |
| 36E8h | 0         | U32       |             | RW     | no       | SYNC surveillance                                     | FBUS.PARAM04    |
| 36E9h | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM05    |
| 36EAh | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM06    |
| 36EBh | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM07    |
| 36ECh | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM08    |
| 36EDh | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM09    |
| 36EEh | 0         | U32       |             | RW     | no       | -   | FBUS.PARAM10    |
| 36F6h | 0         | INT32     |             | RW     | no       | Function of Digital Input 5                           | DIN5.MODE       |



| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                               | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|---|--------------|
| 36F9h | 0         | INT32     |             | RW     | no       | Function of Digital Input 6               | DIN6.MODE    |
| 36FCh | 0         | U32       |             | RW     | no       | Function of Digital Input 7               | DIN7.MODE    |
| 3856h | 0         | INT32     | 1:1         | RW     | no       | velocity window for profile position mode | MT.TVELWND   |
| 3899h | 0         | VisStr    |             | RW     | no       | Motor Name, 20 bytes                      | MOTOR.NAME   |

**Objects 5000h to 5999h**

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object     |
|-------|-----------|-----------|-------------|--------|----------|---|------------------|
| 5000h | 0         | UINT32    |             | RW     | no       | Analog input low-pass filter cutoff frequency.                            | AIN.CUTOFF       |
| 5001h | 0         | UINT32    |             | RW     | no       | Analog input signal dead-band.  | AIN.DEADBAND     |
| 5002h | 0         | UINT32    |             | RW     | no       | Analog current scale factor.  | AIN.ISCALE       |
| 5003h | 0         | UINT32    |             | RW     | no       | Analog input offset.  | AIN.OFFSET       |
| 5009h | 0         | UINT32    |             | RW     | no       | Analog current scale factor.  | AOUT.ISCALE      |
| 500Bh | 0         | UINT32    |             | RW     | no       | Analog output offset.   | AOUT.OFFSET      |
| 5013h | 0         | UINT32    |             | RW     | no       | Controls how often the excitation is updated.                             | BODE.EXCITEGAP   |
| 5015h | 0         | UINT32    |             | RW     | no       | Current command value used during the Bode procedure.                     | BODE.IAMP        |
| 5016h | 0         | UINT32    |             | RW     | no       | Sets whether the excitation uses current or velocity excitation type.     | BODE.INJECTPOINT |
| 5019h | 0         | UINT32    |             | RW     | no       | Length of the PRB signal before it repeats.                               | BODE.PRBDDEPTH   |
| 5060h | 0         | UINT32    |             | RW     | no       | Sets the fault relay mode.  | DOUT.RELAYMODE   |
| 5080h | 0         | UINT32    |             | RW     | no       | Default state of the software enable.                                     | DRV.ENDEFAULT    |
| 5083h | 0         | UINT32    |             | RW     | no       | Continuous rated current value.   | DRV.ICONT        |
| 5084h | 0         | UINT32    |             | RW     | no       | Peak rated current value.   | DRV.IPEAK        |
| 5085h | 0         | UINT32    |             | RW     | no       | Current that will be used during the DRV.ZERO procedure.                  | DRV.IZERO        |
| 508Ch | 0         | UINT32    |             | RW     | no       | Number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use. | FB1.BISSBITS     |
| 508Fh | 0         | UINT32    |             | RW     | no       | Initial feedback value as signed or unsigned.                             | FB1.INITSIGNED   |
| 5096h | 0         | UINT32    |             | RW     | no       | Current value used during the phase finding procedure (PFB.PFIND=1)       | FB1.PFINDCMDU    |
| 5097h | 0         | UINT32    |             | RW     | no       | Number of feedback poles.   | FB1.POLES        |
| 5099h | 0         | UINT32    |             | RW     | no       | Resolver nominal transformation ratio.                                    | FB1.RESKTR       |

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|-------|-----------|-----------|-------------|--------|----------|--|-----------------|
| 509Ah | 0         | UINT32    |             | RW     | no       | Electrical degrees of phase lag in the resolver.   | FB1.RESREFPHASE |
| 509Ch | 0         | UINT32    |             | RW     | no       | Controls tracking calibration algorithm.   | FB1.TRACKINGCAL |
| 50B1h | 0         | UINT32    |             | RW     | no       | Number of successful synchronized cycles needed to lock the PLL.                                   | FBUS.PLLTHRESH  |
| 50BBh | 0         | UINT32    |             | RW     | no       | Denominator of the electronic gearing ratio; active in opmode 2 (position) only.                   | GEAR.IN         |
| 50BCh | 0         | UINT32    |             | RW     | no       | Electronic gearing mode; active in opmode 2 (position) only.                                       | GEAR.MODE       |
| 50BEh | 0         | UINT32    |             | RW     | no       | Numerator of the electronic gearing ratio; active in opmode 2 (position) only.                     | GEAR.OUT        |
| 50C5h | 0         | UINT32    |             | RW     | no       | Homing direction   | HOME.DIR        |
| 50CBh | 0         | UINT32    |             | RW     | no       | Homing mode  | HOME.MODE       |
| 50E2h | 0         | UINT32    |             | RW     | no       | Current loops fieldbus injected feed-forward gain  | IL.KBUSFF       |
| 50FBh | 0         | UINT32    |             | RW     | no       | Motor pitch.   | MOTOR.PITCH     |
| 50FEh | 0         | UINT32    |             | RW     | no       | Type of thermal resistor inside the motor.   | MOTOR.RTYPE     |
| 5104h | 0         | UINT32    |             | RW     | no       | Motor type.  | MOTOR.TYPE      |
| 510Eh | 0         | UINT32    |             | RW     | no       | Motion task to be triggered after an emergency stop procedure; active in opmode 2 (position) only. | MT.EMERGMT      |
| 5121h | 0         | UINT32    |             | RW     | no       | Type of following error warning and fault usage.   | PL.ERRMODE      |
| 5128h | 0         | UINT32    |             | RW     | no       | Feedback source for the position loop.   | PL.FBSOURCE     |
| 5175h | 0         | UINT32    |             | RW     | no       | Service motion current 1; active in opmode 0 (torque) only.  | SM.I1           |
| 5176h | 0         | UINT32    |             | RW     | no       | Service motion current 2; active in opmode 0 (torque) only.  | SM.I2           |
| 5177h | 0         | UINT32    |             | RW     | no       | Service motion mode.   | SM.MODE         |
| 5179h | 0         | UINT32    |             | RW     | no       | Service motion time 1.   | SM.T1           |
| 517Ah | 0         | UINT32    |             | RW     | no       | Service motion time 2.   | SM.T2           |
| 517Eh | 0         | UINT32    |             | RW     | no       | Enables and disables software travel limit switches.   | SWLS.EN         |
| 5184h | 0         | UINT32    |             | RW     | no       | Linear acceleration/deceleration units.  | UNIT.ACCLINEAR  |
| 5187h | 0         | UINT32    |             | RW     | no       | Linear position units.   | UNIT.PLINEAR    |
| 518Ah | 0         | UINT32    |             | RW     | no       | Linear velocity units.   | UNIT.VLINEAR    |

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|-------|-----------|-----------|-------------|--------|----------|--|----------------|
| 518Eh | 0         | UINT32    |             | RW     | no       | Voltage level for over voltage warning.  | VBUS.OVWTHRESH |
| 51AEh | 0         | UINT32    |             | RW     | no       | Feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.                           | VL.FBSOURCE    |
| 51B0h | 0         | UINT32    |             | RW     | no       | Mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.                    | VL.GENMODE     |
| 51B3h | 0         | UINT32    |             | RW     | no       | Scales the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.                             | VL.KO          |
| 51B8h | 0         | UINT32    |             | RW     | no       | Ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 and 2 only. | VL.LMJR        |
| 51BAh | 0         | UINT32    |             | RW     | no       | Bandwidth of the observer in Hz.   | VL.OBSBW       |
| 51BBh | 0         | UINT32    |             | RW     | no       | Observer operating mode.   | VL.OBSMODE     |
| 51CBh | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 1.  | DIN1.FILTER    |
| 51CCh | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 2.  | DIN2.FILTER    |
| 51CDh | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 3.  | DIN3.FILTER    |
| 51CEh | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 4.  | DIN4.FILTER    |
| 51CFh | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 5.  | DIN5.FILTER    |
| 51D0h | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 6.  | DIN6.FILTER    |
| 51D1h | 0         | UINT32    |             | RW     | no       | Filter mode for Digital In 7.  | DIN7.FILTER    |
| 51E7h | 0         | UINT32    |             | RW     | no       | Modbus User Units Input parameter  | MODBUS.PIN     |
| 51E8h | 0         | UINT32    |             | RW     | no       | Modbus User Units Output parameter.  | MODBUS.POUT    |
| 51E9h | 0         | UINT32    |             | RW     | no       | Feedback Resolution (per rev) over Modbus.   | MODBUS.PSCALE  |
| 51ECh | 0         | UINT32    |             | RW     | no       | Secondary feedback (FB2) resolution.   | FB2.ENCREC     |
| 51EDh | 0         | UINT32    |             | RW     | no       | Mode for the second feedback inputs and high speed digital inputs.   | FB2.MODE       |
| 51EEh | 0         | UINT32    |             | RW     | no       | Source for the second feedback input.  | FB2.SOURCE     |
| 51EFh | 0         | UINT32    |             | RW     | no       | Brake apply timeout for vertical axis.   | MOTOR.TBRAKETO |
| 51F0h | 0         | UINT32    |             | RW     | no       | i.p.   | MODBUS.MSGLOG  |
| 520Ch | 0         | UINT32    |             | RW     | no       | Scaling mode for Modbus values.  | MODBUS.SCALING |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object          |
|-------|-----------|-----------|-------------|--------|----------|--|-----------------------|
| 520Dh | 0         | UINT32    |             | RW     | no       | Encoder output pulse width for modes 6 to 7.   | DRV.EMUJEPULSE- WIDTH |
| 520Eh | 0         | UINT32    |             | RW     | no       | Enable/disable motor velocity vs. maximum emulated encoder velocity monitoring function. | DRV.EMUJECHECK- SPEED |
| 5251h | 0         | UINT32    |             | RW     | no       | Analog input deadband mode.  | AIN.DEADBANDMODE      |
| 5252h | 0         | UINT32    |             | RW     | no       | Analog input mode  | AIN.MODE              |
| 5253h | 0         | UINT32    |             | RW     | no       | Direction of IOs from X9.  | DIO10.DIR             |
| 5254h | 0         | UINT32    |             | RW     | no       | Inverting the output voltage of the IO, when in the output direction.                    | DIO10.INV             |
| 5255h | 0         | UINT32    |             | RW     | no       | Direction of IOs from X9.  | DIO11.DIR             |
| 5256h | 0         | UINT32    |             | RW     | no       | Inverting the output voltage of the IO, when in the output direction.                    | DIO11.INV             |
| 5257h | 0         | UINT32    |             | RW     | no       | Direction of IOs from X9.  | DIO9.DIR              |
| 5258h | 0         | UINT32    |             | RW     | no       | Inverting the output voltage of the IO, when in the output direction.                    | DIO9.INV              |
| 5259h | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 130.  | FAULT130.ACTION       |
| 525Ah | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 131.  | FAULT131.ACTION       |
| 525Bh | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 132.  | FAULT132.ACTION       |
| 525Ch | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 133.  | FAULT134.ACTION       |
| 525Dh | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 702.  | FAULT702.ACTION       |
| 525Eh | 0         | UINT32    |             | RW     | no       | Method of acquiring IP Address.  | IP.MODE               |
| 525Fh | 0         | UINT32    |             | RW     | no       | Load inertia.  | LOAD.INERTIA          |
| 5260h | 0         | UINT32    |             | RW     | no       | Motor back EMF constant.   | MOTOR.KE              |
| 5261h | 0         | UINT32    |             | RW     | no       | Changing voltage thresholds.   | VBUS.HALFVOLT         |
| 5262h | 0         | UINT32    |             | RW     | no       | Direction for the second feedback input (X9 and X7).                                     | FB2.DIR               |
| 5263h | 0         | UINT32    |             | RW     | no       | Feedback for handwheel operation.  | DRV.HANDWHEELSRC      |
| 5264h | 0         | UINT32    |             | RW     | no       | Delay time between inactive Hardware Enable input and drive disable.                     | DRV.HWENDELAY         |
| 5265h | 0         | UINT32    |             | RW     | no       | Index into the Current Loop Gain Scheduling Table.                                       | IL.KPLOOKUPINDEX      |
| 5266h | 0         | UINT32    |             | RW     | no       | Value of the current loop gain scheduling index.   | IL.KPLOOKUPVALUE      |
| 5267h | 0         | UINT32    |             | RW     | no       | Fault Action for Fault 451.  | FAULT451.ACTION       |
| 5268h | 0         | UINT32    |             | RW     | no       | Brake Immediately in the case of a drive disable.  | MOTOR.BRAKEIMM        |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object          |
|-------|-----------|-----------|-------------|--------|----------|---|-----------------------|
| 5352h | 0         | UINT16    |             | RW     | no       | Amount of time a communication error must be present before an W&S-fault is thrown.       | WS.CHECKT             |
| 535Ch | 0         | UINT16    |             | RW     | no       | Sets the calming time of the motor for Wake & Shake mode 1.                               | WS.TSTANDSTILL        |
| 535Dh | 0         | UINT16    |             | RW     | no       | Time for the ramp up current in Wake & Shake mode 1.                                      | WS.TIRAMP             |
| 535Eh | 0         | UINT8     |             | RW     | no       | Store additional multiturn information in non-volatile memory and restore it on power up. | FB1.EXTENDEDMULTITURN |
| 5360h | 0         | UINT16    |             | RW     | no       | Rotor time constant.  | MOTOR.IMTR            |
| 5361h | 0         | UINT8     |             | RW     | no       | Sets the feedback source for the current loop for MOTOR.TYPE4.                            | IL.FBSOURCE           |
| 5362h | 0         | UINT32    |             | RW     | no       | The direct-axis current set point used for induction machine closed-loop control.         | MOTOR.IMID            |
| 5375h | 0         | INT32     |             | RO     | no       | The last actual position before the AKD was switched off (24 V)                           | FB1.INITPSAVED        |
| 5377h | 0         | UINT32    |             | RW     | no       | Initial position comparison window  | FB1.INITPWINDOW       |
| 5379h | 0         | UINT8     |             | RO     | no       | Result of initial position check  | FB1.INITPSTATUS       |
| 538Bh | 0         | UINT16    |             | RW     | no       |   | DRV.EMUESTEPMODE ()   |
| 538Ch | 0         | UINT16    |             | RW     | no       |   | DRV.EMUESTEPSTATUS    |
| 538Dh | 0         | UINT16    |             | RW     | no       |   | DRV.EMUESTEPMAX       |
| 538Fh | 0         | INT8      |             | RW     | no       | Compare engine 0 source   | CMP0.SOURCE           |
| 5390h | 0         | INT8      |             | RW     | no       | Compare engine 1 source   | CMP1.SOURCE           |
| 5394h | 0         | U16       |             | RW     | no       | Compare engine 0 output mask  | CMP0.OUTMASK          |
| 539Bh | 0         | U16       |             | RW     | no       | Compare engine 1 output mask  | CMP1.OUTMASK          |
| 53A6h | 0         | U8        |             | RW     | no       | Compare engine 0 modulo enable  | CMP0.MODEN            |
| 53ADh | 0         | U8        |             | RW     | no       | Compare engine 1 modulo enable  | CMP1.MODEN            |
| 53B1h | 0         | U32       |             | RW     | no       | Compare engine 0 advance  | CMP0.ADVANCE          |
| 53B2h | 0         | U32       |             | RW     | no       | Compare engine 1 advance  | CMP1.ADVANCE          |
| 53C7h | 0         | UINT32    |             | RW     | no       | Sets the fault display mode   | DRV.FAULTDISPLAYMODE  |
| 53D5h | 0         | UINT32    |             | RW     | no       | Sets the delay time for PL.CMD  | PL.PDELAY             |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object         |
|-------|-----------|-----------|-------------|--------|----------|--|----------------------|
| 53D6h | 0         | UINT32    |             | RW     | no       | Sets the delay time for the velocity feedforward integrator component                        | VL.FFDELAY           |
| 53D7h | 0         | INT8      |             | RW     | no       | Allows a surface permanent magnet motor to operate as an interior permanent magnet motor     | MOTOR.FIELDWEAKENING |
| 5403h | 0         | UINT32    |             | RW     | no       | Toggles between HOME.IPEAK and current loop limits during homing                             | HOME.IPEAKACTIVE     |
| 5404h | 0         | UINT32    |             | RW     | no       | Scaling factor (numerator) for the command DRV.EMUESTEPCMD                                   | DRV.EMUESTEPCMDPIN   |
| 5405h | 0         | UINT32    |             | RW     | no       | Scaling factor (denominator) for the command DRV.EMUESTEPCMD                                 | DRV.EMUESTEPCMDPOUT  |
| 5406h | 0         | UINT32    |             | RW     | no       | Sets the target position window for the homing procedure; active in opmode 2 (position) only | HOME.TPOSWND         |
| 541fh | 0         | UINT8     |             | RW     | no       | Disables the automatic Wake & Shake in special cases   | WS.FORCEOFF          |
| 5420h | 0         | UINT8     |             | RW     | no       | Defines the behavior of fault 314.   | FAULT314.ACTION      |
| 542Ch | 0         | UINT16    |             | RW     | no       | Input term of position loop gearing factor   | PL.GEARIN            |
| 542Dh | 0         | UINT16    |             | RW     | no       | Output term of position loop gearing factor  | PL.GEAROUT           |
| 547Ah | 0         | UINT8     |             | RW     | no       |  | COGCOMP.TEACHMODE    |
| 547Bh | 0         | INT32     | 1000:1      | RO     | yes      |  | STRINGS.ACTIVEPOWER  |
| 5481h | 0         | U8        |             | RW     | no       |  | FB1.SFDCRCERRORCOUNT |

### 5.2.5 Profile Specific SDOs

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                            | ASCII object |
|-------|-----------|-----------|-------------|--------|----------|--|--------------|
| 6040h | 0         | U16       |             | WO     | yes      | Control word                           | —            |
| 6041h | 0         | U16       |             | RO     | yes      | Status word                            | —            |
| 605Ah | 0         | INT16     |             | RW     | no       | Quick stop option code                 | —            |
| 6060h | 0         | INT8      |             | RW     | yes      | Modes of operation                     | —            |
| 6061h | 0         | INT8      |             | RO     | yes      | Modes of operation display             | —            |
| 6063h | 0         | INT32     |             | RO     | yes      | Position actual value (increments)     | —            |
| 6064h | 0         | INT32     | 1:1         | RO     | yes      | Position actual value (position units) | PL.FB        |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                            | ASCII object         |
|-------|-----------|-----------|-------------|--------|----------|--|----------------------|
| 6065h | 0         | U32       | 1:1         | RW     | no       | Following error window                 | PL.ERRFTHRESH        |
| 606Bh | 0         | INT32     | 1:1         | RO     | no       | Velocity demand value                  | VL.CMD               |
| 606Ch | 0         | INT32     | 1000:1      | RO     | yes      | Velocity actual value (PDO in RPM)     | VL.FB                |
| 606Dh | 0         | U16       |             | RW     | yes      | Velocity window                        |                      |
| 606Eh | 0         | U16       |             | RW     | yes      | Velocity window time                   |                      |
| 6071h | 0         | INT16     |             | RW     | yes*     | Target torque                          | —                    |
| 6072h | 0         | U16       |             | RW     | yes*     | Max torque                             | —                    |
| 6073h | 0         | U16       |             | RW     | no       | Max current                            |                      |
| 6077h | 0         | INT16     |             | RO     | yes      | Torque actual value                    | DRV.ICONT            |
| 607Ah | 0         | INT32     | 1:1         | RW     | yes      | Target position                        | MT.P                 |
| 607Ch | 0         | INT32     | 1:1         | RW     | no       | Reference offset                       | HOME.P               |
| 607Dh |           | Array     |             |        |          | Software position limit                |                      |
| 607Dh | 0         | U8        |             | RO     | no       | highest sub-index                      |                      |
| 607Dh | 1         | INT32     | 1:1         | RW     | no       | Software position limit 1              | SWLS.LIMIT0          |
| 607Dh | 2         | INT32     | 1:1         | RW     | no       | Software position limit 2              | SWLS.LIMIT1          |
| 6081h | 0         | U32       | 1:1         | RW     | yes      | Profile Velocity                       | MT.V                 |
| 6083h | 0         | U32       | 1:1         | RW     | yes      | Profile Acceleration                   | MT.ACC , DRV.ACC     |
| 6084h | 0         | U32       | 1:1         | RW     | yes      | Profile Deceleration                   | MT.DEC , DRV.DEC     |
| 6087h | 0         | U32       |             | RW     | yes      | Torque slope                           | —                    |
| 608Fh |           | Array     |             |        |          | Position encoder resolution            | —                    |
| 608Fh | 0         | U8        |             | RO     | no       | highest sub-index                      | —                    |
| 608Fh | 1         | U32       |             | RW     | no       | Encoder increments                     | —                    |
| 608Fh | 2         | U32       |             | RW     | no       | Motor revolutions                      |                      |
| 6091h |           | Array     |             |        |          | Gear ratio                             | —                    |
| 6091h | 0         | U8        |             | RO     | no       | highest sub-index                      | —                    |
| 6091h | 1         | U32       |             | RW     | no       | Motor revolution                       |                      |
| 6091h | 2         | U32       |             | RW     | no       | Shaft revolutions                      |                      |
| 6092h |           | Array     |             |        |          | Feed constant                          | —                    |
| 6092h | 0         | U8        |             | RO     | no       | highest sub-index                      | —                    |
| 6092h | 1         | U32       |             | RW     | no       | Feed                                   | UNIT.PIN             |
| 6092h | 2         | U32       |             | RW     | no       | Shaft revolutions                      | —                    |
| 6098h | 0         | INT8      |             | RW     | no       | Homing type                            | HOME.MODE , HOME.DIR |
| 6099h |           | Array     |             |        |          | Homing velocity                        | —                    |
| 6099h | 0         | U8        |             | RO     | no       | highest sub-index                      | —                    |
| 6099h | 1         | U32       | 1:1         | RW     | no       | Speed while searching for limit switch | HOME.V               |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description                         | ASCII object          |
|-------|-----------|-----------|-------------|--------|----------|-------------------------------------|-----------------------|
| 6099h | 2         | U32       |             | RW     | no       | Speed while searching for zero mark | HOME.<br>FEEDRATE     |
| 609Ah | 0         | U32       | 1:1         | RW     | no       | Homing acceleration                 | HOME.ACC , HOME.DEC   |
| 60B1h | 0         | INT32     | 1:1         | RW     | yes*     | Velocity offset                     | VL.BUSFF              |
| 60B2h | 0         | INT16     |             | RW     | yes*     | Torque offset (PDO only)            |                       |
| 60B8h | 0         | U16       |             | RW     | yes      | Touch probe function                | —                     |
| 60B9h | 0         | U16       |             | RW     | yes      | Touch probe status                  | —                     |
| 60BAh | 0         | INT32     |             | RW     | yes      | Touch probe 1 positive edge         | —                     |
| 60BBh | 0         | INT32     |             | RW     | yes      | Touch probe 1 negative edge         | —                     |
| 60BCh | 0         | INT32     |             | RW     | yes      | Touch probe 2 positive edge         | —                     |
| 60BDh | 0         | INT32     |             | RW     | yes      | Touch probe 2 negative edge         | —                     |
| 60C0h | 0         | INT16     |             | RW     | no       | Interpolation sub-mode select       | —                     |
| 60C1h |           | Array     |             |        |          | Interpolation data record           | —                     |
| 60C1h | 0         | U8        |             | RO     | no       | highest sub-index                   | —                     |
| 60C1h | 1         | INT32     |             | RW     | yes*     | Interpolation target position       | —                     |
| 60C1h | 2         | U32       |             | RW     | yes      | Interpolation time                  | —                     |
| 60C1h | 3         | INT32     |             | RW     | yes      | Interpolation target velocity       | —                     |
| 60C2h |           | Record    |             |        |          | Interpolation time period           | —                     |
| 60C2h | 0         | U8        |             | RO     | no       | highest sub-index                   | FBUS.<br>SAMPLEPERIOD |
| 60C2h | 1         | U8        |             | RW     | no       | Interpolation time units            | —                     |
| 60C2h | 2         | INT8      |             | RW     | no       | Interpolation time index            | —                     |
| 60C4h |           | Record    |             |        |          | Interpolation data configuration    | —                     |
| 60C4h | 0         | U8        |             | RO     | no       | highest sub-index                   | —                     |
| 60C4h | 1         | U32       |             | RO     | no       | Maximum buffer size                 | —                     |
| 60C4h | 2         | U32       |             | RO     | yes      | Actual buffer size                  | —                     |
| 60C4h | 3         | U8        |             | RW     | no       | Buffer organization                 | —                     |
| 60C4h | 4         | U16       |             | RW     | no       | Buffer position                     | —                     |
| 60C4h | 5         | U8        |             | WO     | no       | Size of data record                 | —                     |
| 60C4h | 6         | U8        |             | WO     | no       | Buffer clear                        | —                     |
| 60D0h |           | Array     |             |        |          | Touch probe source                  | —                     |



| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description   | ASCII object              |
|-------|-----------|-----------|-------------|--------|----------|---|---------------------------|
| 60D0h | 0         | U8        |             | RO     | no       | highest sub-index                                     | -                         |
| 60D0h | 1         | INT16     |             | RW     | no       | Touch probe 1 source                                  | —                         |
| 60D0h | 2         | INT16     |             | RW     | no       | Touch probe 2 source                                  | —                         |
| 60E0h | 0         | UINT16    |             | RO     | yes*     | Positive torque limit value                           | IL.LIMITP                 |
| 60E1h | 0         | UINT16    |             | RO     | yes*     | Negative torque limit value                           | IL.LIMITN                 |
| 60E4h |           | Array     |             |        |          | Additional position actual value                      | —                         |
| 60E4h | 0         | U8        |             | RO     | no       | highest sub-index                                     | —                         |
| 60E4h | 1         | INT32     |             | RO     | no       | 1st additional position actual value                  | FB1.P                     |
| 60E4h | 2         | INT32     |             | RO     | no       | 2nd additional position actual value                  | FB2.P                     |
| 60E4h | 3         | INT32     |             | RO     | no       | 3rd additional position actual value                  | FB3.P                     |
| 60E8h |           | Array     |             |        |          | Additional gear ratio - motor shaft revolutions       | —                         |
| 60E8h | 0         | U8        |             | RO     | no       | highest sub-index                                     | —                         |
| 60E8h | 1         | U32       |             | RW     | no       | 1st additional gear ratio - motor shaft revolutions   | DS402.1ADDPOSGEARMOTORREV |
| 60E8h | 2         | U32       |             | RW     | no       | 2nd additional gear ratio - motor shaft revolutions   | DS402.2ADDPOSGEARMOTORREV |
| 60E8h | 3         | U32       |             | RW     | no       | 3rd additional gear ratio - motor shaft revolutions   | DS402.3ADDPOSGEARMOTORREV |
| 60E9h |           | Array     |             |        |          | Additional feed constant - feed                       | —                         |
| 60E9h | 0         | U8        |             | RO     | no       | highest sub-index                                     | —                         |
| 60E9h | 1         | U32       |             | RW     | no       | 1st additional feed constant - feed                   | DS402.1ADDPOSFCFEED       |
| 60E9h | 2         | U32       |             | RW     | no       | 2nd additional gear ratio - motor shaft revolutions   | DS402.2ADDPOSFCFEED       |
| 60E9h | 3         | U32       |             | RW     | no       | 3rd additional feed constant - feed                   | DS402.3ADDPOSFCFEED       |
| 60EDh |           | Array     |             |        |          | Additional gear ratio - driving shaft revolutions     | —                         |
| 60EDh | 0         | U8        |             | RO     | no       | highest sub-index                                     | —                         |
| 60EDh | 1         | U32       |             | RW     | no       | 1st additional gear ratio - driving shaft revolutions | DS402.1ADDPOSGEARSHAFTREV |

| Index | Sub-index | Data Type | Float Scale | Access | PDO map. | Description  | ASCII object              |
|-------|-----------|-----------|-------------|--------|----------|--|---------------------------|
| 60EDh | 2         | U32       |             | RW     | no       | 2nd additional gear ratio - driving shaft revolutions    | DS402.2ADDPOSGEARSHAFTREV |
| 60EDh | 3         | U32       |             | RW     | no       | 3rd additional gear ratio - driving shaft revolutions    | DS402.3ADDPOSGEARSHAFTREV |
| 60EEh |           | Array     |             |        |          | Additional feed constant - driving shaft revolutions     | —                         |
| 60EEh | 0         | U8        |             | RO     | no       | highest sub-index  | —                         |
| 60EEh | 1         | U32       |             | RW     | no       | 1st additional feed constant - driving shaft revolutions | DS402.1ADDPOSFCFSHAFTREV  |
| 60EEh | 2         | U32       |             | RW     | no       | 2nd additional feed constant - driving shaft revolutions | DS402.2ADDPOSFCFSHAFTREV  |
| 60EEh | 3         | U32       |             | RW     | no       | 3rd additional feed constant - driving shaft revolutions | DS402.3ADDPOSFCFSHAFTREV  |
| 60F4h | 0         | INT32     |             | RO     | yes      | Following error actual value                             | PL.ERR                    |
| 60FCh | 0         | INT32     |             | RO     | yes      | Position demand internal value                           | PL.CMD                    |
| 60FDh | 0         | U32       |             | RO     | yes      | Digital inputs   | DIN1.MODE TO DIN6.MODE    |
| 60FEh |           | Array     |             |        |          | Digital outputs  |                           |
| 60FEh | 0         | U8        |             | RO     | no       | highest sub-index  |                           |
| 60FEh | 1         | U32       |             | RW     | yes      | Physical outputs   |                           |
| 60FEh | 2         | U32       |             | RW     | no       | Bit mask   |                           |
| 60FFh | 0         | INT32     | 1000:1      | RW     | yes*     | Target velocity  | VL.CMDU                   |
| 6502h | 0         | U32       |             | RO     | no       | Supported drive modes                                    | —                         |

## 5.3 Object Descriptions

The objects in this section are sorted by object number.

### 5.3.1 Object 1000h: Device Type (DS301)

This object describes the device type (servo drive) and device functionality (DS402 drive profile). Definition:

|                        |    |      |    |                       |  |  |   |
|------------------------|----|------|----|-----------------------|--|--|---|
| MSB                    |    |      |    | LSB                   |  |  |   |
| Additional information |    |      |    | Device profile number |  |  |   |
| Mode bits              |    | Type |    | 402d=192h             |  |  |   |
| 31                     | 24 | 23   | 16 | 15                    |  |  | 0 |

The device profile number is DS402, the type is 2 for drives, the mode bits 28 to 31 are manufacturer specific and may be changed from its actual value of 0. A read access delivers 0x00020192 at the moment.

|               |              |
|---------------|--------------|
| Index         | 1000h        |
| Name          | device type  |
| Object code   | VAR          |
| Data type     | UNSIGNED32   |
| Category      | mandatory    |
| Access        | R/O          |
| PDO mapping   | not possible |
| Value range   | UNSIGNED32   |
| Default value | no           |

### 5.3.2 Object 1001h: Error register (DS301)

This object is an error register for the device. The device can map internal errors into this byte. It is a part of an Emergency object.

|               |                |
|---------------|----------------|
| Index         | 1001h          |
| Name          | Error register |
| Object code   | VAR            |
| Data type     | UNSIGNED8      |
| Category      | mandatory      |
| Access        | R/O            |
| PDO mapping   | not possible   |
| Value range   | UNSIGNED8      |
| Default value | no             |

Error reasons to be signaled: If a bit is set to 1 the specified error has occurred. The generic error is signaled at any error situation.

| Bit | Description   | Bit | Description                                |
|-----|---------------|-----|--|
| 0   | generic error | 4   | communication error (overrun, error state) |
| 1   | current       | 5   | device profile specific                    |
| 2   | voltage       | 6   | reserved (always 0)                        |
| 3   | temperature   | 7   | manufacturer specific                      |

### 5.3.3 Object 1002h: Manufacturer Status Register (DS301)

The manufacturer status register contains important device information.

|               |                              |
|---------------|------------------------------|
| Index         | 1002h                        |
| Name          | Manufacturer Status Register |
| Object code   | VAR                          |
| Data type     | UNSIGNED32                   |
| Category      | optional                     |
| Access        | R/O                          |
| PDO mapping   | possible                     |
| Value range   | UNSIGNED32                   |
| Default value | no                           |

The following table shows the bit assignment for the status register:

| Bit | Description                                  | Bit | Description  |
|-----|--|-----|--|
| 0   | 1 = Movement (positioning, homing) active    | 16  | 1 = Homing move active   |
| 1   | reference position set                       | 17  | reserved   |
| 2   | 1 = reference switch high (home-position)    | 18  | reserved   |
| 3   | 1 = In Position                              | 19  | 1 = Emergency stop active  |
| 4   | 1 = Current (torque) limitation active       | 20  | reserved   |
| 5   | reserved                                     | 21  | reserved   |
| 6   | reserved                                     | 22  | reserved   |
| 7   | Active Disable activated                     | 23  | 1 = Homing move finished   |
| 8   | Warning active                               | 24  | Power stage deactivating   |
| 9   | 1 = target velocity reached (pp- or pv-Mode) | 25  | 1 = digital input 1 set  |
| 10  | reserved                                     | 26  | 1 = digital input 2 set  |
| 11  | 1 = Homing error                             | 27  | 1 = digital input 3 set  |
| 12  | 1 = Motor standstill                         | 28  | 1 = digital input 4 set  |
| 13  | 1 = Safe Torque Off selected                 | 29  | 1 = Power Ready signal from the power supply is enabled (similar to hardware enable) |
| 14  | 1 = Power stage enabled                      | 30  | 1 = Wake and Shake action is required  |
| 15  | 1 = Error state                              | 31  | Braking, 1 = set points not accepted   |

The following table shows the bit assignments differences from the table above for the power supply status register:

| Bit | Description                       |
|-----|-----------------------------------|
| 13  | STO string 1                      |
| 14  | STO string 2                      |
| 15  | Error state                       |
| 29  | digital input hardware enable set |

### 5.3.4 Object 1003h: Predefined Error Field (DS301)

The object 1003h provides an error history with a maximum size of 10 entries.

Subindex 0 contains the number of errors which have occurred since the last reset of the error history, either by startup of the drive or resetting the error history by writing 0 to subindex 0.

A new Emergency-message is written into subindex 1 shifting the old entries one subindex higher. The old content of subindex 8 is lost.

The UNSIGNED32-information written to the subindexes is defined in the field Error Code in the description of the Emergency Messages (→ p. 65).

|               |                                |
|---------------|--------------------------------|
| Index         | 1003h                          |
| Name          | pre-defined Error Field        |
| Object code   | ARRAY                          |
| Data type     | UNSIGNED32                     |
| Category      | optional                       |
| Subindex      | <b>0</b>                       |
| Description   | highest sub-index supported    |
| Data type     | UNSIGNED8                      |
| Category      | mandatory                      |
| Access        | R/W                            |
| PDO mapping   | not possible                   |
| Value range   | 0 to 10                        |
| Default value | 0                              |
| Subindex      | <b>1 to 10</b>                 |
| Description   | Standard error field (→ p. 65) |
| Category      | optional                       |
| Access        | R/O                            |
| PDO mapping   | not possible                   |
| Value range   | UNSIGNED32                     |
| Default value | no                             |

### 5.3.5 Object 1005h: COB-ID of the SYNC Message (DS301)

This object defines the COB-Id of the synchronisation object (SYNC).

|               |                             |
|---------------|-----------------------------|
| Index         | 1005h                       |
| Name          | COB-ID for the SYNC message |
| Object code   | VAR                         |
| Data type     | UNSIGNED32                  |
| Category      | conditional                 |
| Access        | R/W                         |
| PDO mapping   | not possible                |
| Value range   | UNSIGNED32                  |
| Default value | 0x80                        |

Bit coded information:

| Bit           | Value | Meaning                          |
|---------------|-------|----------------------------------|
| 31 (MSB)      | X     | —                                |
| 30            | 0     | Device not generate SYNC message |
|               | 1     | Device generates SYNC message    |
| 29            | 0     | 11 Bit ID (CAN 2.0A)             |
|               | 1     | 29 Bit ID (CAN 2.0B)             |
| 28 to 11      | X     | —                                |
|               | 0     | if Bit 29=0                      |
| 10 to 0 (LSB) | X     | Bit 0 to 10 of SYNC COB-ID       |

The device does not support the generation of SYNC-messages and only the 11-bit IDs. So the bits 11 to 30 are always 0.

### 5.3.6 Object 1006h: Communication Cycle Period (DS301)

This object can be used to define the period (in  $\mu\text{s}$ ) for the transmission of the SYNC telegram.

|               |                                   |
|---------------|-----------------------------------|
| Index         | 1006h                             |
| Name          | Period of the communication cycle |
| Object code   | VAR                               |
| Data type     | UNSIGNED32                        |
| Category      | O                                 |
| Access        | R/W                               |
| PDO mapping   | not possible                      |
| Value range   | UNSIGNED32                        |
| Default value | 00h                               |

### 5.3.7 Object 1008h: Manufacturer Device Name (DS301)

The device name consists of four ASCII characters in the form Yzzz, whereby Y stands for the mains voltage (L, M, H or U, e.g. H for High Voltage) zzz stands for the power stage current.

|               |                          |
|---------------|--------------------------|
| Index         | 1008h                    |
| Name          | Manufacturer Device Name |
| Object code   | VAR                      |
| Data type     | Visible String           |
| Category      | Optional                 |
| Access        | const                    |
| PDO mapping   | not possible             |
| Value range   |                          |
| Default value | no                       |

### 5.3.8 Object 1009h: Manufacturer Hardware Version

This object will be supported in the future.

|               |                               |
|---------------|-------------------------------|
| Index         | 1009h                         |
| Name          | manufacturer hardware version |
| Object code   | VAR                           |
| Data type     | Visible String                |
| Category      | Optional                      |
| Access        | const                         |
| PDO mapping   | not possible                  |
| Value range   | -                             |
| Default value | no                            |

### 5.3.9 Object 100Ah: Manufacturer Software Version (DS301)

The object contains the manufacturer software version (here: the CANopen-part of the drive firmware).

|               |                               |
|---------------|-------------------------------|
| Index         | 100Ah                         |
| Name          | Manufacturer Software Version |
| Object code   | VAR                           |
| Data type     | Visible String                |
| Category      | Optional                      |
| Access        | const                         |
| PDO mapping   | not possible                  |
| Value range   | 0.01 to 9.99                  |
| Default value | no                            |

### 5.3.10 Object 100Ch: Guard Time (DS301)Response monitoring

The arithmetical product of the Objects 100Ch Guard Time and 100Dh Lifetime Factor is the response monitoring time. The Guard Time is given in milliseconds. The response monitoring is activated with the first Nodeguard object. If the value of the object Guard Time is set to zero, then the response monitoring is inactive.

|               |  |
|---------------|--|
| Index         | 100Ch  |
| Name          | Guard Time   |
| Object code   | VAR  |
| Data type     | UNSIGNED16   |
| Category      | conditional; mandatory, if heartbeat not supported |
| Access        | R/W  |
| PDO mapping   | not possible                                       |
| Value range   | UNSIGNED16   |
| Default value | 0  |

### 5.3.11 Object 100Dh: Lifetime Factor (DS301)

The product of Guard Time and Life Time Factor gives the life time for the nodeguarding protocol. If it's 0, the protocol is not used.

|               |  |
|---------------|--|
| Index         | 100Dh  |
| Name          | Lifetime Factor                                      |
| Object code   | VAR  |
| Data type     | UNSIGNED8  |
| Category      | conditional; (mandatory, if heartbeat not supported) |
| Access        | R/W  |
| PDO mapping   | not possible   |
| Value range   | UNSIGNED8  |
| Default value | 0  |



### 5.3.12 Object 1010h: Store Parameters (DS301)

This object supports the saving of parameters to a flash EEPROM. Only the subindex 1 for saving of all parameters, which can also be saved in the parameter files via the GUI, is supported.

|               |                               |
|---------------|-------------------------------|
| Index         | 1010h                         |
| Name          | store parameters (DRV.NVSAVE) |
| Object code   | ARRAY                         |
| Data type     | UNSIGNED32                    |
| Category      | optional                      |
| Subindex      | <b>0</b>                      |
| Name          | highest sub-index supported   |
| Object code   | VAR                           |
| Data type     | UNSIGNED8                     |
| Category      | mandatory                     |
| Access        | R/O                           |
| PDO Mapping   | not possible                  |
| Value range   | 1                             |
| Default value | 1                             |
| Subindex      | <b>1</b>                      |
| Name          | save all parameters           |
| Object code   | VAR                           |
| Data type     | UNSIGNED32                    |
| Category      | mandatory                     |
| Access        | R/W                           |
| PDO Mapping   | not possible                  |
| Value range   | UNSIGNED32                    |
| Default value | 1                             |

Data definition:

| Bit     | Value | Meaning                                      |
|---------|-------|--|
| 31 to 2 | 0     | reserved (=0)                                |
| 1       | 0     | Device does not save parameters autonomously |
|         | 1     | Device does save parameters autonomously     |
| 0       | 0     | Device does not save parameters on command   |
|         | 1     | Device does save parameters on command       |

By read access to subindex 1 the drive provides information about its storage functionality.

This drive provides a constant value of 1 by read access, i.e. all parameters can be saved by writing to Object 1010 sub 1. In general the drive does not save parameters autonomously with the exception of e.g. the special treatment of the homing of multiturn absolute encoders.

Storing of parameters is only done if a special signature ("save") is written to subindex 1.

"save" is equivalent to the unsigned32 - number 65766173h.

### 5.3.13 Object 1011h: Restore Default Parameters DS301

With this object the default values of parameters according to the communication or device profile are restored. The AKD gives the possibility to restore all default values.

|               |   |
|---------------|---|
| Index         | 1011h                                       |
| Name          | restore default parameters                  |
| Object code   | ARRAY                                       |
| Data type     | UNSIGNED32                                  |
| Category      | optional                                    |
| Subindex      | <b>0</b>                                    |
| Name          | highest sub-index supported                 |
| Object code   | VAR   |
| Data type     | UNSIGNED8                                   |
| Category      | mandatory                                   |
| Access        | R/O   |
| PDO Mapping   | not possible                                |
| Value range   | 1   |
| Default value | 1   |
| Subindex      | <b>1</b>                                    |
| Name          | restore all default parameters (DRV.RSTVAR) |
| Object code   | VAR   |
| Data type     | UNSIGNED32                                  |
| Category      | mandatory                                   |
| Access        | R/W   |
| PDO Mapping   | not possible                                |
| Value range   | UNSIGNED32                                  |
| Default value | 1 (device restores parameter)               |

Restoring default parameters to the RAM will be done, if a special signature ("load") is written to subindex 1. "load" has to be transmitted as unsigned32 - number 64616F6Ch.

**5.3.14 Object 1012h: COB-ID of the Time Stamp (DS301)**

This object defines the COB-ID of the time stamp.

|               |                           |
|---------------|---------------------------|
| Index         | 1012h                     |
| Name          | COB-ID for the time stamp |
| Object code   | VAR                       |
| Data type     | UNSIGNED32                |
| Category      | optional                  |
| Access        | R/W                       |
| PDO mapping   | not possible              |
| Value range   | UNSIGNED32                |
| Default value | 100h                      |

Bit coded information:

| Bit           | Content  | Value     | Meaning                             |
|---------------|----------|-----------|-------------------------------------|
| 31 (MSB)      | consume  | 0         | Drive does not consume time message |
|               |          | 1         | Drive does consume time message     |
| 30            | produce  | 0         | Drive does not produce time message |
|               |          | 1         | Drive does produce time message     |
| 29            | frame    | 0         | Value fixed to 0                    |
| 28 to 11      | reserved | –         | reserved                            |
| 10 to 0 (LSB) | CAN-ID   | 0h - 800h | COB-ID of the time stamp            |

**5.3.15 Object 1014h: COB-ID for Emergency Message (DS301)**

This object defines the COB-ID of the Emergency message.

|               |   |
|---------------|---|
| Index         | 1014h   |
| Name          | COB-ID emergency message                          |
| Object code   | VAR   |
| Data type     | UNSIGNED32  |
| Category      | conditional; mandatory, if Emergency is supported |
| Access        | R/O   |
| PDO mapping   | not possible                                      |
| Value range   | UNSIGNED32  |
| Default value | 80h + Node - ID                                   |

### 5.3.16 Object 1016h: Consumer Heartbeat Time

The consumer heartbeat time defines the expected heartbeat cycle time (ms) and must be higher than the corresponding producer heartbeat time configured on the device producing this heartbeat. Monitoring starts after the reception of the first heartbeat. If the consumer heartbeat time is 0 ms the corresponding entry is not used.

|               |                             |
|---------------|-----------------------------|
| Index         | 1016h                       |
| Name          | consumer heartbeat time     |
| Object code   | ARRAY                       |
| Data type     | UNSIGNED32                  |
| Category      | optional                    |
| Subindex      | <b>0</b>                    |
| Description   | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value range   | 1                           |
| Default value | 1                           |
| Subindex      | <b>1</b>                    |
| Description   | Consumer heartbeat time     |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO Mapping   | not possible                |
| Value range   | unsigned 32                 |
| Default value | 0                           |

Definition of the entry value of Subindex 1

|            |                      |    |           |    |                |
|------------|----------------------|----|-----------|----|----------------|
|            | MSB                  |    |           |    | LSB            |
| Value      | reserved (value: 00) |    | Node-ID   |    | heartbeat time |
| Encoded as | -                    |    | UNSIGNED8 |    | UNSIGNED16     |
| Bit        | 31                   | 24 | 23        | 16 | 15 0           |

### 5.3.17 Object 1017h: Producer Heartbeat Time

The producer heartbeat time defines the cycle time of the heartbeat in ms. If it is 0, it is not used.

|               |   |
|---------------|---|
| Index         | 1017h   |
| Name          | Producer heartbeat time                                 |
| Object code   | VAR   |
| Data type     | UNSIGNED16  |
| Category      | conditional;<br>mandatory, if guarding is not supported |
| Access        | R/W   |
| PDO mapping   | not possible  |
| Value range   | UNSIGNED16  |
| Default value | 0   |

### 5.3.18 Object 1018h: Identity Object (DS301)

The Identity Object contains general device information.

|               |                             |
|---------------|-----------------------------|
| Index         | 1018h                       |
| Name          | Identity Object             |
| Object code   | RECORD                      |
| Data type     | Identity                    |
| Category      | mandatory                   |
| Subindex      | <b>0</b>                    |
| Description   | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 1 to 4                      |
| Default value | 4                           |

Subindex 1 is a unique number for a device manufacturer.

|               |                    |
|---------------|--------------------|
| Subindex      | <b>1</b>           |
| Description   | Vendor ID          |
| Category      | mandatory          |
| Access        | R/O                |
| PDO mapping   | not possible       |
| Value range   | UNSIGNED32         |
| Default value | 0x6Ah (Kollmorgen) |

Subindex 2 contains four ASCII - characters, which determine the voltage range and current class of the device. The voltage range is one character L, M or H for low, medium and high voltage. The next three characters are showing the continuous current of the drive.

|               |                            |
|---------------|----------------------------|
| Subindex      | <b>2</b>                   |
| Description   | Product Code               |
| Category      | optional                   |
| Access        | R/O                        |
| PDO mapping   | not possible               |
| Value range   | e.g. M006 for an MV6 drive |
| Default value | no                         |

Subindex 3 consists of two revision numbers:

- the major revision number in the upper word containing the CAN-version
- the minor revision number is not used in the AKD. The firmware version can be retrieved as a string via object 0x100A or as numbers via object 0x2018 subindex 1 to 4.

E.g. a value of 0x0014 0000 means CAN-version 0.20.

|               |                 |
|---------------|-----------------|
| Subindex      | <b>3</b>        |
| Description   | Revision Number |
| Category      | optional        |
| Access        | R/O             |
| PDO mapping   | not possible    |
| Value range   | UNSIGNED32      |
| Default value | no              |

Subindex 4 gives the serial number of the drive. This number contains the following information in it:

- bits 0..14: Board serial number (production in week of year)
- bits 15..20: week of production
- bits 21..24: year of production - 2009
- bits 25..31: ASCII-code of MFR-ID

|               |               |
|---------------|---------------|
| Subindex      | <b>4</b>      |
| Description   | Serial Number |
| Category      | optional      |
| Access        | R/O           |
| PDO mapping   | not possible  |
| Value range   | UNSIGNED32    |
| Default value | no            |

### 5.3.19 Object 1026h: OS Prompt

The OS prompt is used to build up an ASCII - communication channel to the drive.

|             |           |
|-------------|-----------|
| Index       | 1026h     |
| Name        | OS Prompt |
| Object code | ARRAY     |
| Data type   | UNSIGNED8 |
| Category    | optional  |

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Description   | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 2                           |
| Default value | 2                           |

Subindex 1 is used to send one character to the drive.

|               |              |
|---------------|--------------|
| Subindex      | <b>1</b>     |
| Description   | StdIn        |
| Category      | mandatory    |
| Access        | W            |
| PDO mapping   | not possible |
| Value range   | UNSIGNED8    |
| Default value | —            |

Subindex 2 is used to receive one character from the drive.

|               |              |
|---------------|--------------|
| Subindex      | <b>2</b>     |
| Description   | StdOut       |
| Category      | mandatory    |
| Access        | R/O          |
| PDO mapping   | not possible |
| Value range   | UNSIGNED8    |
| Default value | 0            |

**5.3.20 Objects 1400-1403h: 1st - 4th RxPDO communication parameter (DS301)**

1400h to 1403h for RxPDO 1 to 4

|             |                                  |
|-------------|----------------------------------|
| Index       | 1400h<br>1401h<br>1402h<br>1403h |
| Name        | receive PDO parameter            |
| Object code | RECORD                           |
| Data type   | PDO CommPar                      |
| Category    | mandatory                        |

Defined sub-indices

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Name          | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value Range   | 2                           |
| Default Value | 2                           |

|               |  |
|---------------|--|
| Subindex      | <b>1</b>   |
| Name          | COB-ID used by PDO   |
| Category      | mandatory  |
| Access        | R/W  |
| PDO Mapping   | not possible   |
| Value Range   | UNSIGNED32   |
| Default Value | Index 1400h: 200h + Node-ID                      Index 1401h: 300h + Node-ID<br>Index 1402h: 400h + Node-ID                      Index 1403h: 500h + Node-ID |

Subindex 1 contains the COB-Id of the PDO as a bit coded information:

| Bit      | Value | Meaning  |
|----------|-------|--|
| 31       | 0     | PDO exists/is valid  |
|          | 1     | PDO does not exist/is not valid  |
| 30       | 0     | RTR allowed on this PDO, not to be used (Can in Automation organisation) |
|          | 1     | RTR not allowed on this PDO  |
| 29       | 0     | 11 bit-ID (CAN 2.0A)   |
|          | 1     | 29 bit-ID (CAN 2.0B), not supported                                      |
| 28 to 11 | X     | Identifier-bits with 29 bit-ID, not relevant                             |
| 10 to 0  | X     | Bits 10-0 of COB-ID  |



|               |                   |
|---------------|-------------------|
| Subindex      | <b>2</b>          |
| Name          | transmission type |
| Category      | mandatory         |
| Access        | R/W               |
| PDO Mapping   | not possible      |
| Value Range   | UNSIGNED8         |
| Default Value | FFh               |

Subindex 2 contains the transmission type of the PDO. There are two ways of setting:

- the value FFh or 255 for event-triggered PDO, which is directly interpreted by reception and taken into actions,
- values from 0 to 240, which cause a SYNC-telegram-controlled interpretation of the PDO contents. Values of 1 to 240 mean, that 0 to 239 SYNC-telegrams are ignored, before one is interpreted. The value 0 means that only the next SYNC-telegram is interpreted.

### 5.3.21 Objects 1600-1603h: 1st - 4th RxPDO mapping parameter (DS301)

1600h to 1603h for RxPDO 1 to 4.

|             |                                  |
|-------------|----------------------------------|
| Index       | 1600h<br>1601h<br>1602h<br>1603h |
| Name        | receive PDO mapping              |
| Object Code | RECORD                           |
| Data Type   | PDO Mapping                      |
| Category    | mandatory                        |

|               |   |
|---------------|---|
| Subindex      | <b>0</b>  |
| Name          | highest sub-index supported   |
| Data type     | UNSIGNED8   |
| Category      | mandatory   |
| Access        | R/W   |
| PDO Mapping   | not possible  |
| Value Range   | 0: PDO is not active<br>1 - 8: PDO activated, mappings are taken only byte-wise |
| Default Value | PDO1: 1<br>PDO2: 2<br>PDO3: 2<br>PDO4: 2  |

|               |   |
|---------------|---|
| Subindex      | <b>1 - 8</b>  |
| Name          | PDO - mapping for the n-th application object               |
| Category      | Conditional, depends on number and size of object be mapped |
| Access        | R/W   |
| PDO Mapping   | not possible  |
| Value Range   | UNSIGNED32  |
| Default Value | See below   |

**5.3.22 Objects 1800-1803h: 1st - 4th TxPDO communication parameter (DS301)**

1800h to 1803h for TxPDO 1 to 4.

|               |  |
|---------------|--|
| Index         | 1800h<br>1801h<br>1802h<br>1803h   |
| Name          | transmit PDO parameter   |
| Object code   | RECORD   |
| Data type     | PDO CommPar  |
| Category      | mandatory  |
| Subindex      | <b>0</b>   |
| Name          | highest sub-index supported  |
| Data type     | UNSIGNED8  |
| Category      | mandatory  |
| Access        | R/O  |
| PDO Mapping   | not possible   |
| Value Range   | 5  |
| Default Value | 5  |
| Subindex      | <b>1</b>   |
| Name          | COB-ID used by PDO   |
| Category      | mandatory  |
| Access        | R/W  |
| PDO Mapping   | not possible   |
| Value Range   | UNSIGNED32   |
| Default Value | Index 1800h: 180h + Node-ID<br>Index 1801h: 280h + Node-ID<br>Index 1802h: 380h + Node-ID<br>Index 1803h: 480h + Node-ID |
| Subindex      | <b>2</b>   |
| Name          | transmission type  |
| Category      | mandatory  |
| Access        | R/W  |
| PDO Mapping   | not possible   |
| Value Range   | UNSIGNED8  |
| Default Value | FFh  |
| Subindex      | <b>3</b>   |
| Name          | inhibit time   |
| Category      | optional   |
| Access        | R/W  |
| PDO Mapping   | not possible   |
| Value Range   | UNSIGNED16 (n*1/10ms)  |
| Default Value | 0h   |

|               |                              |
|---------------|------------------------------|
| Subindex      | <b>4</b>                     |
| Name          | reserved                     |
| Category      | optional                     |
| Access        | R/W                          |
| PDO Mapping   | not possible                 |
| Value Range   | 0                            |
| Default Value | 0                            |
| Subindex      | <b>5</b>                     |
| Name          | event timer                  |
| Category      | optional                     |
| Access        | R/W                          |
| PDO Mapping   | not possible                 |
| Value Range   | UNSIGNED 16 (0=not used, ms) |
| Default Value | 0h                           |

Subindex 1 contains the COB-Id of the PDO as a bit coded information:

| Bit-Number | Value | Meaning                                      |
|------------|-------|--|
| 31         | 0     | PDO exists/is valid                          |
|            | 1     | PDO does not exist/is not valid              |
| 30         | 0     | RTR allowed on this PDO, not supported       |
|            | 1     | RTR not allowed on this PDO, not supported   |
| 29         | 0     | 11 bit-ID (CAN 2.0A)                         |
|            | 1     | 29 bit-ID (CAN 2.0B), not supported          |
| 28 to 11   | X     | Identifier-bits with 29 bit-ID, not relevant |
| 10 to 0    | X     | Bits 10-0 of COB-ID                          |

Subindex 2 contains the transmission type of the PDO. There are two ways of setting:

- A value of FFh or 255d for an event-triggered PDO, which is sent immediately after a change in the mapped application objects. Setting of Subindex 3 or 5 has an influence on the sending of a PDO. With Subindex 3 you can configure, in which minimal time the so configured Transmit-PDOs are sent, if PDO-data contents change (reduction of bus-load). With Subindex 5 (event time) a timer is used, which is reset with every event-triggered sending of this PDO. If there is no change of the PDO-content in this time, the PDO is sent caused by this timer event.
- Values from 0 to 240 cause a SYNC-Telegram controlled sending of the PDO.
- Values from 1 to 240 define how often the SYNC-telegram leads to a sending of a PDO.
- The value 0 means, that only the next SYNC-telegram leads to a sending of the so configured PDOs.

**5.3.23 Objects 1A00-1A03h: 1st - 4th TxPDO mapping parameter (DS301)**

1A00h to 1A03h for TxPDO 1 to 4.

|               |   |
|---------------|---|
| Index         | 1A00h<br>1A01h<br>1A02h<br>1A03h  |
| Name          | transmit PDO mapping  |
| Object Code   | RECORD  |
| Data Type     | PDO Mapping   |
| Category      | mandatory   |
| Subindex      | <b>0</b>  |
| Name          | number of mapped application objects in PDO                                     |
| Data type     | UNSIGNED8   |
| Category      | mandatory   |
| Access        | R/W   |
| PDO Mapping   | not possible  |
| Value Range   | 0: PDO is not active<br>1 - 8: PDO activated, mappings are taken only byte-wise |
| Default Value | PDO1: 1<br>PDO2: 2<br>PDO3: 2<br>PDO4: 2  |
| Subindex      | <b>1 - 8</b>  |
| Name          | PDO - mapping for the n-th application object                                   |
| Category      | Conditional, depends on number and size of object be mapped                     |
| Access        | R/W   |
| PDO Mapping   | not possible  |
| Value Range   | UNSIGNED32  |
| Default Value | See below   |

### 5.3.24 Object 1C12h: RxPDO assign (DS301)

This object is used to define the mapping for receive direction of EtherCAT data. Either one of the fixed RxPDO mappings 1701h to 1725h is chosen or 1 to 4 of the free mappings 1600h to 1603h.

|             |              |
|-------------|--------------|
| Index       | 1C12h        |
| Name        | RxPDO assign |
| Object code | ARRAY        |
| Data type   | UNSIGNED16   |
| Category    | optional     |

Defined sub-indices

|               |                                      |
|---------------|--------------------------------------|
| Subindex      | <b>0</b>                             |
| Name          | highest sub-index supported          |
| Data type     | UNSIGNED8                            |
| Category      | mandatory                            |
| Access        | R/W                                  |
| PDO Mapping   | not possible                         |
| Value Range   | 0: pdo not active, 1-4 PDO activated |
| Default Value | 1                                    |

|               |                    |
|---------------|--------------------|
| Subindex      | <b>1 to 4</b>      |
| Name          | Subindex 001..004  |
| Data type     | UNSIGNED8          |
| Category      | optional           |
| Access        | R/W                |
| PDO Mapping   | not possible       |
| Value Range   | UNSIGNED16         |
| Default Value | 1701h via ESI-file |

**5.3.25 Object 1C13h: TxPDO assign (DS301)**

This object is used to define the mapping for transmit direction of EtherCAT data. Either one of the fixed TxPDO mappings 1B01h to 1B26h is chosen or 1 to 4 of the free mappings 1A00h to 1A03h.

|             |              |
|-------------|--------------|
| Index       | 1C13h        |
| Name        | TxPDO assign |
| Object code | ARRAY        |
| Data type   | UNSIGNED16   |
| Category    | optional     |

Defined sub-indices

|               |                                      |
|---------------|--------------------------------------|
| Subindex      | <b>0</b>                             |
| Name          | highest sub-index supported          |
| Data type     | UNSIGNED8                            |
| Category      | mandatory                            |
| Access        | R/O                                  |
| PDO Mapping   | not possible                         |
| Value Range   | 0: pdo not active, 1-4 PDO activated |
| Default Value | 1                                    |

|               |                    |
|---------------|--------------------|
| Subindex      | <b>1 to 4</b>      |
| Name          | Subindex 001..004  |
| Data type     | UNSIGNED16         |
| Category      | optional           |
| Access        | R/W                |
| PDO Mapping   | not possible       |
| Value Range   | UNSIGNED16         |
| Default Value | 1B01h via ESI-file |

### 5.3.26 Object 2000h: System Warnings

This object is used to show up to three actual warnings with their AKD- specific warning number.

|               |                               |
|---------------|-------------------------------|
| Index         | 2000h                         |
| Name          | System Warnings               |
| Object code   | ARRAY                         |
| Data type     | UNSIGNED32                    |
| Subindex      | <b>0</b>                      |
| Description   | highest sub-index supported   |
| Category      | mandatory                     |
| Access        | R/O                           |
| PDO mapping   | not possible                  |
| Value range   | 3                             |
| Default value | 3                             |
| Subindex      | <b>1 to 3</b>                 |
| Description   | DRV.WARNING1 to DRV.WARNINGS3 |
| Mode          | independent                   |
| Access        | R/O                           |
| PDO mapping   | not possible                  |
| Unit          | —                             |
| Value range   | 0 to 999                      |
| Default value | 0                             |

### 5.3.27 Object 2001h: System Faults

This object is used to show up to ten actual faults with their AKD- specific fault number.

|               |                             |
|---------------|-----------------------------|
| Index         | 2001h                       |
| Name          | System Faults               |
| Object code   | ARRAY                       |
| Data type     | UNSIGNED8                   |
| Subindex      | 0                           |
| Description   | highest sub-index supported |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 0xA                         |
| Default value | 0xA                         |
| Subindex      | <b>1 to A</b>               |
| Description   | DRV.FAULT1 to DRV.FAULT10   |
| Mode          | independent                 |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Unit          | —                           |
| Value range   | 0 to 999                    |
| Default value | 0                           |

### 5.3.28 Object 2002h: Manufacturer status bytes

This objects delivers the information of the manufacturer status (object 0x1002 sub 0) as four separate, mappable, bytes.

|               |  |
|---------------|--|
| Index         | 2002h  |
| Name          | Manufacturer status bytes                                |
| Object code   | ARRAY  |
| Data type     | UNSIGNED8  |
| Subindex      | <b>0</b>   |
| Description   | highest sub-index supported                              |
| Category      | mandatory  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Value range   | 0x4  |
| Default value | 0x4  |
| Subindex      | <b>1 to 4</b>  |
| Description   | Manufacturer status byte 1 to Manufacturer status byte 4 |
| Mode          | independent  |
| Access        | R/O  |
| PDO mapping   | possible   |
| Unit          | —  |
| Value range   | 0 to 0xFF  |
| Default value | -  |



### 5.3.29 Object 2011h: DRV.RUNTIME in seconds

This object delivers the runtime of the drive in seconds.

|               |                        |
|---------------|------------------------|
| Index         | 2011h                  |
| Name          | DRV.RUNTIME in seconds |
| Object code   | VAR                    |
| Data type     | UNSIGNED32             |
| Access        | R/O                    |
| Unit          | —                      |
| Value range   | UNSIGNED32             |
| Default value | 0                      |

### 5.3.30 Object 2012h: Fault history: Fault numbers

This object delivers the 20 latest entries of the fault numbers of the fault history table. The latest event can be read via sub-index 1. With new events the list is shifted to higher sub-indices.

|               |  |
|---------------|--|
| Index         | 2012h  |
| Name          | Fault history: Fault numbers   |
| Object code   | ARRAY  |
| Data type     | UNSIGNED32   |
| Subindex      | <b>0</b>   |
| Description   | highest sub-index supported  |
| Category      | mandatory  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Value range   | 0x14h  |
| Default value | 0x14h  |
| Subindex      | <b>1 to 20</b>   |
| Description   | Nth-latest entry in fault number list of fault history table (DRV.FAULTHIST) |
| Mode          | independent  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Unit          | —  |
| Value range   | 0 - 999  |
| Default value | 0  |

### 5.3.31 Object 2013h: Fault history: Time stamps

This object delivers the 20 latest entries of the fault time stamps of the fault history table in seconds related to DRV.RUNTIME. The latest event can be read via sub-index 1. With new events the list is shifted to higher sub-indices.

|               |  |
|---------------|--|
| Index         | 2013h  |
| Name          | Fault history: Time stamps   |
| Object code   | ARRAY  |
| Data type     | UNSIGNED32   |
| Subindex      | <b>0</b>   |
| Description   | highest sub-index supported  |
| Category      | mandatory  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Value range   | 0x14h  |
| Default value | 0x14h  |
| Subindex      | <b>1 to 20</b>   |
| Description   | Nth-latest entry in fault time stamp list of fault history table (DRV.FAULTHIST) |
| Mode          | independent  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Unit          | —  |
| Value range   | UNSIGNED32   |
| Default value | —  |

### 5.3.32 Object 2014-2017h: 1st-4th Mask 1 to 4 for Transmit-PDO

In order to reduce the bus loading with event-triggered PDOs, masking can be used to switch off the monitoring for individual bits in the PDO. In this way it can be arranged, for instance, that actual position values are only signaled once per turn.

This Object masks the PDO-channels 1 to 4. If only two bytes have been defined in a PDO, then it masks just two bytes, although 4 bytes of mask information have been transmitted.

An activated bit in the mask means that monitoring is active for the corresponding bit in the PDO.

|               |                                  |
|---------------|----------------------------------|
| Index         | 2014h<br>2015h<br>2016h<br>2017h |
| Name          | tx_mask 1 to 4                   |
| Object code   | ARRAY                            |
| Data type     | UNSIGNED32                       |
| Subindex      | <b>1</b>                         |
| Description   | tx_mask1 to 4_low                |
| Mode          | independent                      |
| Access        | R/W                              |
| PDO mapping   | not possible                     |
| Unit          | —                                |
| Value range   | UNSIGNED32                       |
| Default value | FFFFFFFFh                        |
| Subindex      | <b>2</b>                         |
| Description   | tx_mask1 to 4_high               |
| Mode          | independent                      |
| Access        | R/W                              |
| PDO mapping   | not possible                     |
| Unit          | —                                |
| Value range   | UNSIGNED32                       |
| Default value | FFFFFFFFh                        |

### 5.3.33 Object 2018h: Firmware Version

This object gives all information regarding the firmware version.

Example: Firmware version M\_01\_00\_01\_005 would show the numbers 1, 0, 1, 5 in the sub-indices 1 to 4.

|               |                  |
|---------------|------------------|
| Index         | 2018h            |
| Name          | firmware version |
| Object code   | ARRAY            |
| Data type     | UNSIGNED16       |
| Subindex      | <b>1</b>         |
| Description   | major version    |
| Mode          | independent      |
| Access        | R/O              |
| PDO mapping   | not possible     |
| Unit          | —                |
| Value range   | UNSIGNED16       |
| Default value | 0                |
| Subindex      | <b>2</b>         |
| Description   | minor version    |
| Mode          | independent      |
| Access        | R/O              |
| PDO mapping   | not possible     |
| Unit          | —                |
| Value range   | UNSIGNED16       |
| Default value | 0                |
| Subindex      | <b>3</b>         |
| Description   | revision         |
| Mode          | independent      |
| Access        | R/O              |
| PDO mapping   | not possible     |
| Unit          | —                |
| Value range   | UNSIGNED16       |
| Default value | 0                |
| Subindex      | <b>4</b>         |
| Description   | branch revision  |
| Mode          | independent      |
| Access        | R/O              |
| PDO mapping   | not possible     |
| Unit          | —                |
| Value range   | UNSIGNED16       |
| Default value | 0                |

### 5.3.34 Object 2026h: ASCII Channel

This object is used to build up an ASCII - communication channel to the drive with 4-byte ASCII-strings.

|             |                |
|-------------|----------------|
| Index       | 2026h          |
| Name        | ASCII Channel  |
| Object code | ARRAY          |
| Data type   | Visible String |
| Category    | optional       |

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Description   | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 2                           |
| Default value | 2                           |

Subindex 1 is used to send four ASCII-characters to the drive.

|               |                |
|---------------|----------------|
| Subindex      | <b>1</b>       |
| Description   | Command        |
| Category      | mandatory      |
| Access        | wo             |
| PDO mapping   | no             |
| Value range   | Visible String |
| Default value | —              |

Subindex 2 is used to receive four characters from the drive.

|               |                |
|---------------|----------------|
| Subindex      | <b>2</b>       |
| Description   | Response       |
| Category      | mandatory      |
| Access        | R/O            |
| PDO mapping   | no             |
| Value range   | Visible String |
| Default value | -              |

### 5.3.35 Object 204Ch: PV Scaling Factor

This object shall indicate the configured numerator and denominator of the pv scaling factor. The pv scaling factor serves to modify the resolution or directing range of the specified set-point. It is also included in calculation of the vl velocity demand, and vl velocity actual value. It does not influence the velocity limit function and the ramp function. The value shall have no physical unit and shall be given in the range from -32 768 to +32 767, but the value of 0 shall not be used.

The velocity scaling factor is only active, when bit 4 of FBUS.PARAM05 is set to 1. Otherwise velocities are scaled as 1/1000 rpm.

|               |                               |
|---------------|-------------------------------|
| Index         | 204Ch                         |
| Name          | pv scaling factor             |
| Object code   | ARRAY                         |
| Data type     | INTEGER32                     |
| Category      | optional                      |
| Subindex      | <b>0</b>                      |
| Description   | highest sub-index supported   |
| Data type     | UNSIGNED8                     |
| Category      | mandatory                     |
| Access        | R/O                           |
| PDO mapping   | not possible                  |
| Value range   | 2                             |
| Default value | no                            |
| Subindex      | <b>1</b>                      |
| Description   | pv scaling factor numerator   |
| Category      | optional                      |
| Access        | R/W                           |
| PDO mapping   | not possible                  |
| Value range   | INTEGER32                     |
| Default value | +1                            |
| Subindex      | <b>2</b>                      |
| Description   | pv scaling factor denominator |
| Category      | optional                      |
| Access        | R/W                           |
| PDO mapping   | not possible                  |
| Value range   | INTEGER32                     |
| Default value | +1                            |

**5.3.36 Object 2071h: Target Current**

This parameter can be used alternatively to the DS402 parameter 6071h and is the input to the torque controller. The value is scaled in mA (milli Amperes).

|               |                                      |
|---------------|--------------------------------------|
| Index         | 2071h                                |
| Name          | Target current                       |
| Object code   | VAR                                  |
| Data type     | INTEGER 32                           |
| Category      | optional                             |
| Access        | RW                                   |
| PDO mapping   | possible                             |
| Value range   | depends on DRV.IPEAK and MOTOR.IPEAK |
| Default value | 0                                    |

**5.3.37 Object 2077h: Current Actual Value**

This parameter can be used alternatively to the DS402 parameter 6077h. The value is scaled in mA (milli Amperes).

|               |                                      |
|---------------|--------------------------------------|
| Index         | 2077h                                |
| Name          | Current actual value                 |
| Object code   | VAR                                  |
| Data type     | INTEGER 32                           |
| Category      | optional                             |
| Access        | RO                                   |
| PDO mapping   | possible                             |
| Value range   | depends on DRV.IPEAK and MOTOR.IPEAK |
| Default value | 0                                    |

**5.3.38 Object 207Fh: Maximum Velocity**

Maximum velocity This parameter limits the velocity of the motor in profile torque and cyclic synchronous torque mode. The scaling is the same as for object 60FFh.

|               |                        |
|---------------|------------------------|
| Index         | 207Fh                  |
| Name          | Maximum velocity       |
| Object code   | VAR                    |
| Data type     | UNSIGNED32             |
| Category      | optional               |
| Access        | RW                     |
| PDO mapping   | possible               |
| Value range   |                        |
| Default value | 0, means no limitation |

### 5.3.39 Object 2080h: Motion Task Select

This parameter can be used to select a motion task to be executed in profile position mode. The selected task will be started on a rising edge of Bit 4 (new\_setpoint) of the DS402 control word "Object 6040h: Control word (DS402)" (→ p. 139) with Bit 5 (change\_set\_immediately) set.

|             |                    |
|-------------|--------------------|
| Index       | 2080h              |
| Name        | Motion Task Select |
| Object code | VAR                |
| Data type   | INTEGER16          |
| Category    | optional           |

|               |          |
|---------------|----------|
| Access        | WO       |
| PDO mapping   | possible |
| Value range   | 0 to 128 |
| Default value | 0        |

### 5.3.40 Object 2081h: Active Motion Task

This parameter can be used to read the number of the active motion task. If no task is currently active, this will return the last active motion task number.

|             |                    |
|-------------|--------------------|
| Index       | 2081h              |
| Name        | Active Motion Task |
| Object code | VAR                |
| Data type   | INTEGER16          |
| Category    | optional           |

|               |           |
|---------------|-----------|
| Access        | RO        |
| PDO mapping   | possible  |
| Value range   | INTEGER16 |
| Default value | 0         |

### 5.3.41 Object 20A0h: Latch position 1, positive edge

This object is used to output the position or a time, depending on CAP0.MODE, at which the first positive edge occurred on a signal, which can be configured with CAP0.TRIGGER. The latch enable must be active for that purpose (see object 20A4 and 20A5). With CAP0.MODE = 3 the latched position of the encoder index pulse is transferred via this object.

|             |   |
|-------------|---|
| Index       | 20A0h   |
| Name        | Latch position 1 positive edge CAP0.PLFB, Time capture CAP0.T |
| Object code | VAR   |
| Data type   | INTEGER32   |
| Category    | optional  |

|               |           |
|---------------|-----------|
| Access        | R/O       |
| PDO mapping   | possible  |
| Value range   | INTEGER32 |
| Float scaling | var       |
| Default value | 0         |



**5.3.42 Object 20A1h: Latch position 1, negative edge**

This object is used to output the position or a time, depending on CAP0.MODE, at which the first negative edge occurred on a signal, which can be configured with CAP0.TRIGGER. The latch enable must be active for that purpose(see object 20A4 and 20A5).

|               |   |
|---------------|---|
| Index         | 20A1h   |
| Name          | Latch position 1 negative edge CAP0.PLFB, Time capture CAP0.T |
| Object code   | VAR   |
| Data type     | INTEGER32   |
| Category      | optional  |
| Access        | R/O   |
| PDO mapping   | possible  |
| Value range   | INTEGER32   |
| Float scaling | var   |
| Default value | 0   |

**5.3.43 Object 20A2h: Latch position 2, positive edge**

This object is used to output the position or a time, depending on CAP1.MODE, at which the first positive edge occurred on a signal, which can be configured with CAP1.TRIGGER. The latch enable must be active for that purpose(see object 20A4 and 20A5).

|               |   |
|---------------|---|
| Index         | 20A2h   |
| Name          | Latch position 2 positive edge CAP1.PLFB, Time capture CAP1.T |
| Object code   | VAR   |
| Data type     | INTEGER32   |
| Category      | optional  |
| Access        | R/O   |
| PDO mapping   | possible  |
| Value range   | INTEGER32   |
| Float scaling | var   |
| Default value | 0   |

### 5.3.44 Object 20A3h: Latch position 2, negative edge

This object is used to output the position or a time, depending on CAP1.MODE, at which the first negative edge occurred on a signal, which can be configured with CAP1.TRIGGER. The latch enable must be active for that purpose (see object 20A4 and 20A5).

|               |   |
|---------------|---|
| Index         | 20A3h   |
| Name          | Latch position 2 negative edge CAP1.PLFB, Time capture CAP1.T |
| Object code   | VAR   |
| Data type     | INTEGER32   |
| Category      | optional  |
| Access        | R/O   |
| PDO mapping   | possible  |
| Value range   | INTEGER32   |
| Float scaling | var   |
| Default value | 0   |

### 5.3.45 Object 20A4h: Latch Control Register

The latch control register is used to enable the latch monitoring of the capture engines 0 and 1. The latch is enabled with a 1 signal and disabled with a 0 signal. Whether or not a latch event has occurred can be recognised by the latch status register (object 20A5).

|               |                        |
|---------------|------------------------|
| Index         | 20A4h                  |
| Name          | Latch Control Register |
| Object code   | VAR                    |
| Data type     | UNSIGNED16             |
| Category      | optional               |
| Access        | rww                    |
| PDO mapping   | possible               |
| Value range   | 0 to 15                |
| Default value | 0                      |

| Bit      | Value (bin)       | Value (hex) | Description                           |
|----------|-------------------|-------------|---------------------------------------|
| 0        | 00000000 00000001 | xx01        | Enable extern latch 1 (positive rise) |
| 1        | 00000000 00000010 | xx02        | Enable extern latch 1 (negative rise) |
| 2        | 00000000 00000100 | xx04        | Enable extern latch 2 (positive rise) |
| 3        | 00000000 00001000 | xx08        | Enable extern latch 2 (negative rise) |
| 4 to 7   |                   |             | Reserve                               |
| 8        | 00000001 00000000 | 01xx        | Read external latch 1 (positive rise) |
| 9        | 00000010 00000000 | 02xx        | Read external latch 1 (negative rise) |
| 10       | 00000011 00000000 | 03xx        | Read external latch 2 (positive rise) |
| 11       | 00000100 00000000 | 04xx        | Read external latch 2 (negative rise) |
| 12 to 15 |                   |             | Reserve                               |

### 5.3.46 Object 20A5h: Latch Status Register

The latch status register is used to look for the states of the capture engines 0 and 1.

|               |                       |
|---------------|-----------------------|
| Index         | 20A5h                 |
| Name          | Latch Status Register |
| Object code   | VAR                   |
| Data type     | UNSIGNED16            |
| Category      | optional              |
| Access        | rwr                   |
| PDO mapping   | possible              |
| Value range   | -                     |
| Default value | 0                     |

| Bit    | Value (bin)       | Value (hex) | Description  |
|--------|-------------------|-------------|--|
| 0      | 00000000 00000001 | zz01        | External latch 1 valid (positive rise)             |
| 1      | 00000000 00000010 | zz02        | External latch 1 valid (negative rise)             |
| 2      | 00000000 00000100 | zz04        | External latch 2 valid (positive rise)             |
| 3      | 00000000 00001000 | zz08        | External latch 2 valid (negative rise)             |
| 4 to 7 |                   |             | Reserve  |
| 8      | 00000001 00000000 | z1zz        | Acknowledge value external latch 1 (positive rise) |
| 9      | 00000010 00000000 | z2zz        | Acknowledge value external latch 1 (negative rise) |
| 10     | 00000011 00000000 | z3zz        | Acknowledge value external latch 2 (positive rise) |
| 11     | 00000100 00000000 | z4zz        | Acknowledge value external latch 2 (negative rise) |
| 12     | 00010000 00000000 | 1zzz        | State Digital Input 4                              |
| 13     | 00100000 00000000 | 2zzz        | State Digital Input 3                              |
| 14     | 01000000 00000000 | 4zzz        | State Digital Input 2                              |
| 15     | 10000000 00000000 | 8zzz        | State Digital Input 1                              |

### 5.3.47 Object 20A6h: Latch position 1, positive or negative edge

This object is used to output the position or a time, depending on CAP0.MODE, at which the first positive or negative edge occurred on a signal, that can be configured with CAP0.TRIGGER. Latch enable must be active for that purpose (see object 20A4 and 20A5).

|               |   |
|---------------|---|
| Index         | 20A6h   |
| Name          | Latch position 1 positive or negative CAP0.PLFB |
| Object code   | VAR   |
| Data type     | INTEGER32                                       |
| Category      | optional  |
| Access        | ro  |
| PDO mapping   | possible  |
| Value range   | INTEGER32                                       |
| Float scaling | var   |
| Default value | 0   |

**5.3.48 Object 20A7h: Latch position 2, positive or negative edge**

This object is used to output the position or a time, depending on CAP1.MODE, at which the first positive or negative edge occurred on a signal, that can be configured with CAP1.TRIGGER. Latch enable must be active for that purpose (see object 20A4 and 20A5).

|               |   |
|---------------|---|
| Index         | 20A7h   |
| Name          | Latch position 2 positive or negative CAP1.PLFB |
| Object code   | VAR   |
| Data type     | INTEGER32                                       |
| Category      | optional  |
| Access        | ro  |
| PDO mapping   | possible  |
| Value range   | INTEGER32                                       |
| Float scaling | var   |
| Default value | 0   |

**5.3.49 Object 20B8h: Reset of changed input information**

This object is used in PDOs to reset the state change information for the digital inputs shown in the Bits 24 to 30 in the object 60FD. Bit 0 to 6 are used to reset the information of the digital input 1 to 7.

|               |                                    |
|---------------|------------------------------------|
| Index         | 20B8h                              |
| Name          | Reset of changed input information |
| Object code   | VAR                                |
| Data type     | UNSIGNED16                         |
| Category      | optional                           |
| Access        | rw                                 |
| PDO mapping   | possible                           |
| Value range   | UNSIGNED16                         |
| Default value | 0                                  |

### 5.3.50 Object 345Ah: Brake Control

These objects implement the possibility to control the brake directly overriding the drive logic. When the brake state is controlled by the fieldbus, the drive state (enabled, disabled, faulted) has no effect on the brake so the fieldbus is in control.

#### NOTICE

Applying or releasing the brake at the wrong time can be a safety hazard and can destroy your mechanic as well as drive or motor. Unexpected behaviour might be possible. It is the responsibility of the customer using this mode to use this function appropriately.

When fieldbus control is disabled, the drive controls the brake as defined by existing AKD brake related parameters. When fieldbus control is enabled, the Brake Command received over the fieldbus takes effect. If the Brake Command is set to APPLY and the current state is RELEASE, the brake begins to apply.

The default value of the fieldbus control is disabled so the drive is always in control until the fieldbus is operational. It is recommended that this bit remain 0 except for special operating conditions where the fieldbus will control the brake. When fieldbus communication is lost, the drive will regain control of the brake if the fieldbus had previously taken control.

| Enable Fieldbus Control | Serious Failure condition present | Brake Command | Fieldbus Control Status | Controlled by... | Final Brake State |
|-------------------------|-----------------------------------|---------------|-------------------------|------------------|-------------------|
| 0                       | x                                 | x             | 0                       | Drive            | Drive             |
| 1*                      | no                                | 0             | 1                       | Fieldbus         | Applied           |
| 1*                      | no                                | 1             | 1                       | Fieldbus         | Released          |
| x                       | yes                               | any           | 0                       | Drive            | Drive             |

1\* indicates that a rising edge was seen since the last time the drive applied the brake

|             |               |
|-------------|---------------|
| Index       | 345Ah         |
| Name        | Brake Control |
| Object code | ARRAY         |
| Data type   | UNSIGNED16    |
| Category    | optional      |

Defined sub-indices

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Name          | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value Range   | 2                           |
| Default Value | 2                           |

|               |                       |
|---------------|-----------------------|
| Subindex      | <b>1</b>              |
| Name          | Brake Control Command |
| Category      | optional              |
| Access        | R/W                   |
| PDO Mapping   | possible              |
| Value Range   | UNSIGNED16            |
| Default Value | 0                     |

With subindex 1 the brake is controlled. Bit definition:

| Bit | Name                    | Description  |
|-----|-------------------------|--|
| 0   | Enable fieldbus control | 0 - brake is not controlled via this object<br>1 - enable fieldbus control via this object. This function works edge triggered, i.e. this bit has to have a 0 -> 1 transition to activate the brake control functionality. After a fault the functionality is reset and has to be activated again. The activation can be controlled by subindex 2 bit 0. |
| 1   | Brake Command           | This command bit is only active, if the functionality was activated via bit 0. The function is as follows:<br>0 - apply the brake<br>1 - release the brake   |

|               |                       |
|---------------|-----------------------|
| Subindex      | <b>2</b>              |
| Name          | Brake Status Response |
| Category      | optional              |
| Access        | R/O                   |
| PDO Mapping   | possible              |
| Value Range   | UNSIGNED16            |
| Default Value | 0                     |

With subindex 2 the brake status can be checked. Bit definition:

| Bit | Name                    | Description   |
|-----|-------------------------|---|
| 0   | Fieldbus control Status | 0 - brake control via 0x345A is disabled or not possible due to drive failure.<br>1 - enable fieldbus control via this object. This function works edge triggered, i.e. this bit has to have a 0 -> 1 transition to activate the brake control functionality. After a fault the functionality is reset and has to be activated again. The activation can be controlled by subindex 2 bit 0. |
| 1   | Brake Status            | 0 - apply the brake<br>1 - release the brake<br><b>Note:</b> When the brake is applied or released, there is a time delay MOTOR.TBRAKEAPP or MOTOR.TBRAKEREL, after the receipt of the command before this status bit changes. The status is always reported: it is not affected by fieldbus control.   |
| 2   | STO Status              | 0 - STO is not active (drive may be enabled)<br>1 - STO is active (drive can not be enabled)  |
| 3   | HW Enable Status        | 0 - HW enable is disabled, drive function can not be enabled<br>1 - HW enable is enabled, drive function can be enabled   |

### 5.3.51 Object 3474h: Parameters for digital inputs

This set of objects is used to set extended parameters for some digital input functions. The parameters can be used for different DINx.MODEs. Therefore the scaling might be different or no scaling is used at all.

Two subindices build an access object to one of these parameters, because they are 64-bit numbers internally, e.g. object 3474 sub 1 gives access to the low 32 bits of DIN1.PARAM whereas 3474 sub 8 gives access to the high 32 bits.

If access to the whole 64 bit number is needed the higher bits must be written first. The access to the lower 32 bits then writes the parameter. If the to be written value fits into 32 bit, only the lower part needs to be written. The most-significant bit is then taken as sign-bit for the number.

|               |                                     |
|---------------|-------------------------------------|
| Index         | 3474h                               |
| Name          | DINx.PARAM                          |
| Object code   | Array                               |
| Data type     | UNSIGNED32                          |
| Category      | optional                            |
| Subindex      | <b>0</b>                            |
| Description   | highest sub-index supported         |
| Category      | mandatory                           |
| Access        | R/O                                 |
| PDO mapping   | not possible                        |
| Value range   | 0xE                                 |
| Default value | 0xE                                 |
| Subindex      | <b>1 to 7</b>                       |
| Description   | DINx.PARAM low 32 bits, x = 1 .. 7  |
| Category      | optional                            |
| Access        | R/W                                 |
| PDO mapping   | not possible                        |
| Value range   | UNSIGNED32                          |
| Default value | 0                                   |
| Subindex      | <b>8 to 0xE</b>                     |
| Description   | DINx.PARAM high 32 bits, x = 1 .. 7 |
| Category      | optional                            |
| Access        | R/W                                 |
| PDO mapping   | not possible                        |
| Value range   | UNSIGNED32                          |
| Default value | 0                                   |

### 5.3.52 Object 3475h: Parameters for digital outputs

This set of objects is used to set extended parameters for some digital output functions. The parameters can be used for different DOUTx.MODEs. Therefore the scaling might be different or no scaling is used at all.

Two subindices build an access object to one of these parameters, because they are 64-bit numbers internally, e.g. object 3475 sub 1 gives access to the low 32 bits of DOUT1.PARAM whereas 3475 sub 3 gives access to the high 32 bits.

If access to the whole 64 bit number is needed the higher bits must be written first. The access to the lower 32 bits then writes the parameter. If the to be written value fits into 32 bit, only the lower part needs to be written. The most-significant bit is then taken as sign-bit for the number.

|               |                                      |
|---------------|--------------------------------------|
| Index         | 3475h                                |
| Name          | DOUTx.PARAM                          |
| Object code   | Array                                |
| Data type     | UNSIGNED32                           |
| Category      | optional                             |
| Subindex      | <b>0</b>                             |
| Description   | highest sub-index supported          |
| Category      | mandatory                            |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | 0x4                                  |
| Default value | 0x4                                  |
| Subindex      | <b>1 to 2</b>                        |
| Description   | DOUTx.PARAM low 32 bits, x = 1 .. 2  |
| Category      | optional                             |
| Access        | R/W                                  |
| PDO mapping   | not possible                         |
| Value range   | UNSIGNED32                           |
| Default value | 0                                    |
| Subindex      | <b>3 to 4</b>                        |
| Description   | DOUTx.PARAM high 32 bits, x = 1 .. 2 |
| Category      | optional                             |
| Access        | R/W                                  |
| PDO mapping   | not possible                         |
| Value range   | UNSIGNED32                           |
| Default value | 0                                    |



### 5.3.53 Object 3496h: Fieldbus synchronization parameters

This set of objects is used to set or read parameters for the fieldbus synchronization used in the interpolated position mode (7) and the cyclic-modes 8 etc. The synchronization between a fieldbus master and the AKD is similar in all the supported fieldbus systems.

The AKD internal 16[kHz] interrupt function is responsible for calling the PLL function. This PLL function is called once per fieldbus cycle (set by object 60C2 sub 1 and 2). If the fieldbus sample period is for example 1[ms], the PLL code is called every 16th time of the 16[kHz] IRQ of the AKD.

Once in a fieldbus sample the SYNC-telegram must arrive, which resets a PLL counter in the Drive. After some time the already mentioned PLL function is called and reads back the time from that PLL counter.

Depending on the measured time the PLL function extends (in case that the measured time is too low) or lowers (in case that the measured time is too high) the sample time of the upcoming 16[kHz] tasks for one fieldbus sample by a selectable value (object 3496 sub 4) in order to move the PLL function closer to the expected distance (object 3496 sub 1).

Beside the objects mentioned here the parameter FBUS.SAMPLEPERIOD is important, which is set by object 60C2 sub 1 and 2. This setting is required in order to share the fieldbus sample time with the slave. This information is e.g. needed for being able to call the AKD internal PLL function once per fieldbus sample.

|             |                                 |
|-------------|---------------------------------|
| Index       | 3496h                           |
| Name        | FBUS synchronization parameters |
| Object code | Array                           |
| Data type   | UNSIGNED32                      |
| Category    | optional                        |

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Description   | highest sub-index supported |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 0x4                         |
| Default value | 0x4                         |

|               |               |
|---------------|---------------|
| Subindex      | <b>1</b>      |
| Description   | FBUS.SYNCDIST |
| Category      | optional      |
| Access        | R/W           |
| PDO mapping   | not possible  |
| Value range   | UNSIGNED32    |
| Default value | 320000 [ns]   |

Sub 1 is the expected time distance in nano seconds between clearing the PLL counter and calling the PLL function.

|               |              |
|---------------|--------------|
| Subindex      | <b>2</b>     |
| Description   | FBUS.SYNCACT |
| Category      | optional     |
| Access        | R/W          |
| PDO mapping   | not possible |
| Value range   | UNSIGNED32   |
| Default value | 320000 [ns]  |

Sub 2 is the actual time distance in nano seconds between clearing the PLL counter and calling the PLL function.

|               |              |
|---------------|--------------|
| Subindex      | <b>3</b>     |
| Description   | FBUS.SYNCWND |
| Category      | optional     |
| Access        | R/W          |
| PDO mapping   | not possible |
| Value range   | UNSIGNED32   |
| Default value | 70000 [ns]   |

Sub 3 is a window, which is used in order to consider the drive as being synchronized. The AKD is considered as synchronized in the following case:

$$\text{FBUS.SYNCDIST} - \text{FBUS.SYNCWND} < \text{FBUS.SYNCACT} < \text{FBUS.SYNCDIST} + \text{FBUS.SYNCWND}$$

|               |               |
|---------------|---------------|
| Subindex      | <b>4</b>      |
| Description   | FBUS.COMPTIME |
| Category      | optional      |
| Access        | R/W           |
| PDO mapping   | not possible  |
| Value range   | UNSIGNED32    |
| Default value | 150 [ns]      |

Sub 4 value indicates the time, which is used for extending or lowering the sample rate of the AKD internal 16[kHz] IRQ, which is responsible for calling the PLL function. The default sample time is  $32 * 1/16[\text{kHz}] = 2[\text{ms}]$ .

The sample time of the AKD high prior interrupt is determined by  $62.5[\mu\text{s}] - \text{FBUS.COMPTIME}$  if  $\text{FBUS.SYNCACT} > \text{FBUS.SYNCDIST}$ .

The sample time of the AKD high prior interrupt is determined by  $62.5[\mu\text{s}] + \text{FBUS.COMPTIME}$  if  $\text{FBUS.SYNCACT} < \text{FBUS.SYNCDIST}$ .

### 5.3.54 Object 34D1h: Legacy EtherCAT input handling

This object defines the handling of Tx-PDO-data of the AKD-series. The legacy behavior was input data (for the EtherCAT-controller) handled with a delay of one bus cycle. The new behavior is to handle the data without this delay. This is especially needed for masters that close the control loop using the drive's velocity or torque mode.

Values:

0 – handling of input data without delay

1 – handling of input data with one cycle delay

#### NOTE

Although the default value is set to 1, the ESI-file will overwrite this value with its defined InitCmds. If the legacy behavior is needed, the value of the InitCmd has to be changed.

This object has only a functionality for CANopen over EtherCAT. The actual value of this object can be also read by using Telnet with the command (see ECAT.INPUTHANDLING).

|             |                                |
|-------------|--------------------------------|
| Index       | 34D1h                          |
| Name        | Legacy EtherCAT input handling |
| Object code | VAR                            |
| Data type   | UNSIGNED8                      |
| Category    | optional                       |

|               |              |
|---------------|--------------|
| Access        | RW           |
| PDO mapping   | not possible |
| Value range   | 0 to 1       |
| Default value | 0            |

### 5.3.55 Object 6040h: Control word (DS402)

The control commands are built up from the logical combination of the bits in the control word and external signals (e.g enable output stage). The definitions of the bits are shown below:

|               |              |
|---------------|--------------|
| Index         | 6040h        |
| Name          | control word |
| Object code   | VAR          |
| Data type     | UNSIGNED16   |
| Access        | R/W          |
| PDO mapping   | possible     |
| Unit          | —            |
| Value range   | 0 to 65535   |
| EEPROM        | no           |
| Default value | 0            |

**Bit assignment in the control word**

| Bit | Name                                    | Bit | Name                  |
|-----|---|-----|-----------------------|
| 0   | Switch on                               | 8   | Pause/halt            |
| 1   | Disable Voltage                         | 9   | reserved              |
| 2   | Quick Stop                              | 10  | reserved              |
| 3   | Enable Operation                        | 11  | reserved              |
| 4   | Operation mode specific                 | 12  | reserved              |
| 5   | Operation mode specific                 | 13  | Manufacturer-specific |
| 6   | Operation mode specific                 | 14  | Manufacturer-specific |
| 7   | Reset Fault (only effective for faults) | 15  | Manufacturer-specific |

**Commands in the control word**

| Command           | Bit 7<br>Fault<br>Reset | Bit 3<br>Enable<br>Operation | Bit 2<br>Quick<br>Stop | Bit 1<br>Disable<br>Voltage | Bit 0<br>Switch<br>on | Transitions  |
|-------------------|-------------------------|------------------------------|------------------------|-----------------------------|-----------------------|--------------|
| Shutdown          | X                       | X                            | 1                      | 1                           | 0                     | 2, 6, 8      |
| Switch on         | X                       | X                            | 1                      | 1                           | 1                     | 3            |
| Disable Voltage   | X                       | X                            | X                      | 0                           | X                     | 7, 9, 10, 12 |
| Quick Stop        | X                       | X                            | 0                      | 1                           | X                     | 7, 10, 11    |
| Disable Operation | X                       | 0                            | 1                      | 1                           | 1                     | 5            |
| Enable Operation  | X                       | 1                            | 1                      | 1                           | 1                     | 4, 16        |
| Fault Reset       | 1                       | X                            | X                      | X                           | X                     | 15           |

Bits marked by an X are irrelevant.

### Mode-dependent bits in the control word

The following table shows the mode-dependent bits in the control word. Only manufacturer-specific modes are supported at present. The individual modes are set by Object 6060<sub>n</sub> Modes of operation.

| Operation mode                  | No. | Bit 4                  | Bit 5                  | Bit 6             |
|---------------------------------|-----|------------------------|------------------------|-------------------|
| Profile Position Mode (pp)      | 01h | new_setpoint           | change_set_immediately | absolute/relative |
| Profile Velocity Mode (pv)      | 03h | reserved               | reserved               | reserved          |
| Profile Torque Mode (tq)        | 04h | reserved               | reserved               | reserved          |
| Homing Mode (hm)                | 06h | homing_operation_start | reserved               | reserved          |
| Interpolated Position Mode (ip) | 07h | Enable Interpolation   | reserved               | reserved          |
| Cyclic sync position Mode (csp) | 08h | reserved               | reserved               | reserved          |
| Cyclic sync velocity mode (csv) | 09h | reserved               | reserved               | reserved          |
| Cyclic sync torque mode (cst)   | 0ah | reserved               | reserved               | reserved          |

Description of the remaining bits in the control word

The remaining bits in the control word are described below.

**Bit 8 Pause** If Bit 8 is set, then the drive halts (pauses) in all modes. The setpoints (speed for homing or jogging, motion task number, setpoints for digital mode) for the individual modes are retained.

**Bit 9,10** These bits are reserved for the drive profile (DS402).

**Bit 13, 14, 15** These bits are manufacturer-specific, and reserved at present.

### 5.3.56 Object 6041h: Status word (DS402)

The momentary state of the state machine can be read out with the aid of the status word.

|               |             |
|---------------|-------------|
| Index         | 6041h       |
| Name          | Status word |
| Object code   | VAR         |
| Data type     | UNSIGNED16  |
| Access        | R/W         |
| PDO mapping   | possible    |
| Unit          | —           |
| Value range   | 0 to 65535  |
| EEPROM        | yes         |
| Default value | 0           |

#### Bit assignment in the status word

| Bit | Name               | Bit | Name                               |
|-----|--------------------|-----|------------------------------------|
| 0   | Ready to switch on | 8   | STO – Safe Torque Off              |
| 1   | Switched on        | 9   | Remote                             |
| 2   | Operation enabled  | 10  | Target reached                     |
| 3   | Fault              | 11  | Internal limit active              |
| 4   | Voltage enabled    | 12  | Operation mode specific (reserved) |
| 5   | Quick stop         | 13  | Operation mode specific (reserved) |
| 6   | Switch on disabled | 14  | Manufacturer-specific (reserved)   |
| 7   | Warning            | 15  | Manufacturer-specific (reserved)   |

**States of the state machine**

| State                  | Bit 6<br>switch on<br>disabled | Bit 5<br>quick stop | Bit 3<br>fault | Bit 2<br>operation<br>enabled | Bit 1<br>switched<br>on | Bit 0<br>ready to<br>switch on |
|------------------------|--------------------------------|---------------------|----------------|-------------------------------|-------------------------|--------------------------------|
| Not ready to switch on | 0                              | X                   | 0              | 0                             | 0                       | 0                              |
| Switch on disabled     | 1                              | X                   | 0              | 0                             | 0                       | 0                              |
| Ready to switch on     | 0                              | 1                   | 0              | 0                             | 0                       | 1                              |
| Switched on            | 0                              | 1                   | 0              | 0                             | 1                       | 1                              |
| Operation enabled      | 0                              | 1                   | 0              | 1                             | 1                       | 1                              |
| Fault                  | 0                              | X                   | 1              | 0                             | 0                       | 0                              |
| Fault reaction active  | 0                              | X                   | 1              | 1                             | 1                       | 1                              |
| Quick stop active      | 0                              | 0                   | 0              | 1                             | 1                       | 1                              |

Bits marked by X are irrelevant

Description of the remaining bits in the status word

**Bit 4:** `voltage_enabled` The DC-link voltage is present if this bit is set.

**Bit 7:** `warning` There are several possible reasons for Bit 7 being set and this warning being produced. The reason of a warning can be seen by the Error code of the Emergency message, which is sent on the bus caused by this warning.

**Bit 9:** The remote-bit is set by the telnet command `FBUS.REMOTE`. The default state is 1 indicating that the power stage shall be only controlled by the DS402 control word. For special actions via telnet like tuning or commutation finding, `FBUS.REMOTE` shall be set to 0 via telnet to inform the fieldbus master.

**Bit 10:** `target_reached` This is set when the drive has reached the target position. In profile position mode the position window is set via `MT.TPOSWND`, in homing mode via `HOME.TPOSWND`. If `FBUS.PARAM05`-bit 15 is set to 1. the Target Reached - bit is also set, when the drive comes to a standstill after the halt bit 8 of the control word was set.

**Bit 11:** `internal_limit_active` This bit specifies that a movement was or is limited. Bit 11 is set when one of the following warnings is set: n478, n107, n108, n154, n157, n158, n159, n160, n161, n163, n164, n165, n167, n168, n169, n170, n171, n174, n179, n135

**Mode-dependent bits in the status word**

The following table shows the mode-dependent bits in the status word. The individual modes are set by " Object 6060h: Modes of Operation (DS402)" (→ p. 144).

| Operation mode                  | No. | Bit 12   | Bit 13          |
|---------------------------------|-----|--|-----------------|
| Profile Position Mode (pp)      | 01h | setpoint acknowledge   | following error |
| Homing Mode (hm)                | 06h | homing attained  | homing error    |
| Interpolated Position Mode (ip) | 07h | ip mode active   | following error |
| Cyclic sync position Mode (csp) | 08h | This bit stays on 1 as long as the drive is following the position set-points. | following error |
| Cyclic sync velocity mode (csv) | 09h | This bit stays on 1 as long as the drive is following the position set-points. | reserved        |
| Cyclic sync torque mode (cst)   | 0ah | This bit stays on 1 as long as the drive is following the position set-points. | reserved        |

**5.3.57 Object 605Ah: Quick stop option code (DS402)**

This object defines the action, which is taken as quick stop function.

|               |                        |
|---------------|------------------------|
| Index         | 605Ah                  |
| Name          | Quick stop option code |
| Object code   | VAR                    |
| Data type     | INTEGER16              |
| Category      | optional               |
| Access        | R/W                    |
| PDO mapping   | not possible           |
| Value range   | 1, 2, 5, 6             |
| Default value | 2                      |

Supported codes:

| Bit | Description  |
|-----|--|
| 1   | Slow down on slow down ramp and transit into Switch On Disabled  |
| 2   | Slow down on quick stop ramp and transit into Switch On Disabled |
| 5   | Slow down on slow down ramp and stay in Quick Stop Active        |
| 6   | Slow down on quick stop ramp and stay in Quick Stop Active       |

### 5.3.58 Object 6060h: Modes of Operation (DS402)

This object is used to set the mode, which can be read out by Object 6061h. Two types of operating mode are used:

- manufacturer-specific operating modes
- operating modes as per CANopen drive profile DS402

These operating modes are defined in the CANopen drive profile DS402. After the mode has been changed, the corresponding setpoint must be set once more (for instance, the homing velocity in the mode homing\_setpoint). If the position or jogging mode is stored, then the Homing mode is set after a RESET of the drive.

#### NOTE

An operating mode only becomes valid when it can be read by Object 6061h.



#### **WARNING** Automatic Restart!

Risk of death or serious injury for humans working in the machine. The drive could move unexpectedly. When the drive is enabled, a mode change is only permissible at zero speed.

- Never change the mode while the motor is running!
- Set the speed setpoint to 0 before changing over.

|               |                                     |
|---------------|-------------------------------------|
| Index         | 6060h                               |
| Name          | mode of operation                   |
| Object code   | VAR                                 |
| Data type     | INTEGER8                            |
| Category      | mandatory                           |
| Access        | R/W                                 |
| PDO mapping   | possible                            |
| Value range   | -3, -2, -1, 1, 3, 4, 6, 7, 8, 9, 10 |
| Default value | —                                   |

Supported modes (negative values are manufacturer specific modes):

| Value (hex) | Mode                             |
|-------------|----------------------------------|
| -3          | Electronic gearing mode          |
| -2          | Analog velocity mode             |
| -1          | Analog current mode              |
| 1           | Profile position mode            |
| 3           | Profile velocity mode            |
| 4           | Profile torque mode              |
| 6           | Homing mode                      |
| 8           | Cyclic synchronous position mode |
| 9           | Cyclic synchronous velocity mode |
| 10          | Cyclic synchronous torque mode   |



**5.3.59 Object 6061h: Modes of Operation Display (DS402)**

This object can be used to read the mode that is set by Object 6060h. An operating mode only becomes valid when it can be read by Object 6061h (see also Object 6060h).

|               |                                     |
|---------------|-------------------------------------|
| Index         | 6061h                               |
| Name          | mode of operation display           |
| Object code   | VAR                                 |
| Data type     | INTEGER8                            |
| Category      | mandatory                           |
| Access        | R/O                                 |
| PDO mapping   | possible                            |
| Value range   | -3, -2, -1, 1, 3, 4, 6, 7, 8, 9, 10 |
| Default value | —                                   |

**5.3.60 Object 6063h: position actual value\* (DS402)**

The object position actual value provides the momentary actual position in increments. If FB1.EXTENDEDMULTITURN is configured, the saved extended multiturn position will be returned

The resolution is defined with Object 608F as power-of-two number.

|               |  |
|---------------|--|
| Index         | 6063h  |
| Name          | position actual value                          |
| Object code   | VAR  |
| Data type     | INTEGER32                                      |
| Mode          | pc, pp   |
| Access        | R/W  |
| PDO mapping   | possible                                       |
| Unit          | increments (1 turn = $2^{\text{FB1.PSCALE}}$ ) |
| Value range   | $(-2^{31})$ to $(2^{31}-1)$                    |
| Default value | $2^{20}$                                       |
| EEPROM        | no   |

**5.3.61 Object 6064h: position actual value (DS402)**

The object position actual value provides the actual position (PL.FB). If FB1.EXTENDEDMULTITURN is configured, the saved extended multiturn position will be returned. The resolution can be altered by the gearing factors of the position controller (Object 6091/6092).

|               |                              |
|---------------|------------------------------|
| Index         | 6064h                        |
| Name          | position actual value, PL.FB |
| Object code   | VAR                          |
| Data type     | INTEGER32                    |
| Mode          | pp, csp                      |
| Access        | R/W                          |
| PDO mapping   | possible                     |
| Unit          | position units               |
| Value range   | $(-2^{31})$ to $(2^{31}-1)$  |
| Default value | —                            |
| EEPROM        | no                           |

**5.3.62 Object 6065h: Following error window**

The following error window defines a range of tolerated position values symmetrically to the position demand value. A following error might occur when a drive is blocked, unreachable profile velocity occurs, or at wrong closed loop coefficients. If the value of the following error window is 0, the following control is switched off.

|               |                        |
|---------------|------------------------|
| Index         | 6065h                  |
| Name          | Following error window |
| Object code   | VAR                    |
| Data type     | UNSIGNED32             |
| Category      | optional               |
| Access        | R/W                    |
| PDO mapping   | not possible           |
| Value range   | UNSIGNED32             |
| Default value | 0                      |

**5.3.63 Object 606Ch: Velocity actual value (DS402)**

The object velocity actual value represents the actual speed.

|               |   |
|---------------|---|
| Index         | 606Ch   |
| Name          | velocity actual value, VL.FB                                |
| Object code   | VAR   |
| Data type     | INTEGER32   |
| Mode          | pv  |
| Access        | R/O   |
| PDO mapping   | possible  |
| Unit          | velocity units (SDO is in user units and the PDO is in RPM) |
| Value range   | $(-2^{31})$ to $(2^{31}-1)$                                 |
| Default value | —   |
| Float scaling | 1000:1  |
| EEPROM        | no  |

**5.3.64 Object 6071h: Target torque (DS402)**

This parameter is the input value for the torque controller in profile torque mode and the value is given per thousand (1‰) of rated torque.

|               |   |
|---------------|---|
| Index         | 6071h                                   |
| Name          | Target torque                           |
| Object code   | VAR                                     |
| Data type     | INTEGER16                               |
| Category      | conditional; mandatory, if tq supported |
| Access        | R/W                                     |
| PDO mapping   | possible                                |
| Value range   | INTEGER16                               |
| Default value | 0                                       |

**5.3.65 Object 6073h: Max current (DS402)**

This value represents the maximum permissible torque creating current in the motor and is given per thousand (1‰) of rated current.

|               |              |
|---------------|--------------|
| Index         | 6073h        |
| Name          | Max current  |
| Object code   | VAR          |
| Data type     | UNSIGNED16   |
| Category      | optional     |
| Access        | R/W          |
| PDO mapping   | not possible |
| Value range   | UNSIGNED16   |
| Default value | 0            |

**5.3.66 Object 6077h: Torque actual value (DS402)**

The torque actual value corresponds to the instantaneous torque in the drive motor. The value is given per thousand (1‰) of rated torque. This object reflects the actual current (DRV.ICONT).

|               |                     |
|---------------|---------------------|
| Index         | 6077h               |
| Name          | Torque actual value |
| Object code   | VAR                 |
| Data type     | INTEGER16           |
| Category      | optional            |
| Access        | R/O                 |
| PDO mapping   | possible            |
| Value range   | INTEGER16           |
| Default value | 0                   |

**5.3.67 Object 607Ah: Target position (DS402)**

The object target position defines the target position for the drive. The target position is interpreted as a relative distance or an absolute position, depending on Bit 6 of the control word. The type of relative movement can be further defined by the manufacturer-specific parameter 35B9h Subindex 0. Other properties like following motion tasks can be set with this object as well. The mechanical resolution is set via the scaling objects 6091h and 6092h.

|               |                               |
|---------------|-------------------------------|
| Index         | 607Ah                         |
| Name          | target position, MT.P         |
| Object code   | VAR                           |
| Data type     | INTEGER32                     |
| Mode          | pp, csp                       |
| Access        | R/W                           |
| PDO mapping   | possible                      |
| Unit          | user-defined                  |
| Value range   | $-(2^{31}-1)$ to $(2^{31}-1)$ |
| Default value | —                             |

**5.3.68 Object 607Ch: Homing offset (DS402)**

The reference offset (home offset) is the difference between the zero position for the application and the zero point of the machine. All subsequent absolute motion tasks take account of the reference offset.

|               |                             |
|---------------|-----------------------------|
| Index         | 607Ch                       |
| Name          | home offset, HOME.P         |
| Object code   | VAR                         |
| Data type     | INTEGER32                   |
| Mode          | hm                          |
| Access        | R/W                         |
| PDO mapping   | not possible                |
| Unit          | user-defined                |
| Value range   | $(-2^{31})$ to $(2^{31}-1)$ |
| Default value | 0                           |

### 5.3.69 Object 607Dh: Software position limit (DS402)

Software position limit contains the sub-parameters min position limit and max position limit. New target positions are checked against these limits. The limits are relative to the machine home position, which is the result of homing (including the home offset (Object 607Ch)). As default the software position limits are switched off. Changed values must be saved and the drive must be restarted to take enable the new the software limits.

|               |                                      |
|---------------|--------------------------------------|
| Index         | 607Dh                                |
| Name          | Software position limit, SWLS.LIMIT0 |
| Object code   | ARRAY                                |
| Data type     | INTEGER32                            |
| Category      | optional                             |
| Subindex      | <b>0</b>                             |
| Description   | highest sub-index supported          |
| Category      | mandatory                            |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | 2                                    |
| Default value | 2                                    |
| Subindex      | <b>1</b>                             |
| Description   | min position limit 1, SWLS.LIMIT0    |
| Category      | mandatory                            |
| Access        | R/W                                  |
| PDO mapping   | not possible                         |
| Value range   | INTEGER32                            |
| Default value | 0 (switched off)                     |
| Subindex      | <b>2</b>                             |
| Description   | Min Position Limit 2, SWLS.LIMIT1    |
| Category      | mandatory                            |
| Access        | R/W                                  |
| PDO mapping   | not possible                         |
| Value range   | INTEGER32                            |
| Default value | 0 (switched off)                     |

**5.3.70 Object 6081h: Profile velocity (DS402)**

The profile velocity is the final velocity that should be reached after the acceleration phase of a motion task. It is scaled in user-defined position units per second. The position units are scaled via the objects "6091h" (→ p. 95) and "6092h" (→ p. 95) (with FBUS.PARAMOS05 = 16).

|               |                        |
|---------------|------------------------|
| Index         | 6081h                  |
| Name          | profile velocity, MT.V |
| Object code   | VAR                    |
| Data type     | UNSIGNED32             |
| Mode          | pp                     |
| Access        | R/W                    |
| PDO mapping   | possible               |
| Unit          | speed units            |
| Value range   | 0 to ( $2^{32}-1$ )    |
| Default value | 10                     |

**5.3.71 Object 6083h: Profile acceleration (DS402)**

The acceleration ramp (profile acceleration) is given in units that are defined by the user (position units per s<sup>2</sup>). The position units are scaled via the objects 6091 and 6092. This object is connected to the AKD-parameter DRV.ACC in the Profile Velocity Mode and to the motion task parameter MT.ACC in all other modes.

|               |   |
|---------------|---|
| Index         | 6083h   |
| Name          | profile acceleration, MT.ACC (DRV.ACC in Profile Velocity Mode) |
| Object code   | VAR   |
| Data type     | UNSIGNED32  |
| Mode          | pp, pv  |
| Access        | R/W   |
| PDO mapping   | possible  |
| Unit          | acceleration units  |
| Value range   | 0 to ( $2^{32}-1$ )   |
| Default value | 0   |

**5.3.72 Object 6084h: Profile deceleration (DS402)**

The braking/deceleration ramp is handled in the same way as the acceleration ramp (" Object 6083h: Profile acceleration (DS402)" (→ p. 150)).

|               |   |
|---------------|---|
| Index         | 6084h   |
| Name          | profile deceleration, MT.DEC (DRV.DEC in Profile Velocity Mode) |
| Object code   | VAR   |
| Data type     | UNSIGNED32  |
| Mode          | pp, pv  |
| Access        | R/W   |
| PDO mapping   | possible  |
| Unit          | deceleration units  |
| Value range   | 0 to ( $2^{32}-1$ )   |
| Default value | 0   |

### 5.3.73 Object 6087h Torque slope (DS402)

This object defines the rate of change of torque. The value is given in units of per thousand of rated torque per second. The minimum rate settable for the AKD is equivalent to the value of DRV.ICONT (= 1000 per mille) per ~ 420 milliseconds equivalent to a value of ~ 2385 per mille / second.

|               |                               |
|---------------|-------------------------------|
| Index         | 6087h                         |
| Name          | Torque slope                  |
| Object code   | VAR                           |
| Data type     | UNSIGNED32                    |
| Category      | mandatory, if tq is supported |
| Access        | R/W                           |
| PDO mapping   | possible                      |
| Value range   | UNSIGNED32                    |
| Default value | -                             |

### 5.3.74 Object 608Fh: Position encoder resolution (DS402)

The position encoder resolution defines the ratio of encoder increments per motor revolution on the CANopen end. Encoder increments are set either directly by subindex 1 (only powers of 2 available) or implicit by writing to the parameter FB1.PSCALE.

|               |                             |
|---------------|-----------------------------|
| Index         | 608Fh                       |
| Name          | Position encoder resolution |
| Object Code   | ARRAY                       |
| Data Type     | UNSIGNED 32                 |
| Category      | optional                    |
| Subindex      | <b>0</b>                    |
| Name          | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value Range   | 2                           |
| Default Value | 2                           |
| Subindex      | <b>1</b>                    |
| Name          | Encoder increments          |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO Mapping   | not possible                |
| Value Range   | UNSIGNED 32                 |
| Default Value | 2 <sup>20</sup>             |
| Subindex      | <b>2</b>                    |
| Name          | Motor revolutions           |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO Mapping   | not possible                |
| Value Range   | UNSIGNED 32                 |
| Default Value | 1                           |

**5.3.75 Object 6091h: Gear Ratio (DS402)**

The gear ratio defines the ratio of feed in position units per driving shaft revolutions. This includes the gear if present.

gear ratio = motor shaft revolutions / driving shaft revolutions

|               |                             |
|---------------|-----------------------------|
| Index         | 6091h                       |
| Name          | Gear Ratio                  |
| Object Code   | ARRAY                       |
| Data Type     | UNSIGNED 32                 |
| Category      | optional                    |
| Subindex      | <b>0</b>                    |
| Name          | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value Range   | 2                           |
| Default Value | 2                           |
| Subindex      | <b>1</b>                    |
| Name          | Motor revolution            |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO Mapping   | not possible                |
| Value Range   | UNSIGNED 32                 |
| Default Value | 1                           |
| Subindex      | <b>2</b>                    |
| Name          | Shaft revolutions           |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO Mapping   | not possible                |
| Value Range   | UNSIGNED 32                 |
| Default Value | 1                           |



**5.3.76 Object 6092h: Feed constant (DS402)**

The feed constant defines the ratio of feed in position units per driving shaft revolutions. This includes the gear if present.

|             |               |
|-------------|---------------|
| Index       | 6092h         |
| Name        | Feed constant |
| Object Code | ARRAY         |
| Data Type   | UNSIGNED 32   |
| Category    | optional      |

|               |                             |
|---------------|-----------------------------|
| Subindex      | <b>0</b>                    |
| Name          | highest sub-index supported |
| Data type     | UNSIGNED8                   |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO Mapping   | not possible                |
| Value Range   | 2                           |
| Default Value | 2                           |

|               |              |
|---------------|--------------|
| Subindex      | <b>1</b>     |
| Name          | Feed         |
| Category      | mandatory    |
| Access        | R/W          |
| PDO Mapping   | not possible |
| Value Range   | UNSIGNED 32  |
| Default Value | 1            |

|               |                   |
|---------------|-------------------|
| Subindex      | <b>2</b>          |
| Name          | Shaft revolutions |
| Category      | mandatory         |
| Access        | R/W               |
| PDO Mapping   | not possible      |
| Value Range   | UNSIGNED 32       |
| Default Value | 1                 |

**5.3.77 Object 6098h: Homing method (DS402)**

|               |                                    |
|---------------|------------------------------------|
| Index         | 6098h                              |
| Name          | homing method, HOME.MODE, HOME.DIR |
| Object code   | VAR                                |
| Data type     | INTEGER8                           |
| Mode          | hm                                 |
| Access        | R/W                                |
| PDO mapping   | not possible                       |
| Unit          | position units                     |
| Value range   | -128 to 127                        |
| Default value | 0                                  |

**Description of the homing methods**

Choosing a homing method by writing a value to homing method (Object 6098h) will clearly establish:

- the homing signal (P-Stop, N-Stop, reference switch)
- the direction of actuation

and where appropriate

- the position of the index pulse.

The reference position is give by the reference offset (Object 607Ch).

A detailed description of the types of homing movement can be found in the description of WorkBench.

The following homing methods are supported:

| Method as per DS402 | Brief description: Homing   | command                               |
|---------------------|---|---------------------------------------|
| -128 to -8          | reserved  | —                                     |
| -7                  | find home input in negative direction, then find next feedback zero   | HOME.MODE=18,<br>HOME.DIR=0           |
| -6                  | find home input in positive direction, then find next feedback zero   | HOME.MODE=18,<br>HOME.DIR = 1         |
| -5                  | set reference point at actual position and store value in NVRAM   | HOME.MODE=17,<br>HOME.DIR not changed |
| -4                  | find reference switch with fast velocity (6099h sub1) and home on reference switch with low velocity (6099h sub 2), positive count direction  | HOME.MODE=16,<br>HOME.DIR=0           |
| -3                  | find reference switch with fast velocity (6099h sub 1) and home on reference switch with low velocity (6099h sub 2), negative count direction | HOME.MODE=16,<br>HOME.DIR=0           |
| -2                  | home to mechanical limit, positive count direction  | HOME.MODE = 8,<br>HOME.DIR = 1        |
| -1                  | home to mechanical limit, negative count direction  | HOME.MODE = 8,<br>HOME.DIR = 0        |
| 0                   | reserved  | —                                     |
| 1                   | homing to negative limit switch, with zeroing, negative count direction   | HOME.MODE=2,<br>HOME.DIR=0            |
| 2                   | homing to positive limit switch, with zeroing, positive count direction   | HOME.MODE=2,<br>HOME.DIR=1            |
| 3 to 7              | not supported   | —                                     |

| Method as per DS402 | Brief description: Homing   | command                      |
|---------------------|---|------------------------------|
| 8                   | homing to reference switch, with zeroing, positive count direction  | HOME.MODE=5,<br>HOME.DIR=1   |
| 9 to 11             | not supported   | —                            |
| 12                  | homing to reference switch, with zeroing, negative count direction  | HOME.MODE=5,<br>HOME.DIR=0   |
| 13 to 14            | not supported   | —                            |
| 15 to 16            | reserved  | —                            |
| 17                  | homing to negative limit switch, without zeroing, negative count direction  | HOME.MODE=1,<br>HOME.DIR=0   |
| 18                  | homing to negative limit switch, without zeroing, positive count direction  | HOME.MODE=1,<br>HOME.DIR=1   |
| 19 to 23            | not supported   | —                            |
| 24                  | homing to reference switch, without zeroing, positive count direction   | HOME.MODE=4,<br>HOME.DIR=1   |
| 25 to 27            | not supported   | —                            |
| 28                  | homing to reference switch, without zeroing, negative count direction   | HOME.MODE=4,<br>HOME.DIR=0   |
| 29 to 30            | not supported   | —                            |
| 31 to 32            | reserved  | —                            |
| 33                  | homing within a single turn, negative count direction. If the feedback has an index pulse, HOME.MODE 11 will be used. | HOME.MODE=7,11<br>HOME.DIR=0 |
| 34                  | homing within a single turn, positive count direction. If the feedback has an index pulse, HOME.MODE 11 will be used. | HOME.MODE=7,11<br>HOME.DIR=1 |
| 35                  | set reference point at present position   | HOME.MODE=0,<br>HOME.DIR=0   |
| 36 to 127           | reserved  | —                            |

**5.3.78 Object 6099h: Homing speeds (DS402)**

|               |   |
|---------------|---|
| Index         | 6099h                                       |
| Name          | homing speeds                               |
| Object code   | ARRAY                                       |
| Data type     | UNSIGNED32                                  |
| Subindex      | <b>1</b>                                    |
| Description   | speed during search for switch, HOME.V      |
| Mode          | hm  |
| Access        | R/W   |
| PDO mapping   | not possible                                |
| Unit          | velocity units                              |
| Value range   | 0 to $(2^{32}-1)$                           |
| Default value | equivalent 60 rpm                           |
| Subindex      | <b>2</b>                                    |
| Description   | speed during search for zero, HOME.FEEDRATE |
| Mode          | hm  |
| Access        | R/W   |
| PDO mapping   | not possible                                |
| Unit          | velocity units                              |
| Value range   | 0 to $(2^{32}-1)$                           |
| Default value | 50% of Object 6099 sub 1                    |

**5.3.79 Object 609Ah: Homing acceleration (DS402)**

|               |                     |
|---------------|---------------------|
| Index         | 609Ah               |
| Name          | homing acceleration |
| Object code   | VAR                 |
| Data type     | UNSIGNED32          |
| Mode          | hm                  |
| Access        | R/W                 |
| PDO mapping   | not possible        |
| Unit          | acceleration units  |
| Value range   | 0 to $(2^{32}-1)$   |
| Default value | 0                   |

### 5.3.80 Object 60B1h: Velocity Offset

This object provides the offset of the velocity value in cyclic synchronous position mode.

The velocity offset is based on VL.BUSFF.

For FBUS.PARAM05 Bit 4 is 0:

- PDO unit is [RPM]
- SDO unit is [RPM] per default. The SDO unit can also be influenced by changing UNIT.VROTARY or UNIT.VLINEAR.

For FBUS.PARAM05 Bit 4 is 1:

The PV scaling factor via object 204Ch is used in addition to the raw units [RPM].

#### NOTE

The final feedforward value that is applied to the VL.CMD is calculated by  $VL.BUSFF * VL.KBUSFF / 4$ . The factor 1/4 needs to be taken into account when using the velocity offset.

|               |                 |
|---------------|-----------------|
| Index         | 60B1h           |
| Name          | Velocity Offset |
| Object code   | VAR             |
| Data type     | INTEGER32       |
| Category      | optional        |
| Access        | R/W             |
| PDO mapping   | possible        |
| Value range   | INTEGER32       |
| Default value | 0               |

### 5.3.81 Object 60B2h: Torque Offset

This object (IL.BUSFF ) provides the offset of the commanded torque from a bus network connected to the drive. Scaling is 1/1000 of rated torque.

|               |               |
|---------------|---------------|
| Index         | 60B2h         |
| Name          | Torque Offset |
| Object code   | VAR           |
| Data type     | INTEGER16     |
| Category      | optional      |
| Access        | R/O           |
| PDO mapping   | possible      |
| Value range   | INTEGER16     |
| Default value | 0             |

### 5.3.82 Object 60B8h: Touch probe function

This object indicates the configured function of the touch probe.

|               |                      |
|---------------|----------------------|
| Index         | 60B8h                |
| Name          | Touch probe function |
| Object code   | Variable             |
| Data type     | UNSIGNED16           |
| Category      | optional             |
| Access        | R/W                  |
| PDO Mapping   | yes                  |
| Value range   | UNSIGNED16           |
| Default value | 0                    |

Definition of the possible functions:

| Bit    | Value | Meaning  |
|--------|-------|--|
| 0      | 0     | Switch off touch probe 1                                     |
|        | 1     | Enable touch probe 1   |
| 1      | 0     | Trigger first event  |
|        | 1     | Continuous   |
| 3, 2   | 00b*  | Trigger with touch probe 1 input                             |
|        | 01b   | Trigger with zero impulse signal or position encoder         |
|        | 10b   | Touch probe source as defined in object 60D0h, sub-index 01h |
|        | 11b   | reserved   |
| 4      | 0     | Switch off sampling at positive edge of touch probe 1        |
|        | 1     | Enable sampling at positive edge of touch probe 1            |
| 5      | 0     | Switch off sampling at negative edge of touch probe 1        |
|        | 1     | Enable sampling at negative edge of touch probe 1            |
| 6, 7   | -     | User-defined (e.g. for testing)                              |
| 8      | 0     | Switch off touch probe 2                                     |
|        | 1     | Enable touch probe 2   |
| 9      | 0     | Trigger first event  |
|        | 1     | continuous   |
| 11, 10 | 00b   | Trigger with touch probe 2 input                             |
|        | 01b   | Trigger with zero impulse signal or position encoder         |
|        | 10b   | Touch probe source as defined in object 60D0h, sub-index 02h |
|        | 11b   | reserved   |
| 12     | 0     | Switch off sampling at positive edge of touch probe 2        |
|        | 1     | Enable sampling at positive edge of touch probe 2            |
| 13     | 0     | Switch off sampling at negative edge of touch probe 2        |
|        | 1     | Enable sampling at negative edge of touch probe 2            |
| 14, 15 | -     | User-defined (e.g. for testing)                              |

\* b = binary

If both edges are selected at the same time (bit 4=1 and bit 5=1 for probe 1 or bit 12=1 and bit 13=1 for probe 2), the first edge (positive or negative) triggers the probe function. The position, latched at this edge, is taken over for both edges (positive and negative).

**5.3.83 Object 60B9h: Touch probe status**

This object indicates the status of the touch probe.

|               |                    |
|---------------|--------------------|
| Index         | 60B9h              |
| Name          | Touch probe status |
| Object code   | Variable           |
| Data type     | UNSIGNED16         |
| Category      | optional           |
| Access        | R/O                |
| PDO Mapping   | yes                |
| Value range   | UNSIGNED16         |
| Default value | 0                  |

Definition of the status:

| Bit      | Value | Meaning                                     |
|----------|-------|---|
| 0        | 0     | Touch probe 1 is switched off               |
|          | 1     | Touch probe 1 is enabled                    |
| 1        | 0     | Touch probe 1 no positive edge value stored |
|          | 1     | Touch probe 1 positive edge position stored |
| 2        | 0     | Touch probe 1 no negative edge value stored |
|          | 1     | Touch probe 1 negative edge position stored |
| 3 to 5   | 0     | reserved                                    |
| 6, 7     | -     | User-defined (e.g. for testing)             |
| 8        | 0     | Touch probe 2 is switched off               |
|          | 1     | Touch probe 2 is enabled                    |
| 9        | 0     | Touch probe 2 no positive edge value stored |
|          | 1     | Touch probe 2 positive edge position stored |
| 10       | 0     | Touch probe 2 no negative edge value stored |
|          | 1     | Touch probe2 negative edge position stored  |
| 11 to 13 | 0     | reserved                                    |
| 14, 15   | -     | User-defined (e.g. for testing)             |

**5.3.84 Object 60BAh: Touch probe 1 positive edge**

This object provides the position value of the touch probe 1 at positive edge.

|               |                             |
|---------------|-----------------------------|
| Index         | 60BAh                       |
| Name          | Touch probe 1 positive edge |
| Object code   | Variable                    |
| Data type     | INTEGER32                   |
| Category      | optional                    |
| Access        | R/O                         |
| PDO Mapping   | yes                         |
| Value range   | INTEGER32                   |
| Default value | no                          |

**5.3.85 Object 60BBh: Touch probe 1 negative edge**

This object provides the position value of the touch probe 1 at negative edge.

|               |                             |
|---------------|-----------------------------|
| Index         | 60BBh                       |
| Name          | Touch probe 1 negative edge |
| Object code   | Variable                    |
| Data type     | INTEGER32                   |
| Category      | optional                    |
| Access        | R/O                         |
| PDO Mapping   | yes                         |
| Value range   | INTEGER32                   |
| Default value | no                          |

**5.3.86 Object 60BCh: Touch probe 2 positive edge**

This object provides the position value of the touch probe 2 at positive edge.

|               |                             |
|---------------|-----------------------------|
| Index         | 60BCh                       |
| Name          | Touch probe 2 positive edge |
| Object code   | Variable                    |
| Data type     | INTEGER32                   |
| Category      | optional                    |
| Access        | R/O                         |
| PDO Mapping   | yes                         |
| Value range   | INTEGER32                   |
| Default value | no                          |



**5.3.87 Object 60BDh: Touch probe 2 negative edge**

This object provides the position value of the touch probe 2 at negative edge.

|               |                             |
|---------------|-----------------------------|
| Index         | 60BDh                       |
| Name          | Touch probe 2 negative edge |
| Object code   | Variable                    |
| Data type     | INTEGER32                   |
| Category      | optional                    |
| Access        | R/O                         |
| PDO Mapping   | yes                         |
| Value range   | INTEGER32                   |
| Default value | no                          |

**5.3.88 Object 60C0h: Interpolation sub mode select**

In the AKD, linear interpolation between position setpoints is supported.

|               |                               |
|---------------|-------------------------------|
| Index         | 60C0h                         |
| Name          | Interpolation sub mode select |
| Object code   | VAR                           |
| Data type     | INTEGER16                     |
| Category      | optional                      |
| Access        | R/W                           |
| PDO mapping   | not possible                  |
| Value range   | 0                             |
| Default value | 0                             |

**Value description**

| Value(decimal) | Description                                |
|----------------|--|
| 0              | Linear interpolation with a constant time. |

### 5.3.89 Object 60C1h: Interpolation data record

In the AKD, a single setpoint (target position, Subindex 1) is supported for the linear interpolation. After the last item of an interpolation data record is written to the devices input buffer, the buffer pointer is automatically incremented to the next buffer.

|               |  |
|---------------|--|
| Index         | 60C1h  |
| Name          | Interpolation data record  |
| Object code   | ARRAY  |
| Data type     | INTEGER32  |
| Category      | optional   |
| Subindex      | <b>0</b>   |
| Description   | highest sub-index supported  |
| Data type     | UNSIGNED8  |
| Category      | mandatory  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Value range   | 1  |
| Default value | 1  |
| Subindex      | <b>1</b>   |
| Description   | Interpolation target position in counts, the first parameter of interpolation function |
| Category      | mandatory  |
| Access        | R/W  |
| PDO mapping   | possible   |
| Value range   | INTEGER32  |
| Default value | no   |

#### NOTE

A set-point value of the Interpolation data record is only taken, if beside the state machine state "Operation Enable" also the bit 4 of the DS402 controlword (Enable Interpolation, see "Object 6040h: Control word (DS402)" (→ p. 139)) is set.

### 5.3.90 Object 60C2h: Interpolation time period

The interpolation time period is used for the PLL (phase locked loop) synchronized position modes. The unit (subindex 1) of the time is given in  $10^{\text{interpolation time index}}$  seconds. Only multiples of 1 ms are allowed. The two values define the internal AKD parameter FBUS.SAMPLEPERIOD (given in multiples of 62.5 Mikroseconds). Both values must be written to set a new interpolation time period. FBUS.SAMPLEPERIOD will only be updated then.

|               |  |
|---------------|--|
| Index         | 60C2h  |
| Name          | Interpolation time period                      |
| Object code   | RECORD   |
| Data type     | Interpolation time period record (0080h)       |
| Category      | optional                                       |
| Subindex      | <b>0</b>                                       |
| Description   | highest sub-index supported, FBUS.SAMPLEPERIOD |
| Category      | mandatory                                      |
| Access        | R/O  |
| PDO mapping   | not possible                                   |
| Value range   | 2  |
| Default value | 2  |
| Subindex      | <b>1</b>                                       |
| Description   | Interpolation time units                       |
| Category      | mandatory                                      |
| Access        | R/W  |
| PDO mapping   | not possible                                   |
| Value range   | UNSIGNED8                                      |
| Default value | 2  |
| Subindex      | <b>2</b>                                       |
| Description   | Interpolation time index                       |
| Category      | mandatory                                      |
| Access        | R/W  |
| PDO mapping   | not possible                                   |
| Value range   | INTEGER8                                       |
| Default value | -3   |

**5.3.91 Object 60C4h: Interpolation data configuration**

In the AKD, for linear interpolation, only the value 1 in Subindex 5 is possible.

|                 |   |
|-----------------|---|
| Index           | 60C4h   |
| Name            | Interpolation data configuration                |
| Object code     | RECORD  |
| Data type       | Interpolation data configuration record (0081h) |
| Category        | optional  |
| <b>Subindex</b> | <b>0</b>  |
| Description     | highest sub-index supported                     |
| Category        | mandatory                                       |
| Access          | R/O   |
| PDO mapping     | not possible                                    |
| Value range     | 6   |
| Default value   | 6   |
| <b>Subindex</b> | <b>1</b>  |
| Description     | Maximum buffer size                             |
| Category        | mandatory                                       |
| Access          | R/O   |
| PDO mapping     | not possible                                    |
| Value range     | UNSIGNED32                                      |
| Default value   | 10  |
| <b>Subindex</b> | <b>2</b>  |
| Description     | Actual buffer size                              |
| Category        | mandatory                                       |
| Access          | R/O   |
| PDO mapping     | possible  |
| Value range     | 0 to 9  |
| Default value   | 9   |
| <b>Subindex</b> | <b>3</b>  |
| Description     | Buffer organization                             |
| Category        | mandatory                                       |
| Access          | R/W   |
| PDO mapping     | not possible                                    |
| Value range     | UNSIGND8  |
| Default value   | 0   |

|               |                     |
|---------------|---------------------|
| Subindex      | <b>4</b>            |
| Description   | Buffer position     |
| Category      | mandatory           |
| Access        | R/W                 |
| PDO mapping   | not possible        |
| Value range   | UNSIGNED16          |
| Default value | 0                   |
| Subindex      | <b>5</b>            |
| Description   | Size of data record |
| Category      | mandatory           |
| Access        | W                   |
| PDO mapping   | not possible        |
| Value range   | 1 to 254            |
| Default value | 1                   |
| Subindex      | <b>6</b>            |
| Description   | Buffer clear        |
| Category      | mandatory           |
| Access        | W                   |
| PDO mapping   | not possible        |
| Value range   | UNSIGNED8           |
| Default value | 0                   |

### 5.3.92 Object 60D0h: Touch probe source

This object provides the source of the touch probe function, when the dedicated bits 2/3 or 10/11 of the touch probe function (object 60B8h) are set accordingly.

|               |                             |
|---------------|-----------------------------|
| Index         | 60D0h                       |
| Name          | Touch probe source          |
| Object code   | Array                       |
| Data type     | Integer 16                  |
| Category      | optional                    |
| Subindex      | <b>0</b>                    |
| Description   | Highest sub-index supported |
| Category      | mandatory                   |
| Access        | R/O                         |
| PDO mapping   | not possible                |
| Value range   | 2                           |
| Default value | 2                           |
| Subindex      | <b>1</b>                    |
| Description   | Touch probe 1 source        |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO mapping   | not possible                |
| Value range   | -11 to -1, 1 to 5           |
| Default value | 1                           |
| Subindex      | <b>2</b>                    |
| Description   | Touch probe 2 source        |
| Category      | mandatory                   |
| Access        | R/W                         |
| PDO mapping   | not possible                |
| Value range   | -11 to -1, 1 to 5           |
| Default value | 1                           |

Value description:

| Value     | Description                               | Value | Description         |
|-----------|---|-------|---------------------|
| 1         | Touch Probe 1 Input                       | 3     | Touch Probe 3 Input |
| 2         | Touch Probe 2 Input                       | 4     | Touch Probe4 Input  |
| -1 to -11 | AKD Input related to CAPx.TRIGGER 0 to 10 |       |                     |

**5.3.93 Object 60E0h: Positive Torque Limit Value**

The object gives the configured maximum motor torque in positive direction. The value is given per thousand (1 ‰) of rated torque.

|               |  |
|---------------|--|
| Index         | 60E0h  |
| Name          | Positive Torque Limit Value                        |
| Object code   | Variable   |
| Data type     | UIINTEGER16  |
| Category      | optional   |
| Access        | R/O  |
| PDO Mapping   | yes  |
| Value range   | UIINTEGER16 (limited by DRV.IPEAK and MOTOR.IPEAK) |
| Default value | 0  |

**5.3.94 Object 60E1h: Negative Torque Limit Value**

The object gives the configured maximum motor torque in negative direction. The value is given per thousand (1 ‰) of rated torque.

|               |  |
|---------------|--|
| Index         | 60E1h  |
| Name          | Negative Torque Limit Value                        |
| Object code   | Variable   |
| Data type     | UIINTEGER16  |
| Category      | optional   |
| Access        | R/O  |
| PDO Mapping   | yes  |
| Value range   | UIINTEGER16 (limited by DRV.IPEAK and MOTOR.IPEAK) |
| Default value | 0  |

**5.3.95 Object 60E4h: Additional position actual value**

This object provides the additional position actual values. The values are given in user-defined position units. The value is calculated analog to the calculation for the actual position 6064h via object 6091h and 6092h, but for this with the factors given by the objects 60E8h, 60E9h, 60EDh and 60EEh.

|               |                                      |
|---------------|--------------------------------------|
| Index         | 60E4h                                |
| Name          | Additional position actual value     |
| Object code   | ARRAY                                |
| Data type     | INTEGER32                            |
| Category      | optional                             |
| Subindex      | <b>0</b>                             |
| Description   | highest sub-index supported          |
| Category      | mandatory                            |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | 3                                    |
| Default value | 3                                    |
| Subindex      | <b>1</b>                             |
| Description   | 1st additional position actual value |
| Category      | mandatory                            |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | INTEGER32                            |
| Default value | 1                                    |
| Subindex      | <b>2</b>                             |
| Description   | 2nd additional position actual value |
| Category      |                                      |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | INTEGER32                            |
| Default value | 1                                    |
| Subindex      | <b>3</b>                             |
| Description   | 3rd additional position actual value |
| Category      | optional                             |
| Access        | R/O                                  |
| PDO mapping   | not possible                         |
| Value range   | INTEGER32                            |
| Default value | 0                                    |



### 5.3.96 Object 60E8h: Additional gear ratio – motor shaft revolutions

This object provides the motor shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding subindex of the object 60EDh (driving shaft revolutions for the additional gear ratio calculation). The value of the object 60E4h is calculated analog to the gear ration calculation for the actual position 6064h via object 6091h.

|               |   |
|---------------|---|
| Index         | 60E8h   |
| Name          | Additional gear ratio – motor shaft revolutions |
| Object code   | ARRAY   |
| Data type     | UNSIGNED32                                      |
| Category      | optional  |
| Subindex      | <b>0</b>  |
| Description   | highest sub-index supported                     |
| Category      | mandatory                                       |
| Access        | R/O   |
| PDO mapping   | not possible                                    |
| Value range   | 3   |
| Default value | 3   |
| Subindex      | <b>1</b>  |
| Description   | 1st additional gear ratio - motor shaft         |
| Category      | mandatory                                       |
| Access        | R/W   |
| PDO mapping   | not possible                                    |
| Value range   | UNSIGNED32                                      |
| Default value | 1   |
| Subindex      | <b>2</b>  |
| Description   | 2nd additional gear ratio - motor shaft         |
| Category      |   |
| Access        | R/W   |
| PDO mapping   | not possible                                    |
| Value range   | UNSIGNED32                                      |
| Default value | 1   |
| Subindex      | <b>3</b>  |
| Description   | 3rd additional gear ratio - motor shaft         |
| Category      | optional  |
| Access        | R/W   |
| PDO mapping   | not possible                                    |
| Value range   | UNSIGNED32                                      |
| Default value | 1   |

**5.3.97 Object 60E9h: Additional feed constant – feed**

This object provides the feed for the additional feed constant calculation. This object shall be used with the corresponding subindex of the object 60EEh (driving shaft revolutions for the additional feed constant calculation). The value of the object 60E4h is calculated analog to the feed constant calculation for the actual position 6064h via object 6092h.

|               |                                     |
|---------------|-------------------------------------|
| Index         | 60E9h                               |
| Name          | Additional feed constant – feed     |
| Object code   | ARRAY                               |
| Data type     | UNSIGNED32                          |
| Category      | optional                            |
| Subindex      | <b>0</b>                            |
| Description   | highest sub-index supported         |
| Category      | mandatory                           |
| Access        | R/O                                 |
| PDO mapping   | not possible                        |
| Value range   | 3                                   |
| Default value | 3                                   |
| Subindex      | <b>1</b>                            |
| Description   | 1st additional feed constant – feed |
| Category      | mandatory                           |
| Access        | R/W                                 |
| PDO mapping   | not possible                        |
| Value range   | UNSIGNED32                          |
| Default value | 1                                   |
| Subindex      | <b>2</b>                            |
| Description   | 2nd additional feed constant – feed |
| Category      |                                     |
| Access        | R/W                                 |
| PDO mapping   | not possible                        |
| Value range   | UNSIGNED32                          |
| Default value | 1                                   |
| Subindex      | <b>3</b>                            |
| Description   | 3rd additional feed constant – feed |
| Category      | optional                            |
| Access        | R/W                                 |
| PDO mapping   | not possible                        |
| Value range   | UNSIGNED32                          |
| Default value | 1                                   |

### 5.3.98 Object 60EDh: Additional gear ratio – driving shaft revolutions

This object provides the driving shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding subindex of the object 60E8h (motor shaft revolutions for the additional gear ratio calculation). The value of the object 60E4h is calculated analog to the gear ration calculation for the actual position 6064h via object 6091h.

|               |   |
|---------------|---|
| Index         | 60EDh   |
| Name          | Additional gear ratio – driving shaft revolutions |
| Object code   | ARRAY   |
| Data type     | UNSIGNED32  |
| Category      | optional  |
| Subindex      | <b>0</b>  |
| Description   | highest sub-index supported                       |
| Category      | mandatory   |
| Access        | R/O   |
| PDO mapping   | not possible                                      |
| Value range   | 3   |
| Default value | 3   |
| Subindex      | <b>1</b>  |
| Description   | 1st additional gear ratio - driving shaft         |
| Category      | mandatory   |
| Access        | R/W   |
| PDO mapping   | not possible                                      |
| Value range   | UNSIGNED32  |
| Default value | 1   |
| Subindex      | <b>2</b>  |
| Description   | 2nd additional gear ratio - driving shaft         |
| Category      |   |
| Access        | R/W   |
| PDO mapping   | not possible                                      |
| Value range   | UNSIGNED32  |
| Default value | 1   |
| Subindex      | <b>3</b>  |
| Description   | 3rd additional gear ratio - driving shaft         |
| Category      | optional  |
| Access        | R/W   |
| PDO mapping   | not possible                                      |
| Value range   | UNSIGNED32  |
| Default value | 1   |

**5.3.99 Object 60EEh: Additional feed constant - driving shaft revolutions**

This object provides the driving shaft revolutions for the additional feed constant calculation. This object shall be used with the corresponding subindex of the object 60E9h (feed for the additional feed constant calculation). The value of the object 60E4h is calculated analog to the feed constant calculation for the actual position 6064h via object 6092h.

|               |  |
|---------------|--|
| Index         | 60EEh  |
| Name          | Additional feed constant - driving shaft revolutions     |
| Object code   | ARRAY  |
| Data type     | UNSIGNED32   |
| Category      | optional   |
| Subindex      | <b>0</b>   |
| Description   | highest sub-index supported                              |
| Category      | mandatory  |
| Access        | R/O  |
| PDO mapping   | not possible   |
| Value range   | 3  |
| Default value | 3  |
| Subindex      | <b>1</b>   |
| Description   | 1st additional feed constant – driving shaft revolutions |
| Category      | mandatory  |
| Access        | R/W  |
| PDO mapping   | not possible   |
| Value range   | UNSIGNED32   |
| Default value | 1  |
| Subindex      | <b>2</b>   |
| Description   | 2nd additional feed constant – driving shaft revolutions |
| Category      |  |
| Access        | R/W  |
| PDO mapping   | not possible   |
| Value range   | UNSIGNED32   |
| Default value | 1  |
| Subindex      | <b>3</b>   |
| Description   | 3rd additional feed constant – driving shaft revolutions |
| Category      | optional   |
| Access        | R/W  |
| PDO mapping   | not possible   |
| Value range   | UNSIGNED32   |
| Default value | 1  |

**5.3.100 Object 60F4h: Following error actual value (DS402)**

This object returns the current value of the following error in units defined by the user.

|               |                              |
|---------------|------------------------------|
| Index         | 60F4h                        |
| Name          | Following error actual value |
| Object code   | VAR                          |
| Data type     | Integer32                    |
| Category      | optional                     |
| Access        | R/O                          |
| PDO mapping   | possible                     |
| Value range   | INTEGER32                    |
| Default value | 0                            |

**5.3.101 Object 60FCh: Position demand internal value (DS402)**

This object provides the output of the trajectory generator in position modes. The value is consistent in scaling to the actual internal position value (6063h) and the first setpoint in object 60C1h.

|               |                                |
|---------------|--------------------------------|
| Index         | 60FCh                          |
| Name          | Position demand internal value |
| Object code   | VAR                            |
| Data type     | INTEGER32                      |
| Category      | optional                       |
| Access        | R/O                            |
| PDO mapping   | possible                       |
| Value range   | INTEGER32                      |
| Default value | 0                              |

**5.3.102 Object 60FDh: Digital inputs (DS402)**

This index defines simple digital inputs for drives. The manufacturer bits 16 to 22 display the actual state of the digital inputs 1 to 7 (DINx.STATE). The manufacturer bits 24 to 30 latch a state change of the digital inputs 1 to 7. Bits 24 to 30 can be reset with object "20B8h" (→ p. 132).

|               |                |
|---------------|----------------|
| Index         | 60FDh          |
| Name          | digital inputs |
| Object code   | VAR            |
| Data type     | UNSIGNED32     |
| Category      | optional       |
| Access        | R/O            |
| PDO mapping   | possible       |
| Value range   | UNSIGNED32     |
| Default value | 0              |

|                       |    |          |   |        |             |                   |                   |
|-----------------------|----|----------|---|--------|-------------|-------------------|-------------------|
| 31                    | 16 | 15       | 4 | 3      | 2           | 1                 | 0                 |
| manufacturer specific |    | reserved |   | enable | home switch | pos. limit switch | neg. limit switch |
| MSB                   |    |          |   |        |             |                   | LSB               |

**5.3.103 Object 60FEh: Digital outputs (DS402)**

This index defines simple digital outputs for drives. The manufacturer bits 16 and 17 are show the actual status of the digital outputs 1 and 2.

|                       |                             |       |       |          |   |           |
|-----------------------|-----------------------------|-------|-------|----------|---|-----------|
| Index                 | 60FEh                       |       |       |          |   |           |
| Name                  | digital outputs             |       |       |          |   |           |
| Object code           | Array                       |       |       |          |   |           |
| Data type             | UNSIGNED32                  |       |       |          |   |           |
| Category              | optional                    |       |       |          |   |           |
| Subindex              | <b>0</b>                    |       |       |          |   |           |
| Description           | highest sub-index supported |       |       |          |   |           |
| Category              | mandatory                   |       |       |          |   |           |
| Access                | R/O                         |       |       |          |   |           |
| PDO mapping           | not possible                |       |       |          |   |           |
| Value range           | 2                           |       |       |          |   |           |
| Default value         | 2                           |       |       |          |   |           |
| Subindex              | <b>1</b>                    |       |       |          |   |           |
| Description           | physical outputs            |       |       |          |   |           |
| Category              | mandatory                   |       |       |          |   |           |
| Access                | R/W                         |       |       |          |   |           |
| PDO mapping           | possible                    |       |       |          |   |           |
| Value range           | UNSIGNED32                  |       |       |          |   |           |
| Default value         | 0                           |       |       |          |   |           |
| Subindex              | <b>2</b>                    |       |       |          |   |           |
| Description           | bit mask                    |       |       |          |   |           |
| Category              | optional                    |       |       |          |   |           |
| Access                | R/W                         |       |       |          |   |           |
| PDO mapping           | not possible                |       |       |          |   |           |
| Value range           | UNSIGNED32                  |       |       |          |   |           |
| Default value         | 0                           |       |       |          |   |           |
| 31                    | 18                          | 17    | 16    | 15       | 1 | 0         |
| manufacturer specific |                             | DOUT2 | DOUT1 | reserved |   | set brake |
| MSB                   |                             |       |       |          |   | LSB       |

**5.3.104 Object 60FFh: Target velocity (DS402)**

The speed setpoint (target velocity) represents the setpoint for the ramp generator.

|               |                             |
|---------------|-----------------------------|
| Index         | 60FFh                       |
| Name          | target velocity, VL.CMDU    |
| Object code   | VAR                         |
| Data type     | INTEGER32                   |
| Mode          | pv                          |
| Access        | R/W                         |
| PDO mapping   | possible                    |
| Unit          | increments                  |
| Value range   | $(-2^{31})$ to $(2^{31}-1)$ |
| Default value | —                           |
| Float scaling | 1000:1                      |
| EEPROM        | no                          |

**5.3.105 Object 6502h: Supported drive modes (DS402)**

A drive can support more than one and several distinct modes of operation. This object gives an overview of the implemented operating modes in the device. This object is read only.

|               |                        |
|---------------|------------------------|
| Index         | 6502h                  |
| Name          | supported drive modes  |
| Object code   | VAR                    |
| Data type     | UNSIGNED32             |
| Category      | optional               |
| Access        | R/O                    |
| PDO mapping   | not possible           |
| Value range   | UNSIGNED32             |
| Default value | 0xE5 (csp ip hm pv pp) |

|                       |    |          |       |     |     |     |    |    |          |    |    |    |    |     |
|-----------------------|----|----------|-------|-----|-----|-----|----|----|----------|----|----|----|----|-----|
| 31                    | 16 | 15       | 11    | 10  | 9   | 8   | 7  | 6  | 5        | 4  | 3  | 2  | 1  | 0   |
| manufacturer specific |    | reserved | cstca | cst | csv | csp | ip | hm | reserved | tq | pv | vl | pp |     |
| MSB                   |    |          |       |     |     |     |    |    |          |    |    |    |    | LSB |

## 6 Record of Document Revisions

| Revision   | Remarks  |
|------------|--|
| -, 11/2009 | Beta launch version  |
| -, 12/2009 | Minor formatting changes   |
| A, 07/2010 | FBUS.PARAM04 added, part number added, page format, release information  |
| B, 10/2010 | Setup for KAS added  |
| C, 01/2011 | HW Rev. C  |
| D, 04/2011 | WoE, corrections   |
| E, 10/2011 | Flexible mapping, cover page layout  |
| F, 03/2012 | Minor corrections  |
| G, 11/2012 | New chapter EEPROM content   |
| H, 05/2013 | Fixed mapping, supported cyclic values, FBUS.PARAM05 added, several updates, formatting according to 82079   |
| J, 05/2014 | Appendix with object dictionaries and object descriptions  |
| K, 12/2014 | Object dictionaries and object descriptions updated  |
| L, 11/2015 | Objects 60C1/60D0/20A4/20A5 updated, objects 1C12/1C13/605A/60E0/60E1/60FC added, object dictionary updated  |
| M, 09/2016 | Supported cyclical actual values (3470) updated, object 6077 updated, chapter "Important Parameters" updated. Added objects 35B8h, 35BDh, and 6087h. |
| N, 03/2017 | Setting up Ethernet over EtherCAT (EoE) (→ p. 20) added.   |
| P, 10/2017 | Added 0x1725 and 0x1B26 to Fixed PDO Mappings (→ p. 43). Corrections to Objects 1C12h and 1C13h.   |
| R, 11/2018 | Updated warning symbols.   |
| T, 11/2019 | Updated Emergency Service Changes, RX PDO size limitation and FBUS.PARAM05. Added Objects 2080h and 2081h, and example for Flexible PDO Mapping.     |
| U, 10/2020 | Added objects 34D1h, 547Ah, 547Bh and edited to data type for objects 2001h and 2012   |



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