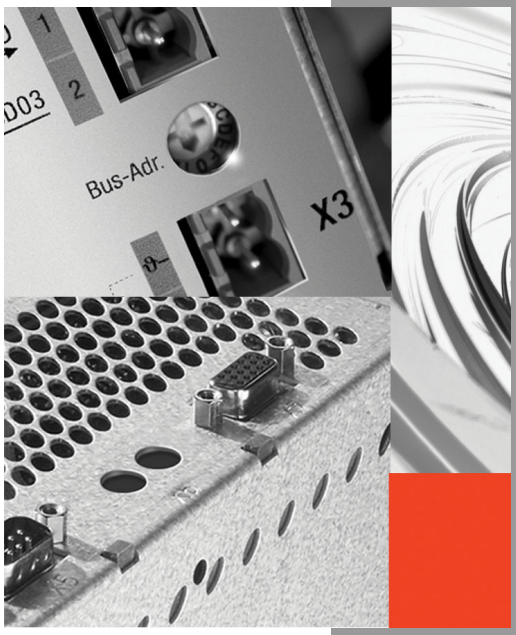
DE

CANopen Communication

User Manual

for

CDE3000/CDB3000/CDF3000



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Documentation overview

Document	Ordering designation	Purpose
Operation manual CDE/CDB3000	1001.00B.x-xx	Project planning and initial commissioning
Application Manual CDE/CDB3000	1001.02B.x-xx	Adapting the drive system to the application
Communication manual PROFIBUS-DP	1001.07B.x-xx	Project planning and description of function

User Manual CANopen Communication

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Valid from software version V0.40 CDE3000

Valid from Software version V1.20 CDB3000

Valid from software version V1.30 CDF3000

Dear user

this manual addresses you as **project engineer, commissioning engineer or programmer** for drive and automation solutions on the CAN_{open} field bus. It is assumed that you have been are already familiar with this type of field bus because of corresponding training or literature.

At this point we assume that your drive has already been commissioned – otherwise you should first read the operating instructions.

Note: This manual applies or the positioning control systems CDE3000 and CDB3000, so that in the following only the abbreviations CDE or CDB will be used.

Guide through this manual

Pictograms

→ **Attention!**Operating errors may cause damage to or malfunction of the drive.

→ **Danger, high voltage!**Improper behaviour may cause fatal accident.

→ **Danger from rotating parts!**The drive may automatically start.

→ **Note:** Useful information

Table of Content

1 General

In this manual the term **”Master”** denotes a superordinate control, which takes over the organization of the bus-system.

The terms **"Drive unit“** or **"Slave"** represent a converter or a servo controller.

1.1 Measures for your safety

The drive controllers CDE/CDB3000 are quick and safe to handle. For your own safety and for the safe functioning of your machine you should strictly comply with the following points:

Read the Operation Manual first!

- Follow the safety instructions!

Electric drives are generally potential danger sources:

- Electrical voltage >230 V/460 V:
  Dangerously high voltage may still be present 10 minutes after the power is cut. You should therefore always
  check that there is no voltage present.
- Rotating parts
- Hot surfaces

Your qualification:

- In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device.
- Knowledge of the national accident prevention regulations (e. g. VBG 4 in Germany)
- Required knowledge concerning the installation and networking with the CAN fieldbus

During installation follow these instructions:

- Always comply with the connection conditions and technical specifications.
- Comply with the standards for electrical installations, such as wire cross-section, earthing lead etc.
- Do not touch electronic components and contacts (electrostatic discharge may destroy components).

1.2 Introduction CANopen

CANopen is a networking concept based on the serial bus system CAN (Controller Area Network). CAN offers a vast variety of advantages, especially the Multi-Master ability, the Real-Time ability, the resistive properties in case of electro-magnetic disturbances as well as the excellent availability and the low costs of the controller chips. These benefits helped CAN to become a widely accepted bus system, also in automation engineering.

Simple communication, irrespective of the manufacturer

Integration of any equipment in a manufacturer specific network is always related with high expenses. CANopen was developed to solved this problem. With CANopen the use of CAN identifiers (message addresses), the time-related performance on the bus, the network management (e.g. system start and monitoring of clients) as well as the coding of data contents is uniformly specified. CANopen enables economical communication of equipment from different manufacturers in a network.

CANopen uses a partial amount of the CAL offered communication services for definition of an open interface. The selected CAL-services are, so to speak, compiled in a set of operating instructions. These operating instructions are called CANopen Communication Profile.

CANopen functionality of the CDE3000/CDB3000

The CANopen communication profile is documented in CiA DS-301 and regulates the aspect "How" of the communication. Here a differentiation is made between Process Data Objects (PDO's) and Service Data Objects (SDO's). In addition the communication profile defines a simple network management.

The equipment profile for variable speed drives DSP-402 (Rev. 2.0) was generated on basis of the DS-301 (Rev. 4.01) communication services. The supported modes of operation and equipment parameters are described there under.

Apart from the functionalities defined in the profiles there are further, manufacturer specific extensions. The DS-301 profile is implemented in the CDE/CDB3000. DSP-402 supports the obligatory parts, such as control word, status word and operating modes. CDE/CDB3000 parameters are manufacturer specific extensions.

The following chapter provides an overview over the CANopen functionality incorporated in the CDE/CDB3000. This is followed by the necessary information for commissioning.

1.3 System prerequisites

It is assumed that you are in possession of a common CANopen setup program or a CANopen interface driver. The exact protocol definitions can be found in the CAL specification.

These objects enable a highly flexible configuration of the actual CANopen communication and adaptation to the individual requirements of the user.

1.4 Further documentation

- Operating instructions, for commissioning of the drive unit
- User manual for further parameterization to adapt to the application. The user manual can be downloaded from the service section of our website http://www.lust-tec.de in the form of a PDF-file.
- CiA DS-301 (Rev. 4.0): Application Layer and Communication Profile
- CiA DSP-402 (Rev. 2.0): Device Profile Drives and Motion Control

2 Installation and connection

Attention: Do not plug in or pull out CANopen connecting plugs **during operation!**

2.1 Setting the address

Step	Action	Comment
1	Please inform yourself about the address to be used for the module to be installed.	Consult your project engineer.
2	**Choose the type of addressing:** • by bus parameter • by coding switch S3 • by bus parameter and coding switch S3	see below
	Address setting completed, to continue see "Installation".	

Three possibilities of allocating addresses

1. Only via bus parameter 580-COADR:
   In the screen mask "Bus Systems" of the DRIVEMANAGER user interface an address between 0 and 127 can be set via parameter 580-COADR (factory setting 1).

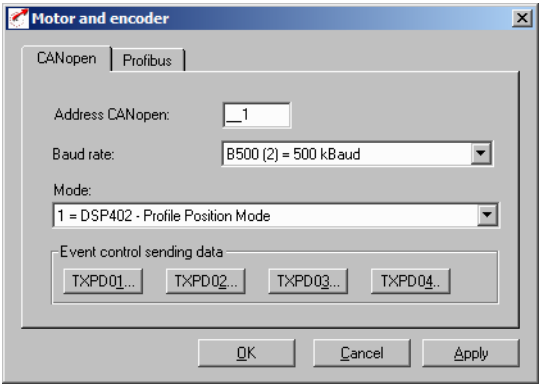


Fig. 2.1 CAN-Bus address setting via parameter

2. Only via coding switch S3:

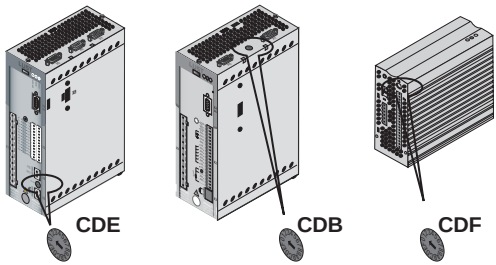


Fig. 2.2 Position of coding switch on CDE3000/CDB3000/CDF3000

Coding switch S3 on the positioning control can be used to select an address from 1 to 15 (0h-Fh - 4 bit) in hexadecimal mode.

Example for the address 11 Dec = B Hex

Fig. 2.3 Example for the use of coding switches

Please bear in mind that the parameter 850-COADR has a factory setting of 1 and in this case needs to be set to 0!

3. Combination of bus address parameter and coding switch:
CAN-address = hardware address (S3) + parameter 580-COADR

This variant is of advantage, if e.g. the same parameter set is to be used with up to 15 drives, whereby, however, the lowest address is 30. Parameter 850-COADR is then set to 30. The equipment address is then set via the coding switch, which is varied in the range between 0 - 15.

2.2 Installation

Step	Action	Comment
1	Make sure that the hardware release is wired to CDE3000 (X2), CDB3000 (X2) or CDF3000 (X2).	see chapter 2.2.1
2	Route the CAN-connection via plug connector X5 • Connection of the CAN signal lines • Connection of the interface power supply • Wiring of the equipment internal bus terminating resistor at the last drive controller	see Table 2.1 and Table 2.2
3	Switch on the drive unit.	
	Installation completed, continue see chapter 3 "Commissioning and configuration".	

The CAN_{open}-interface is integrated in the positioning controller. It is connected via connector X5. Towards the drive controller electronics the interface is of isolated design. The supply for the isolated secondary side is provided by the customer via plug connector X5.

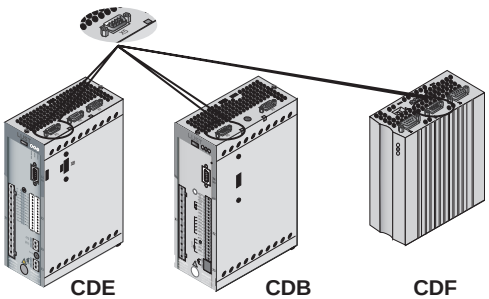


Fig. 2.4 Position of CAN connection on CDE3000/CDB3000CDF3000

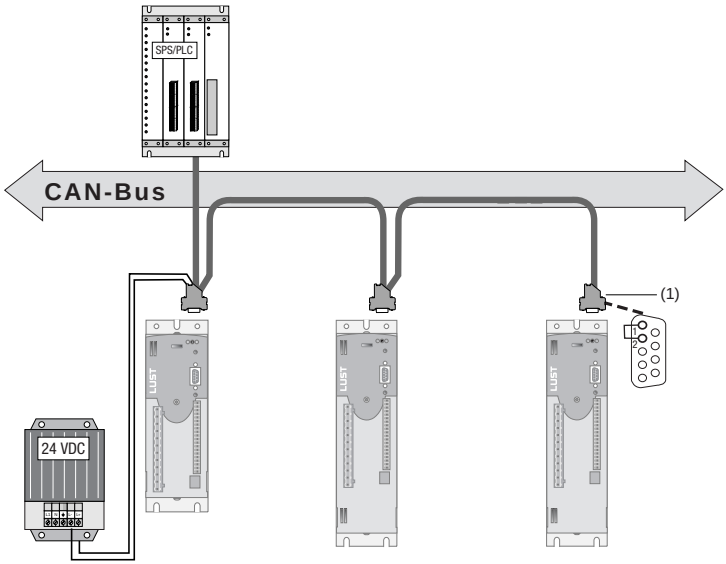
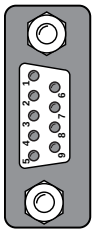


Fig. 2.5 System connection.
(1) Bus terminating resistor connector

Connection	Miniature D-Sub 9-pin pin
Wave terminating resistor - Bus termination -	120 Ω (internal) to be wired by customer via bridge (Pin 1-2) (max. 2)
Max. incoming frequency	1 MHz
Ext. voltage supply	+ 24 V ±25%, 50 mA (potential-free to drive controller)
Voltage ripple	max. 3 Vss
Power consumption	max. 50 mA per client
Cable type	9-core, surge impedance 120 Ω

Table 2.1 Specification CAN bus connection

X5



Pin	Function
1	Bridge on Pin 2 for active bus termination
2	CAN_LOW
3	CAN_GND
4	Don't use
5	Don't use
6	CAN_GND
7	CAN_HIGH
8	Don't use
9	CAN_+24 V

Table 2.2 Assignment of connection X5:

2.2.1 Hardware release (ENPO)

All units of series CDx have an control input for ENPO hardware release attached to the control terminal. This input must be interconnected to 24V for operation of the output stage.

Series CDB (optional), CDE and CDF additionally offer the function "Safe Failure" acc. to EN954-1, category 3, control terminal ISDSH. With these units the logic for this function must be fulfilled by the superordinate control, as specified in the user manual.

The function /STOP (Quick Stop) via the control word must additionally be observed.

According to the CANopen profile this bit is low active, which applies also for the Lust specific EasyDrive control words. This means that drive operation is only possible is both the ENPO hardware release and the HALT bit have been set.

2.3 Transmission speeds

The CAN-bus can be operated with the following baud rates:

Transmission speed	Max. length of line over the entire net	
1000 kBaud	40 m	
800 kBaud		
500 KBaud	100 m	Factory setting
250 kBaud		
125 KBaud	450 m	
50 KBaud		
20 KBaud	1000 m	
10 KBaud		

Table 2.3 Transmission speeds

When choosing the transmission rate one must bear in mind that the **length of the line** does not exceed the maximum length of line for the respective transmission rate.

3 Commissioning and configuration

3.1 Commissioning

The DriveManager user interface serves the general commissioning of the drive system. The DriveManager contains tools to identify motor data, to access a motor database in case of servo motors and for the general configuration of the units.

Initial commissioning is a separate chapter in the operation via user interface and is described in detail in the equipment user manual.

3.2 Commissioning sequence

Prerequisites:

- The drive unit is wired as specified in the operating instructions and initial commissioning has been carried out. (For a CAN communication test it is sufficient to connect the power supply and the ENPO-signal (hardware release) to connector X2.)

Step	Action	Comment
1	Check the wiring. Bear in mind, that the hardware release ENPO (X2) is not interconnected.	
2	Switch on the mains supply and the 24V power supply for the CAN interface.	
3	Configure the drive unit by following the user manual.	(Inputs/outputs, software functions, ...)
4	Check the controlling quality and, if necessary, optimize the controller adjustment by following the operating instructions.	
5	Choose a preset solution for CAN bus operation form the user manual.	For initial testing of the CAN communication the following settings acc. to Fig. 3.1 and Table 3.1 are additionally required.
6	Test the drive in connection with the superordinate control, see chapter 3.4.	
7	Finally save the setting by pressing button ->	see Fig. 3.2 

Note: Concerning the subject "Units and Standards" please read chapter 5.4.

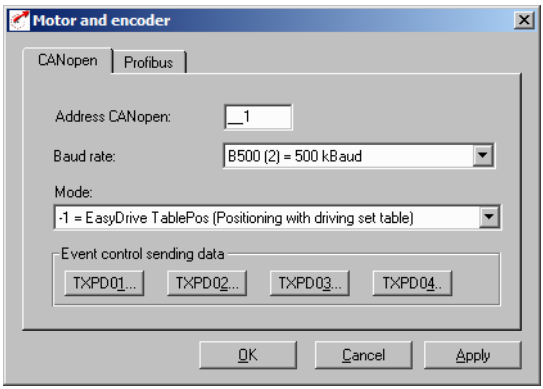


Fig. 3.1 Function mask "Bus Systems"

Parameter	Function	Description
580-COADR	Address CANopen	Address specification via parameter. Further information on setting addresses, see chapter 2.1
581-COBDR	Baud rate	Permissible Baud rates, see chapter 2.3
638-H6060	Mode of operation	Object 6060 Modes of Operation to select the mode of operation Is automatically set via the selection of a preset solution. Permissible modes of operation, see chapter 6.

Table 3.1 Parameters in the function mask "Bus Systems"

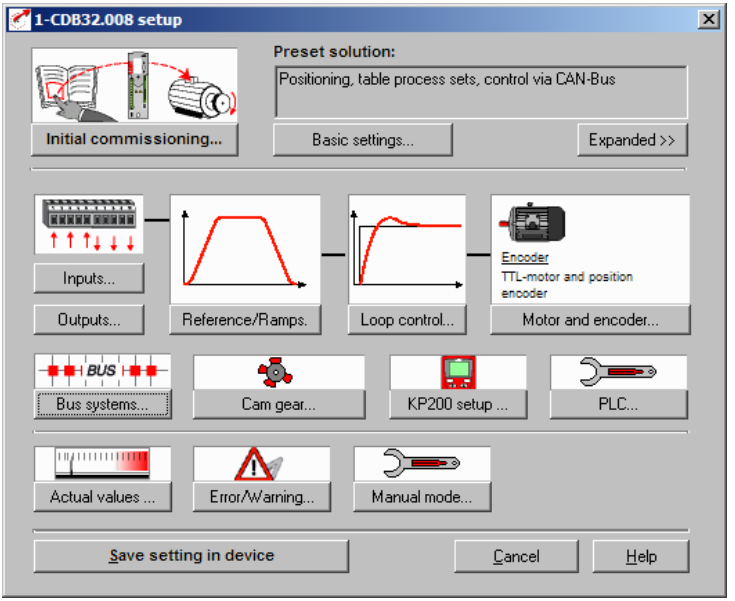


Fig. 3.2 Saving the settings

Note: More detailed information on optimization of software functions and control circuits can be found in the equipment user manual.

3.3 Notes on commissioning

There may be several reasons for a drive unit not to respond to a telegram:

- There will be no response if the scope of the telegram (baud rate, data capacity) in the master computer is not correct.
- There will be no response when addressing a drive unit with an incorrect bus address.
- There will be no response if the serial link between master computer and drive unit is not correctly set up.
- There will be no response if the CAN-connection is not connected to the 24V power supply or the wiring is faulty.
- There will be no valid response, if several units with the same address are connected to the bus.

3.4 Testing the superordinate control

For activation of changed settings the unit must be switched off once. After switching on and after a certain initialization period of a few seconds, the unit must transmit a single **Boot-up message** (ID 700h + Node ID = 701h at module address 1). In this case the communication is correct.

Note: During transmission the number of data bytes must not necessarily by accounted for, but is of advantage.

3.5 Data handling

3.5.1 Saving the settings

All configuration data can be saved to a SMARTCARD or as file to the DRIVEMANAGER. In the DRIVEMANAGER a parameter set always consists of three files with the extensions *.00D, *.00T und *.00X. The file selection windows in the DRIVEMANAGER always only show the file *.00D.

3.5.2 Re-establishing the as-delivered condition

There are two possibilities to reset the parameter setting of the equipment to as-delivered condition:

- **Via field bus**
  Set parameter 04-PROG (subject area _86SY System) to value 1. This resets all equipment parameters (only equipment configuration, without motor and control parameters) up to operation level 4 to factory setting.
  Set parameter 04-PROG to 850. This resets all equipment parameters up to operation level 5 (Service) to factory setting. This applies also for motor and control parameters.
- **Via DRIVEMANAGER**
  In the main screen of the DRIVEMANAGER call up item "Reset to Factory Setting" under menu option "Active Unit".
- **Via KeyPad**
  Keep both cursor keys on the control unit KEYPAD KP200 depressed during power on. This resets all equipment parameters up to operation level 5 to factory setting.

Note: In all cases it will take approx. 10 s until the units report "Standby". During this time the unit runs a self-test and changes all settings to factory settings. However, this setting will only be maintained after the data in the unit have been saved. Saving of data is initiated via the user interface DRIVEMANAGER or by writing the parameters 150-SAVE = 1 via the bus system.
The memorizing process can also be supplemented via the object 1010 hex!

Attention: Saving the data takes a few 100 ms. During this time the unit must not be switched off, as this would cause the loss of the settings.

After saving the parameter 150-SAVE is automatically set to 0 by the unit. This process can be used for temporal monitoring of the function.

3.6 Commissioning via DriveManager

Commissioning procedure by following the user manual

1. Initial commissioning by following the operating instructions:

Prerequisite is the general initial commissioning by following the operating instructions.
The user manual solely deals with the adaptation of the software functions.

If the settings made during initial commissioning by following the operating instructions are not sufficient for the application:

2. Selecting the optimal pre-set solution

The pre-set solutions cover the typical applications for the positioning controls.

The data set most appropriate for the application is selected.

3. Individual adaptation of the preset solution to the application.

The pre-set solution serves as initial point for an application related adaptation. Further function related adaptations are made to the parameters in the function oriented subject areas. Safe your settings in the unit!

4. Check the settings of the application solution

With respect to the safety of man and machine the application solution should only be checked at low rotary speeds. The correct sense of rotation must be assured. In events of emergency can be stopped by disconnecting the ENPO-signal and thus blocking the controller output stage.

5. Completion of commissioning

After successful commissioning save your settings (with SMARTCARD or DRIVEMANAGER) and memorize the data set in the unit.

3.7 Control functions

Control functions can be optimally adapted to the corresponding application. For this reason several control formats are available. The selection of the corresponding formats can be made during the setup phase by the master via bus or by setting the corresponding equipment parameters.

The status machine of the drive units has a cycle time of 1 ms.

During this cycle time all control commands and setpoints are processed by the drive unit.

Note: Control PDO's may only be transmitted by the master during a minimal cycle time of >1ms, as otherwise protocols cannot be processed in the unit. An error message "E-CAN xxx", see chapter x "Fault Rectification" is displayed.

There are various control modes (modes of operation) available to control the units via CAN.

With the "EASYDRIVE"-control modes the most important control functions of the unit can be activated via a LUST specific control PDO. This control information corresponds with a terminal replica.

This mode is referred to as "**EasyDrive control mode**" hereafter. Digital control functions like "controller release or states of digital outputs" can be activated directly in the control word by means of bits.

Besides the manufacture specific operating modes EasyDrive Basic and EasyDrive TablePos, EasyDrive ProgPos, CDE/B/F supports also the Profile Velocity, Homing und Profile Position Mode acc. to DSP402.

Apart from the operating mode Easydrive Basic (regulation of rotary speed) all other modes of operation are performed in position controlled operation.

During initial commissioning of the units an assistant parameter in the unit selects a preset solution matching the application the unit is to be used for. The user interface DriveManager is used to select the preset solution under the menu "INITIAL COMMISSIONING". A detailed description of the existing presettings can be found in the user manual for the corresponding unit.

For CANopen operation the following presettings are available to choose from:

3.7.1 Preset solutions for operation via CANopen

The following table lists the modes of operation which are possible via CANopen.

During initial commissioning the preset solution is selected by the assistant parameter 152-ASTER, whereupon the unit automatically changes the required parameters for this type of control. These parameters include control type, control location, setpoint source, I/O-configuration and, if necessary, modes of operation and preset mapping.

If a unit is to be configured later via a superimposed control, this control should write to parameter 152-ASTER, since this would cause the automatic conversion of parameters as previously described, which would typically result in a timeout message when accessing the parameter. For this the control should access the parameter 151-ASTPR to enter the preset solution. This process does not change the function of the unit, but enables the DriveManager user interface to start with the masks matching the preset solution.

Preset solutions 152-ASTER assistant parameter 151-ASTPR original parameter set	**Type of control**	**Permissible modes of operation** **Definition control protocol**	**Function / application**
SCC_2(4) speed regulation, fixed speeds, control via CAN-bus	Speed regulation 300-CFCON=SCON	EasyDrive Basic (-2)	Speed controlled applications with fixed values from table without functions, such as referencing, standardized units, etc.
SCC-3(6) speed regulation, setpoint and control via CAN-bus	Speed regulation 300-CFCON=SCON	EasyDrive Basic (-2)	Speed controlled applications with setpoint via bus without functions, such as referencing, standardized units, etc.
SCC_4(10) speed regulation, setpoint via PLC, control via CAN-bus	Speed regulation 300-CFCON=SCON	EasyDrive Basic (-2) EasyDrive ProgPos (-3)	Speed controlled applications with setpoint from equipment integrated PLC-sequencing control

Table 3.2 Preset solutions

Preset solutions 152-ASTER assistant parameter 151-ASTPR original parameter set	Type of control	Permissible modes of operation Definition control protocol	Function / application
PCC_1(12) positioning, travel set specification and control via CAN-bus	Position control 300-CFCON = PCON	Homing mode (6), Profile velocity mode (3) and profile position mode (1) Online reversible via object 6060h- modes of operation	Standard mode of operation acc. to DS402
PCC_2(16) positioning, table travel sets, control via CAN-bus	Position control 300-CFCON = PCON	EasyDrive TablePos (-1)	Position controlled applications with travel sets from table, with functions, such as linking of travel sets, referencing, standardized units, etc.
PCC_3(19) positioning, travel set specification via PLC, control via CAN-bus	Position control 300-CFCON = PCON	EasyDrive ProgPos (-3)	Position controlled applications with nominal values from equipment integrated PLC-sequencing control with functions, such as linking of travel sets, referencing, standardized units, etc.

Table 3.2 Preset solutions

The numerical values in parentheses represent the parameter settings.

3.8 Selecting the mode of operation

The active mode of operation is generally selected via the DS402 object 6060h. This object is mapped in equipment parameter 638-H6060 and can be changed. The possible modes of operation depend on the selected preset solution or the type of control resulting from this, see Table 3.2.

3.8.1 Modes of operation function

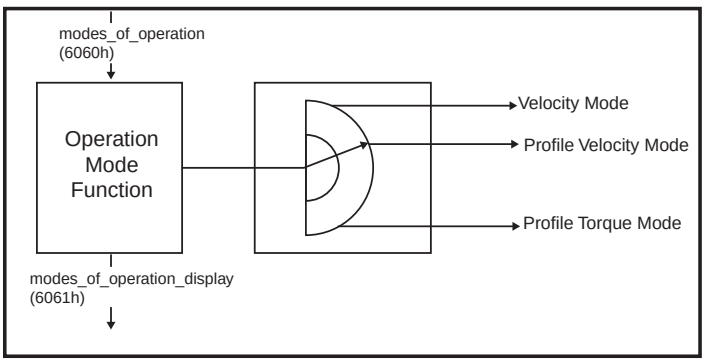


Fig. 3.3 Modes of operation function

The user has the possibility to change between the different modes of operation, as long as these are supported by the unit.

The status word contains bits the meaning of which does not depend on the mode of operation. For monitoring it is only important that the bits change their meaning when changing the mode of operation. See also chapter 6.

Object 6060h or parameter 638-H6060

-3 = EasyDrive ProgPos (PLCmotion control)

-2 = EasyDrive Basic (speed control with setpoint specification)

-1 = EasyDrive TablePos (positioning with travel set table)

1 = DS402 - profile position mode

3 = DS402 - profile velocity mode

6 = DS402 – homing mode

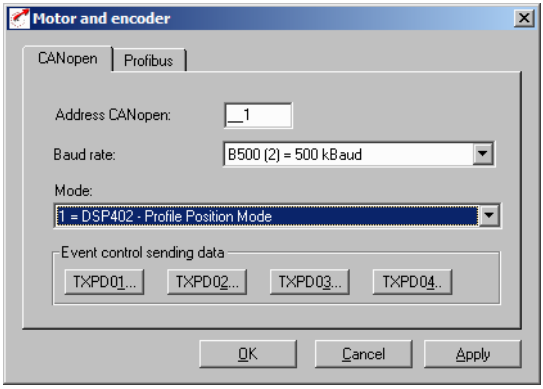


Fig. 3.4 Bus systems

3.8.2 Parameters in the graphical screen masks of the DriveManager

In the parameter input fields of the graphical screen masks the parameter numbers and parameter abbreviations are not directly visible. The following method can be used to view the parameter behind the setting mask:

- Place the cursor into the input field for the parameter value
- Press key F1 on the PC

An information window with the most important information for the corresponding parameter pops up.

Example: Parameter for the setting of the smoothing time for jerk limited ramps

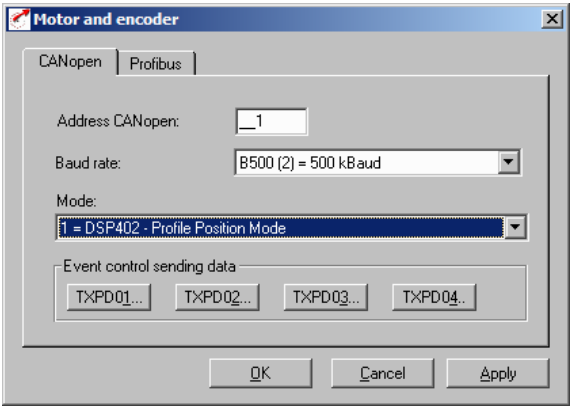


Fig. 3.5 Parameter properties

4 Parameterizing the units

4.1 Parameter channel (Service Data Objects)

The Service Data Object (SDO) enables Write/Read-Access to the object directory. This SDO is realized by the CMS-Object Multiplexed Domain according to the CAL-specification. The design of the protocol enables

transmission of data of any length. For SDO-Transfer a so-called SDO-Client is integrated in the unit. Communication takes place via two reversed identifiers.

Receive SDO:	600 h
Transmit SDO:	580 h

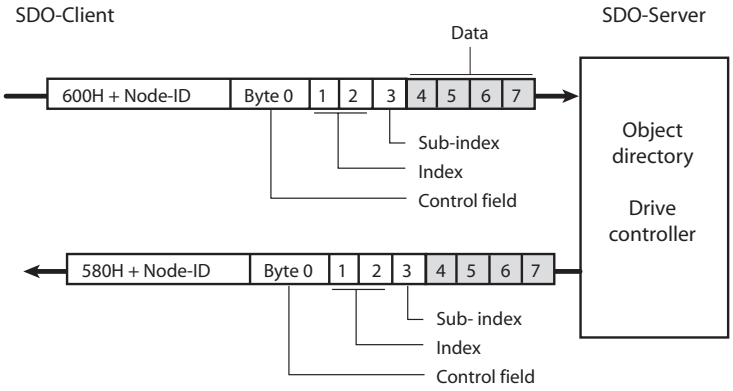


Fig. 4.1 Example of an SDO data transmission in Expedited Mode

In the CAL-specification a differentiation is generally made between three protocol services:

- Download protocol (write)
- Upload protocol (read)
- Abort protocol (error)

The Up- and Download protocols additionally differentiate between:

- Expedited Multiplexed Domain Protocol, for access to objects with a data length of up to 4 Byte (shown above) and
- Multiplexed Domain Protocol, for access to objects of any length

4.1.1 Data types

Note: The user interface DRIVEMANAGER or the control unit KEYPAD KP200 show many parameter settings in the form of value substitution text.
Example: Parameter 150-SAVE = STOP

For writing and reading via field bus these value substitution texts must be replaced by the corresponding numerical values. These values are specified in the user manual for the units and in this document, in parentheses () after the value substitution text.

Example: Parameter 152-ASTER = BUS_1 (9)

The drive units support the following parameter data formats:

Data types	Value range	Function
USIGN8	0...255	Unsigned
USIGN16	0...65535	
USIGN32	0...4294967295	
INT8	-128...127	Integer, signed
INT16	-32768...32767	
INT32	-2147483648...2147483647	
INT32Q16	-32767,66...32766,99	32 bit number with standardization 1/65536, i.e the low-word indicates the fractional digits.
FIXPOINT16	0,00...3276,80	Fixed-point number with standardization 1 /20, i.e. increment value 0.05
FLOAT32	see IEEE	32 bit floating point number in IEEE-format
ERR_STRUC		Error number (1 byte), error location (1 byte), error time (2 bytes)
STRING		ASCII-symbol, max. 100 byte for bus operation incl. zero terminator

Table 4.1 Data types, see Table 4.2

4.1.2 Representation of data types in the control protocol

All data types are shown sign correct as 32 bit values in the Intel format.

Data byte of the control protocol	3	4	5	6
USIGN8/INT8 * USIGN16/INT16 * USIGN32/INT32	Low Word Low Byte	Low Word High Byte	High Word Low Byte	High Word High Byte
INT32Q16	Fractional digit Low	Fractional digit High	Integer digit Low	Integer digit High
FIXPOINT16*	see examples			
FLOAT32	IEEE-format			
ERR_STRUC	Error number	Error location	TOP Low	TOP High
STRING	see examples			
* sign correct filled (00H or FFH) TOP= operating hours (Time of operation) in full hours				

Table 4.2 Arrangement of data types in the data field

Data types	Example	LL 3	LH 4	HL 5	HH 6
INT32Q16	10,5 Dec	00 80 H (0,5 Dec)		0A 00 H (10 Dec)	
FIXPOINT16	10,05 Dec [* 20 = 201 Dec]	C9 00 00 00 H (201 Dec)			
ERR_STRUC	E-OP2 with error location 172 at 85 operating hours	10 H (16 Dec = E-OP2)	AC H (172 Dec)	55 00 H (85 hours TOP)	
STRING	“Drive unit”	41 H (A)	44 H (D)	43 H (C)	00 H (End detection)

Table 4.3 Example for the mapping of data types

4.2 Examples on SDO handling

Via Receive SDO (COB-ID’s: 600 h + Node-ID) one can access the CANopen objects and the parameters of the drive controller.

In Expedited Mode maximum 4 data bytes can be transmitted in a data transmission protocol. This allows to describe all equipment parameters with only one transmission protocol, except the ones of type String.

String parameters can be described using the Multiplexed Domain protocol.

Where do I find the equipment parameters?

All equipment parameters are addressed via a parameter number. The drive controller has parameter numbers between 1 and 999.

Besides the standardized objects the CAN_{open} profile additionally provides a section for manufacturer specific entries. This section is located between 2000 h and 5FFF h. If you want to read or write the parameter 303-FMAX1 (maximum frequency 1) of the unit, the object index is formed of 2000 h + parameter number (Hex).

In our example: Index = 2000 h + 12F h

The entries in section "Control field" are generated by the CAN_{open} driver. They are only listed to complete the documentation of the examples. The entries depend on the transmitted data.

The control field is described in profile DS301.

4.2.1 Parameter set download

The following data can be transmitted to the CDB/E/F3000 via the CANopen interface:

- Parameter set / PLC program
- The download of a parameter data set or a PLC program can take place by means of SDO transfer or user interface DriveManager V3.2 and higher. All manufacturer specific equipment parameters can additionally be accessed via the objects 2000h-23E7h.

If a coherent valid data set, i.e. not only individual parameters, are to be transferred to the unit from the CAN-Master, the following must be observed:
When transmitting an individual parameter the drive controller checks whether the parameter matches an existing data set. The test of this new parameter value partly also uses already existing parameter values.

It is therefore possible that the drive controller my reject a parameter, even though it originates from a valid parameter data set, but is not yet complete in the unit. Possible error messages are:

Error		Cause
E-PLS	Plausibility error	Parameter settings not plausible among each other (control parameters)
E-PAR	Parameterization error	Parameter settings in the setpoint structure are mutually exclusive

Table 4.4 Error table

Since the cause of the error may probably not be eliminated by a simple reset, it may be necessary to re-establish the factory settings.

Remedy:

The new parameter data set is transmitted from the host computer to the drive controller without checking the parameter values individually. Once the upload is completed the drive controller will run a plausibility check for the now complete data set. If the data are not plausible the complete data set is rejected and the old data set reactivated.

This procedure requires a handshake, which is described in detail hereafter.

Handshake for uploading a complete parameter data set

1. Upload log on with parameter 80-SLOAD = -1
   - Writing on this parameter is only possible with the system stopped. After the write process the drive controller is secured against switching on, until the download is completed.
2. Transfer of complete parameter data set
   - Several Select-Telegrams transfer the individual parameters from the host computer to the drive controller. The controller then initially accepts the new parameter values without running a plausibility check.
3. Upload termination on with parameter 80-SLOAD = -2
   - Once all parameter data have been transmitted the host computer sets SLOAD to the value (-2). This signalizes the end of data transmission to the drive controller. The controller now starts to run a plausibility check for its complete data set. If valid, the parameters are written into the EEPROM with the attribute "CardWriteable". The drive is released again and ready to be started. Parameter 80-SLOAD is set in accordance with the result of the parameter test.
4. Polling of parameter 80-SLOAD with timeout (10 s)
   - If SLOAD becomes 0 within the timeout, the transmission has been completed correctly. The parameters are written into the EEPROM with the attribute "Card-Writeable". The drive is released again and ready to be started.
   - If SLOAD = (-1) within the timeout, the drive controller is still busy with testing and saving. If SLOAD > 0, the data set has been rejected by the drive controller. The SLOAD value in this case corresponds with the number of the first parameter with invalid value.

Note: If the connection is interrupted during transmission or the timeout has expired, the transmission needs to be repeated or the drive controller restarted. With the plausibility check disabled the protocols are always positively acknowledged, even if the parameter could not be accessed. This ensures that the Master is not interrupted by error messages during the download. Illegal parameter changes are thus not performed.

4.3 Implemented DS301 – functionality

4.3.1 Communication-Objects

- Bootup after DS301 V4.01 (Quarding Boot-up via identifier 700h)
- 4 dynamically mappable TXPDOs (transmission type 1 to 240, 254 and 255dec possible).
- 4 dynamically mappable RXPDOs (transmission type 1 to 240 and 254dec possible). Observe the definition of temporal conditions (minimum temporal distance 1ms, error message when falling short of).
- 1 Server SDO. Observe the definition of temporal conditions (typical processing time in unit 20ms
- 1 Emergency object
  Error codes acc. to DS402 plus manufacturer specific error location and number.
- one Sync – Object
- NMT-Statemachine acc. to DS301
- Nodeguarding und heart beat (see below)
- Processing cycle:
  PDO-protocols can be processed in a minimum cycle time of 1ms, if protocols arrive quicker an error message E-CAN – xxx is generated.
- SDO-protocols and NMT-services are processed in a 10ms-cycle.
- Initialization values of the COB-Ids acc. to Predefined Connection Set
- Access to equipment parameter 2000H – 23E7H (expedited/non-expedited)

4.3.2 Object directory in DS301:

Object No.	Object name	Object code	Type	Attr.
0x1000	Device_Type	VAR	Unsigned32	ro
0x1001	Error_Register	VAR	Unsigned8	ro
0x1003	Pre-Defined_Error_Field One subentry	ARRAY	Unsigned32	ro
0x1005	COB-ID_SYNC	VAR	Unsigned32	rw
0x1006	Communication_Cycle_Period	VAR	Unsigned32	rw
0x1007	Synchronous_Window_Length	VAR	Unsigned32	rw
0x1008	Manufacturer device name	String(clarification pending)		
0x1009	Manufacturer hardware version	String		
0x100A	Manufacturer software version	String		
0x100C	Guard_Time	VAR	Unsigned16	rw
0x100D	Life_Time_Factor	VAR	Unsigned8	rw
0x1010	Store Parameters	ARRAY		
0x1011	Restore Default Parameters	ARRAY		
0x1014	COD-ID_EMCY	VAR	Unsigned32	rw
0x1016	Consumer_Heartbeat_Time	ARRAY	Unsigned32	rw
0x1017	Producer_Heartbeat_Time	VAR	Unsigned16	rw
0x1018	Identity_Object support every 4 entries (serial number, ...)	RECORD	Identity (23h)	ro
0x1400	1st_Receive_PDO_Parameter	RECORD	PDO CommPar	rw
0x1401	2nd_Receive_PDO_Parameter	RECORD	PDO CommPar	
0x1402	3st_Receive_PDO_Parameter	RECORD	PDO CommPar	rw
0x1403	4st_Receive_PDO_Parameter	RECORD	PDO CommPar	rw
0x1600	1st_Receive_PDO_Mapping max 8 objects	RECORD	PDO Mapping (21h)	rw
0x1601	2nd_Receive_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1602	3nd_Receive_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1603	4nd_Receive_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1800	1st_Transmit_PDO_Parameter	RECORD	PDO CommPar (20h)	rw

Table 4.5 Object directory

Object No.	Object name	Object code	Type	Attr.
0x1801	2nd_Transmit_PDO_Parameter	RECORD	PDO CommPar (20h)	rw
0x1802	3nd_Transmit_PDO_Parameter	RECORD	PDO CommPar	rw
0x1803	4nd_Transmit_PDO_Parameter	RECORD	PDO CommPar	rw
0x1A00	1st_Transmit_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1A01	2nd_Transmit_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1A02	3nd_Transmit_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw
0x1A03	4nd_Transmit_PDO_Mapping max 8 objects	RECORD	PDO Mapping	rw

Table 4.5 Object directory

Asynchronous PDOs have Default transmission type 254

4.4 PDO Transmission types

In connection with the PDO-transmission various transmission types are defined in the CANopen profile DS301. Transmission type and event control can be separately set for all supported RXPDO's and TXPDO's. The drive controller supports the following transmission types:

acyclic synchronous Type No. 0 h
Meaning: Transmission type acyclic synchronous represents the transmission of a PDO in connection with a Sync-Object, i.e. RXPDO's are only evaluated in the unit after receipt of a Sync-Object, TXPDO's are only sent after the receipt.

acyclic synchronous Type No. 1-F0 h
Meaning: The difference to transmission type acyclic synchronous is the fact that RXPDO's are only evaluated after receipt of 1-F0 h Sync-Objects or TXPDO's are sent after all 1-F0 h Sync-Objects.

asynchronous Type No. FE h
Meaning: RXPDO's are immediately evaluated upon receipt, TXPDO's are sent by an equipment specific event. The Sync-Object is of no relevance in this transmission type.

Note: The desired transmission type is set via the corresponding CANopen objects 1400h for RXPDOs and 1800h for TXPDOs.

4.5 PDO Mapping

4.5.1 Mapping general

On CDE/B/F3000 variable mapping of parameters is possible for all 4 RX- and TXPDOs.

Mapping takes place in accordance with the definition of the CANopen communication profile DS301.

Information on parameters, such as data length and parameter number, see chapter 4.1.

Event controlled sending of TXPDO

Note: Event control is only active if the corresponding ”transmission type” has been set to asynchronous (FE hex). Parameters '148-TXEV1' , '149-TXEV2', ”675-TXEV3” and ”676-TXEV4” contain the bit coded possible internal events to trigger the corresponding TXPDO.

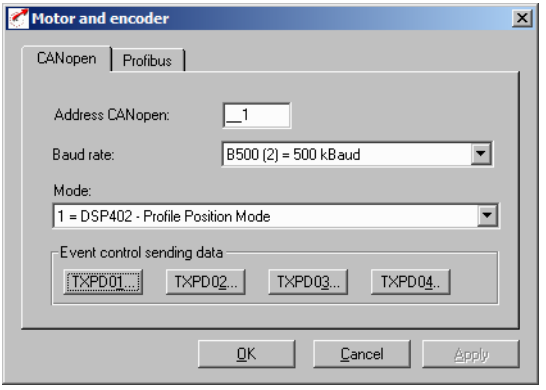


Fig. 4.2 Bus systems

All events listed in the following table are equal ranked and can be "or"-connected among one another. The parameters are bit coded.

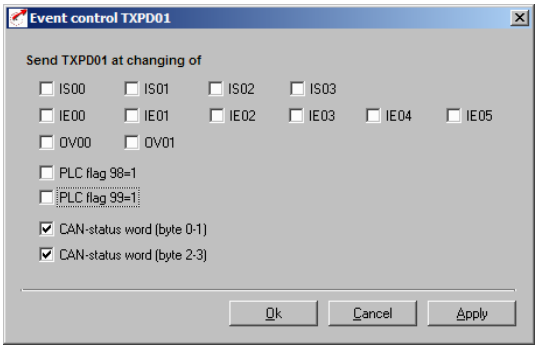


Fig. 4.3 Event control TXPD01

*) PLC-flag is deleted after event evaluation.

**) Virtual outputs are parameterized in the same way as standard outputs, but have no terminal connection. They can be used to trigger an event. An event each is generated at the High and Low flank of the signal.

Note: CAN status word has changed:
Changes to the data byte 0+1 or 2+3 of the status information triggers an event. See following descriptions for the individual preset solutions. If the inputs are used to trigger an event, one event each is triggered at the High and the Low flank. The two flags (only with preset solution) can trigger an event from within a sequential program. The event is triggered when setting and resetting 1 (SET M98=1).

Cyclic sending of TX PDO's is activated by setting a cycle time in ms in the object 0x1800, 5 event timer.

4.5.2 Preset mapping

Via parameters

Manufacturer specific parameters	PDO
657-R1SEL	RXPD01
658-T1SEL	TXPD01
665-R2SEL	RXPD02
666-R3SEL	RXPD03
667-R4SEL	RXPD04
668-T2SEL	TXPD02
669-T2SEL	TXPD03
670-T2SEL	TXPD04

Table 4.6 Preset mapping

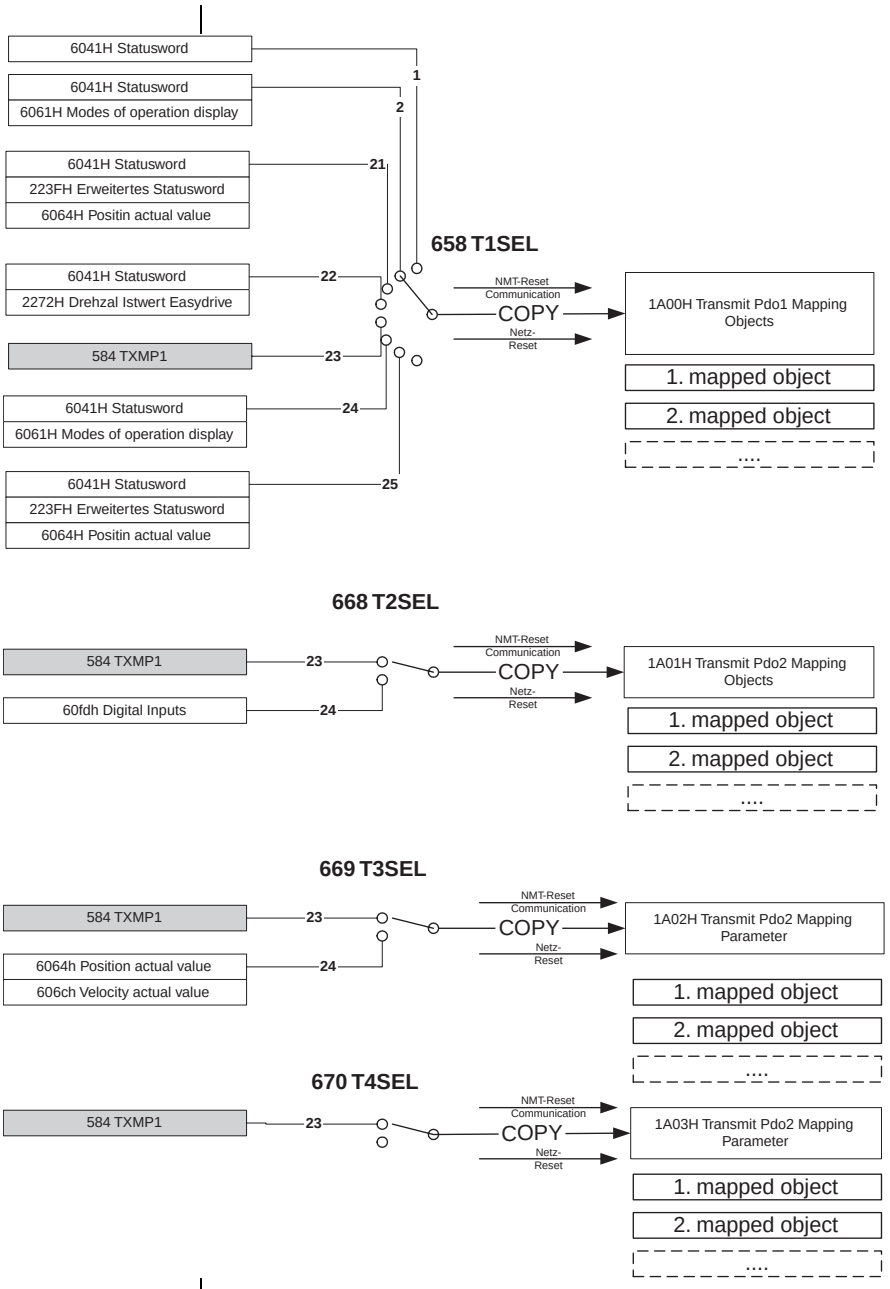
a predefined mapping can be activated. With setting 23 dynamic mapping is active.

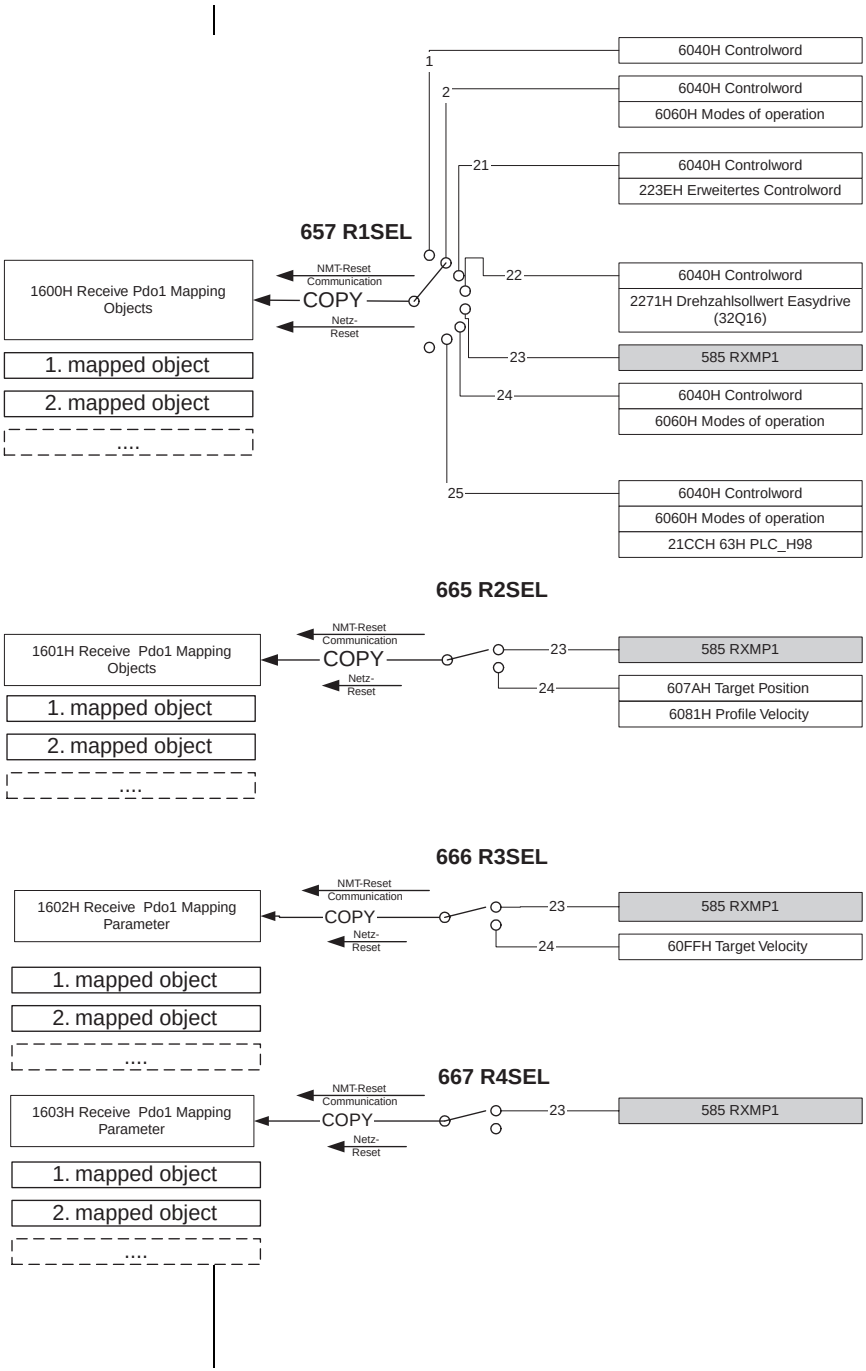
Dynamic mapping can also be used with predefined mapping.

After Power-On the predefined mapping is active by default.

Factory setting is 21. This means that the predefined mapping for the manufacturer specific modes of operation ”EasyDrive TablePos” is active.

The default setting is automatically set by selecting the "preset solution" via the DRIVEMANAGER.


6041H Statusword
6041H Statusword
6061H Modes of operation display
6041H Statusword
223FH Erweitertes Statusword
6064H Positin actual value
6041H Statusword
2272H Drehzal Istwert Easydrive
584 TXMP1
6041H Statusword
6061H Modes of operation display
6041H Statusword
223FH Erweitertes Statusword
6064H Positin actual value
1
2
21
22
23
24
25
658 T1SEL
NMT-Reset Communication
COPY
Netz-Reset
1A00H Transmit Pdo1 Mapping Objects
1. mapped object
2. mapped object
....
668 T2SEL
584 TXMP1
60fdh Digital Inputs
23
24
NMT-Reset Communication
COPY
Netz-Reset
1A01H Transmit Pdo2 Mapping Objects
1. mapped object
2. mapped object
....
669 T3SEL
584 TXMP1
6064h Position actual value
606ch Velocity actual value
23
24
NMT-Reset Communication
COPY
Netz-Reset
1A02H Transmit Pdo2 Mapping Parameter
1. mapped object
2. mapped object
....
670 T4SEL
584 TXMP1
23
NMT-Reset Communication
COPY
Netz-Reset
1A03H Transmit Pdo2 Mapping Parameter
1. mapped object
2. mapped object
....


657 R1SEL
1600H Receive Pdo1 Mapping Objects
1. mapped object
2. mapped object
....
NMT-Reset Communication
COPY
Netz-Reset
1
6040H Controlword
2
6040H Controlword
6060H Modes of operation
21
6040H Controlword
223EH Erweitertes Controlword
22
6040H Controlword
2271H Drehzahlsollwert Easydrive (32Q16)
23
585 RXMP1
24
6040H Controlword
6060H Modes of operation
25
6040H Controlword
6060H Modes of operation
21CCH 63H PLC_H98
665 R2SEL
1601H Receive Pdo1 Mapping Objects
1. mapped object
2. mapped object
....
NMT-Reset Communication
COPY
Netz-Reset
23
585 RXMP1
24
607AH Target Position
6081H Profile Velocity
666 R3SEL
1602H Receive Pdo1 Mapping Parameter
1. mapped object
2. mapped object
....
NMT-Reset Communication
COPY
Netz-Reset
23
585 RXMP1
24
60FFH Target Velocity
667 R4SEL
1603H Receive Pdo1 Mapping Parameter
1. mapped object
2. mapped object
....
NMT-Reset Communication
COPY
Netz-Reset
23
585 RXMP1

A major proportion of the equipment specific parameters, such as e.g. the actual motor current value, are part of the manufacturer specific area (2001H-23E7H) and can also be mapped in the PDOs.

4.6 Emergency Objects

Byte	0	1	2	3	4	5	6	7
Error	Emergency Error Code	Error Register (generic error)	Error number	Error location	Operating hours			
Warnings	00H	FFH	Error Register (generic error)	FFH	Warning High Byte	Warning Low Byte		

Table 4.7 Emergency Object

Decisive factors for quick localization are error code and error location. In byte 3 and 4 of the emergency telegram you find the error code, which represents an initial grouping of the error cause (see). The exact error cause is determined by the error location in byte 5. Bytes 6 and 7 contain the internal operating hour meter of the equipment (parameter 87-TOP).

CANopen errors, i.e. incorrect configurations, bus disturbances, etc. are indicated by error code 0xFF00.

Note: In case of an error the controller responds according to the parameterized error reaction. These are individually adjustable for individual errors

Note: The LED-status indications are explained in the user manual.

4.6.1 Error reset via bus system

Existing errors are reset by transition from Pre-Operational to Operational status. The error reset is signalized by transmission of the following Emergency Message:

ID	Data bytes	Description
Emergency	00 00 00 00 00 00 xx xx	Emergency Message Error Reset

Table 4.8 Error reset

xx xx Operating Hour Meter

If the cause of the error has not been remedied the drive controller will return to error state after transmitting another Emergency Message.

Another possibility is given by the object 6040 h controlword:

Draft 402	6040h	VAR	controlword	Integer16	rw	M

4.6.2 Error reset general

Equipment errors can be reset with the following mechanisms:

- Controlword bit 8, flank controlled
- Status transition preoperational -> operational
- Control input with programmed reset functionality
- Hardware release ENPO on control terminal
- KeyPad
- DriveManager user interface
- Writing of value 1 to the parameter 74-ERES via user interface or bus system

Note: A detailed list of all error messages with remedial action can be found in the user manual.

4.6.3 Standard error messages/ Emergency Error-Codes

Error-No.	Error	Emergency Error Code	Description
1	E-CPU	0x5220	Hardware or software error
2	OFF	0x3100	Mains failure
3	E-OC	0x2340	Overcurrent cut-off
4	E-OV	0x3110	Overvoltage cut-off
5	E-OLM	0x2310	Ixlxt-motor cut-off
6	E-OLI	0xff00	Ixt-converter cut-off
7	E-OTM	0x4310	Motor overtemperature
8	E-OTI	0x4210	Drive unit overtemperature
9	E-PLS	0x6110	Plausibility error with parameter or program sequence
10	E-PAR	0x6320	Parameterization error
11	E-FLT	0x6100	Floatingpoint error
12	E-PWR	0x5400	Unknown power circuitry
13	E-EXT	0x9000	external error message (input)
14	E-USR	0x6200	reserved for special software

Table 4.9 Error messages CDE3000/CDB3000

Error-No.	Error	Emergency Error Code	Description
15	E-OPT	0x7000	Error on module in options module location
16	E-CAN	0x7000	CAN bus error
17	E-PLC	0xff00	Error in processing of PLC sequential program
18	E-SIO	0x7510	Error in serial interface
19	E-EEP	0x5530	Faulty EEPROM
20	E-WBK	0x5440	Open circuit at current input 4-20 mA
21	-	-	-
22	-	-	-
23	-	-	-
24	-	-	-
25	-	-	-
26	E-OL5		Ixt-cut-off below 5 Hz to protect the converter
30	E-ENC		Error in rotary position transducer interface
31	-	-	-
32	E-FLW	0x8611	Servo lag
33	E-SWL	0x8612	Software limit switch evaluation has responded
34	-	-	-
35	-	-	-
36	E-POS	0x8600	Positioning error
37	-	-	-
38	E-HW	0x8612	Hardware limit switched has been approached
39	E-HWE	0x8612	Hardware limit switched mixed up

Table 4.9 Error messages CDE3000/CDB3000

4.6.4 Communication error

Communication errors are displayed with E-CAN (error number 16). An error location E-CAN-XX is specified in addition to the detailed display

Error location	Description
0	CAN bus error
31	BUSOFF detected
32	Unable to send Transmit Telegram

Table 4.10 Error table

Error location	Description
33	Guarding error
34	Node-Error
35	Initialization error
36	PDO object outside value range
37	Error in initialization of communication parameters
38	Target position memory - overflow
39	Heartbeat - Error
40	invalid CAN-address
41	Insufficient memory to save communication objects
42	Guarding error in monitoring of a Sync/PDO object

Table 4.10 Error table

4.7 Heartbeat function

The Heartbeat function acc. to DS301 (V4.01) is supported. The objects 1016H Consumer Heartbeat Time and 1017H Producer Heartbeat Time are implemented with limitations, should the Lust controller be used to take over the consumer part, only 1 entry can be made in object 1016H.

Monitoring of the producer starts in NMT-Status PreOperational. In case of an error the error reaction configured in object 6007H Abort connection option code is executed. Monitoring is restarted after receipt of the next Heartbeat object.

Heartbeat Protocol

The Heartbeat Protocol defines an ERROR CONTROL SERVICE without the use of REMOTE FRAMES. A HEARTBEAT PRODUCER Transmits a cyclic HEARTBEAT MESSAGE. This message is received be one or several HEARTBEAT CONSUMER(S). The relation between PRODUCER and CONSUMER can be configured through the following objects. The HEARTBEAT CONSUMER monitors the receipt of the HEARTBEAT PROTOCOL under due consideration of the set HEARTBEAT CONSUMER TIME.

If the HEARTBEAT PROTOCOL does not arrive within the HEARTBEAT CONSUMER TIME, a HEARTBEAT EVENT is generated.

Note: Node Guarding and Heartbeat cannot be used simultaneously.

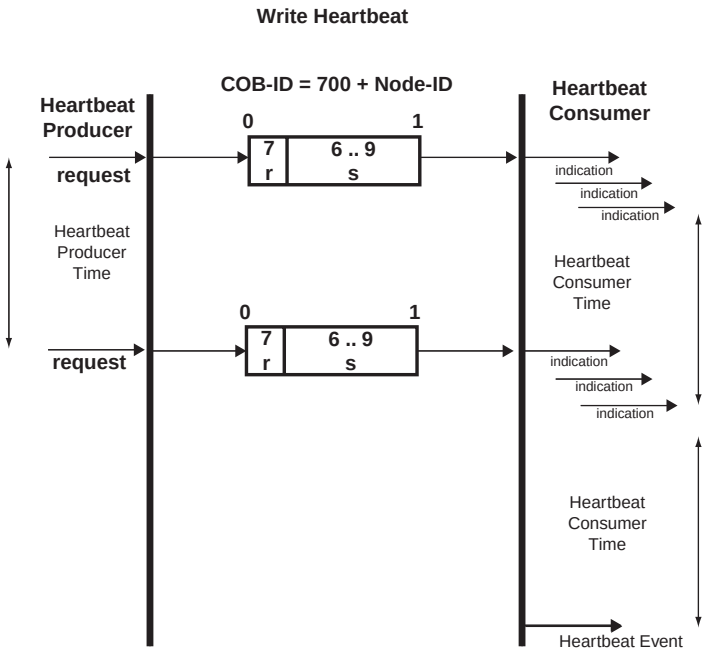


Fig. 4.4 Heartbeat Protocol

r: reserved (always 0)

s: the state of the Heartbeat producer

0: BOOTUP

4: STOPPED

5: OPERATIONAL

127: PRE-OPERATIONAL

The HEARTBEAT PROTOCOL starts immediately after the entry of the HEARTBEAT PRODUCER TIME. If the unit is switched on with a HEARTBEAT PRODUCER TIME unequal 0, the HEARTBEAT PROTOCOL starts with the status transition INITIALISING -> PRE-OPERATIONAL. In this case the BOOTUP MESSAGE is considered to be the first HEARTBEAT MESSAGE.

The functions NODE GUARDING and HEARTBEAT must not be used simultaneously in a unit. If the HEARTBEAT PRODUCER TIME is unequal 0, the HEARTBEAT PROTOCOL is used.

Object 1016h: Consumer Heartbeat Time

The CONSUMER HEARTBEAT TIME defines the expected HEARTBEAT CYCLE TIME. The CONSUMER HEARTBEAT TIME must be set longer than the corresponding PRODUCER HEARTBEAT TIME, which is set in the corresponding PRODUCER.
Monitoring starts with the receipt of the first HEARTBEAT PROTOCOLS. If the CONSUMER HEARTBEAT TIME = 0 is set, the function is not used. The time is set with a resolution of 1ms.

Unsigned32

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

Fig. 4.5 Structure of Consumer Heartbeat Time entry

5 Implemented DS402 – functionality

The functions described in this chapter solely refer to control activities in the Modes of Operation of the DS402 profile

1 – Profile position mode

3 – Profile velocity mode

6 – Homing Mode

When using the manufacturer specific ”EasyDrive Modes” the equipment control is not in accordance with the described state machine.

5.1 Equipment control and state machine

The drive control is accomplished through the DriveCom state machine defined in DS402 (see DS402 10.1.1 Statemachine).

Remote-Signal is not planned.

5.1.1 General information

The DEVICE CONTROL FUNCTION monitors all controller functions.

This function is subdivided into:

device control of the state machine

operation mode function

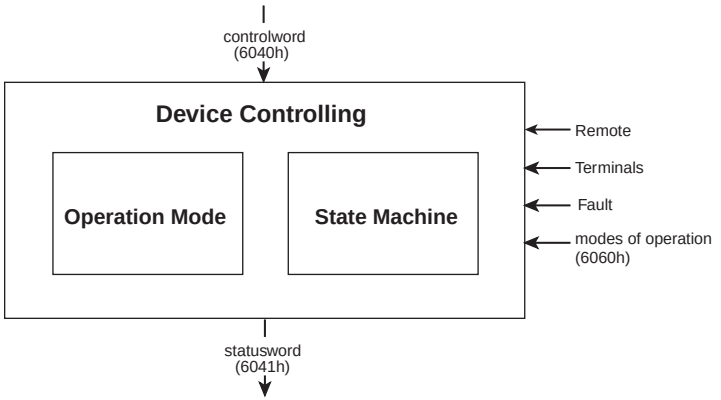


Fig. 5.1 Device controlling

The status of the controller is controlled by the CONTROLWORD.

The status of the controller is indicated in the STATUSWORD.

In REMOTE MODE the controller is directly controlled by the CANopen network via PDO and SDO.

The state machine is controlled by the CONTROLWORD. The state machine is influenced by internal events, such as e.g. errors.

5.1.2 State machine

The state machine describes the CONTROLLER STATUS and enables control possibilities by the Master. An individual status shows a specific internal or external performance. At the same time the status of a controller limits the possible control commands, e.g. triggering a point-to-point positioning is only possible in

OPERATION ENABLE

state.

States may be changed by the CONTROLWORD or other internal events. The current status is indicated by the STATUSWORD.

The state machine in Fig. 5.3. describes the status of the controller with respect to user commands and internal error messages.

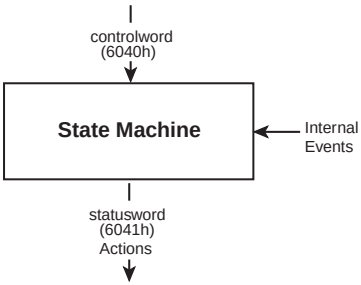


Fig. 5.2 State machine

5.1.3 Equipment states

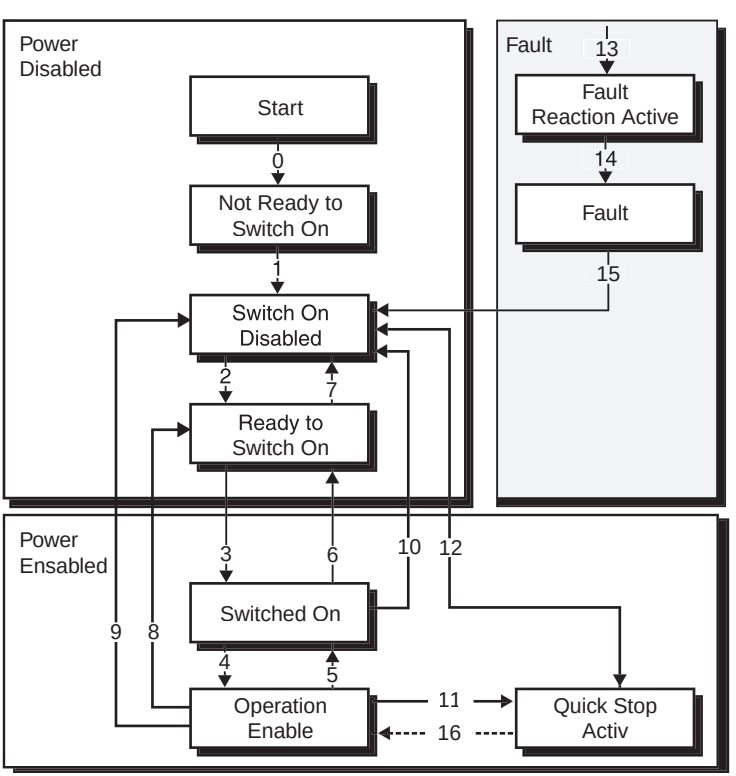


Fig. 5.3 State machine

The following equipment states are possible:

NOT READY TO SWITCH ON:

Low voltage applied to the drive.
The drive is initialized or runs a self test.
The brake, if present, is closed in this status
The drive function is switched off.

SWITCH ON DISABLED:

Drive initialization completed.
The drive parameters were set.
The drive parameters were changed.
No voltage applied to the unit (for safety reasons).
The drive function is switched off.

READY TO SWITCH ON:

Voltage applied to the unit.
The drive parameters were changed.
The drive function is switched off.

SWITCHED ON:

Unit under voltage.
POWER AMPLIFIER ready for operation.
The drive parameters were changed.
The drive function is switched off.

OPERATION ENABLE:

No errors detected.
Drive function released and motor under voltage.
The drive parameters were changed.
(Refers to standard application for drive.)

QUICK STOP ACTIVE:

The drive parameters were changed.
QUICK-STOP function in progress.
Drive function released and motor under voltage.
With the QUICK STOP OPTION CODE set to 5 (stay in status QUICK STOP ACTIVE), you cannot leave QUICK STOP ACTIVE state, but you can use the ENABLE OPERATION command to change to the state OPERATION ENABLE.

FAULT REACTION ACTIVE:

The drive parameters were changed.
An error occurs in the unit.
QUICK-STOP function was performed.
Drive function released and motor under voltage.

FAULT:

The drive parameters were changed.
An error occurs in the unit.
Voltage on/off depends on the application.
The drive function is switched off.

Bit combinations of the DRIVECOM state machine

Equipment control commands

The following bit combinations of control bits 0-3 and 7 make up the equipment control commands for the state transitions of the state machine:

	Control bit					
Command	**7**	**3**	**2**	**1**	**0**	**Transitions**
STOP	X	X	1	1	0	2, 6, 8
SWITCH ON	X	X	1	1	1	3
VOLTAGE LOCKOUT	X	X	X	0	X	7, 9, 10, 12
QUICK STOP	X	X	0	1	X	11
OPERATION LOCKOUT	X	0	1	1	1	5
RELEASE OPERATION	X	1	1	1	1	4
RESET ERROR	0 > 1	X	X	X	X	15

Device status

The following bits of the DRIVECOM status word indicate the actual system state:

	Status bit					
Status	**6**	**5**	**3**	**2**	**1**	**0**
NOT READY TO SWITCH ON	0	X	0	0	0	0
STARTING LOCKOUT	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 RELEASED	0	1	0	1	1	1
FAULTS	0	X	1	0	0	0
ERROR REACTION ACTIVE	0	X	1	1	1	1
QUICK STOP ACTIVE	0	0	0	1	1	1

Table 4.11 Bit combinations of the DRIVECOM state machine

5.2 Option codes

The devices support option codes for four different possibilities to stop the drive. These four possibilities are :

- STOP function – interrupts a progressing movement
- Controller lockout function – stops the movement by removing the controller release (software !)
- Quick stop function – stops the movement by triggering a quick stop
- Error reaction function – stops the movement in case of an error

For all variants the desired device reaction is parameterized by means of the option code. In the DRIVEMANAGER the selection mask is contained in the section Travel Profile – Stop Ramps.

CANopen	Function	Representation in device parameter
Object 605D	Stop option code (settings 3 and 4 are not supported)	664-HAOPC
Object 605B	Shut down option code (settings 0 and 1 available)	663-SDOPC
Object 605C	Disable operation option code (not implemented)	
Object 605A	Quick stop option code (settings 3, 4, 7 and 8 are not supported, leave the state by transition 12)	661-QSOPC
Object 605E	Fault reaction option code (only setting –1 possible, each error message has an individual fault reaction, which can be set via manufacturer specific parameters)	662-FROPC

Table 5.1 Option codes

As standard parameters these objects are part of the data set.

The following explains the associations and performance of the Option Codes. The parameters can be changed via bus, or in the DriveManager mask shown below.

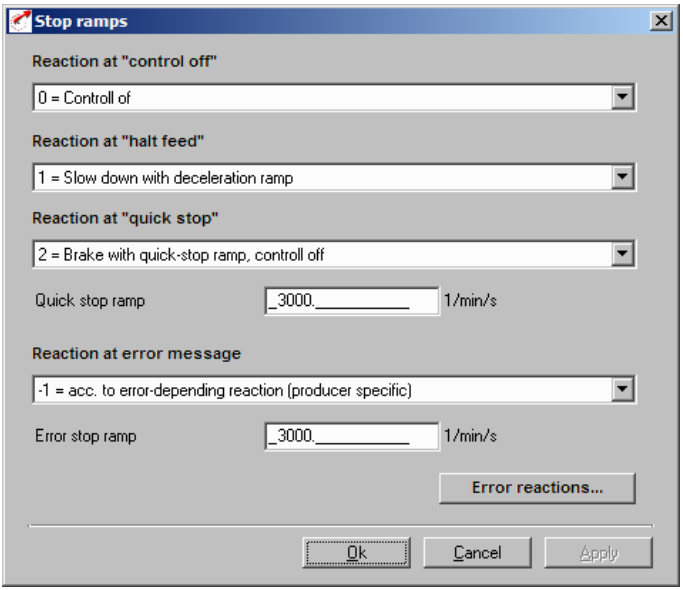


Fig. 5.4 Stop ramps

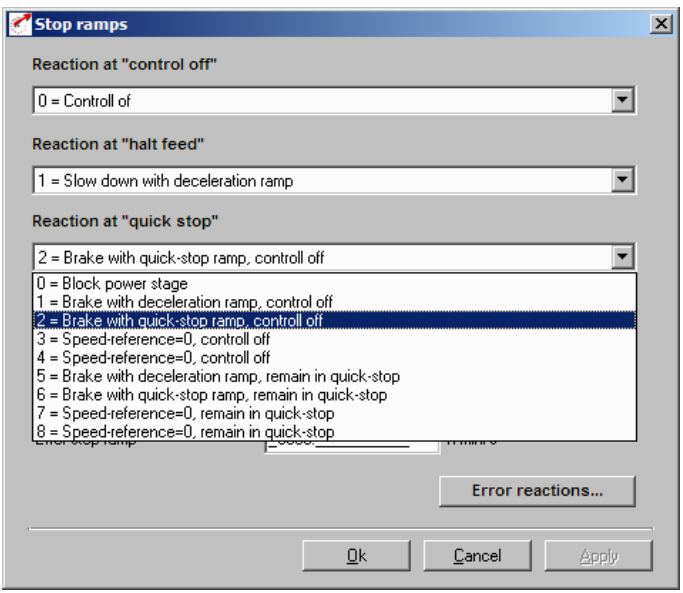


Fig. 5.5 Stop ramps error reactions

5.3 Device Control Objects

The following table lists the implemented objects to control the drive:

Object No.	Object Name	Object Code	Type	Attr.
0x6007	Abort_Connection_Option_Code **0** no action **1** malfunction **2** device control command Disable Voltage **3** device control command Quick Stop	VAR	Integer16	rw
0x6040	Controlword	VAR	Unsigned16	rw
0x6041	Statusword	VAR	Unsigned16	ro
0x605B	Shutdown_Option_Code -1: Ramp dependent on 0x605A (Quick Stop Option Code) 0: Disable Drive Function 1: slow down with slow down ramp; disable of the drive	VAR	Integer16	rw
0x605C	Disable_Operation_Option_Code	VAR	Integer16	rw
0x605A	Quick_Stop_Option_Code 0 disable drive function 1 slow down on slow down ramp 2 slow down on quick stop ramp 3 slow down on the current limit 4 slow down on the voltage limit 5 slow down on slow down ramp and stay in QUICK STOP 6 slow down on quick stop ramp and stay in QUICK STOP 7 slow down on the current limit and stay in QUICK STOP	VAR	Integer16	rw
0x605D	Halt_Option_Code	VAR	Integer16	rw
0x605E	Fault_Reaction_Option_Code -1 slow down on slow down ramp and stay in fault reaction active (drive active)	VAR	Integer16	rw
0x6060	Modes_Of_Operation **-3:** EasyDrive ProgPos **-2**: EasyDrive Basic **-1**: EasyDrive TablePos **1**: profile position mode **3**: profile velocity mode **6**: homing mode	VAR	Integer8	wo
0x6061	Modes_Of_Operation_Display s. 0x6060	VAR	Integer8	ro

Table 5.2 Device Control Objects

5.4 Units and standardizations, factor group

The DriveManager user interface contains a standardization assistant, which enables simple setting of mechanical and electrical interrelations for the standardization of units for the values required for the control. The assistant converts the application values to the representation of parameters from the DS402 factor group. The parameters from the factor group are listed below and can also be set directly by the user.

However, normally the method of having the parameter settings computed by the standardization assistant is much easier.

The standardization assistant supports the user in the configuration of single and dual rotary position transducer systems.

In systems with 2 rotary position transducers the following method is to be employed.

5.4.1 Single rotary position transducer system

In the first step the correct rotary position transducer must be configured. The following mask in the DriveManger serves this purpose. An assistant parameter is used to select the type of rotary position transducer and to set the corresponding data.

The mechanical coupling of the sensor is configured by parameterizing a transmission ratio.

With motor shaft mounted transducers the transmission ratio between motor shaft and transducer is 1:1.

With output side mounted transducers the exact transmission ratio between motor shaft and rotary position transducer shaft must be entered.

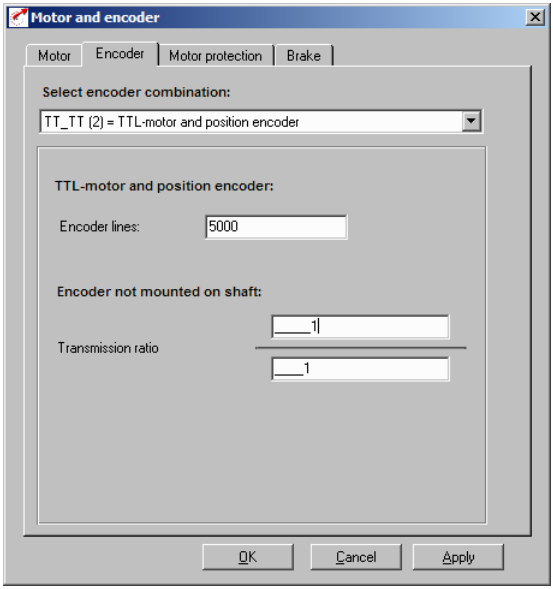


Fig. 5.6 Motor and transducer

The second steps connects the travel device mechanically with the transducer. For this purpose a unit is selected with the desired resolution:

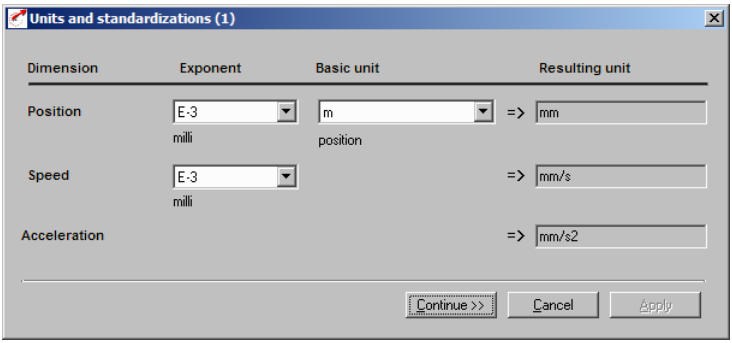


Fig. 5.7 Units and standardization 1

In step three the mechanical reference values are entered:

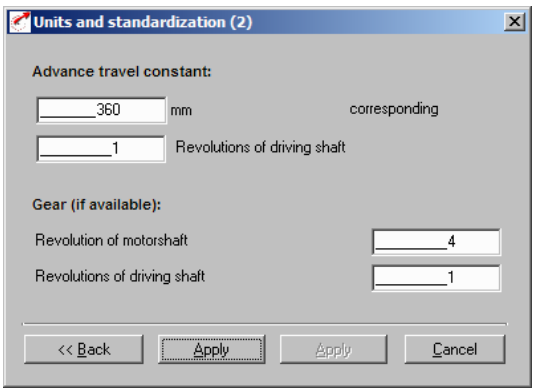


Fig. 5.8 Units and standardization 2

With the confirmation READY the user interface computes the parameters of the Factor Group:

Factor group acc. to DS402:

Object No.	Object Name	Object Code	Type	Attr.	Device parameters
0x607E	Polarity	VAR	Unsigned8	rw	795-FGPOL
0x6089	Position_Notation_Index Only display for standardization block	VAR	Integer8	rw	780-FGPNI
0x608A	Position_Dimension_Index Only display for standardization block	VAR	Unsigned8	rw	781-FGPDI
0x608B	Velocity_Notation_Index Only display for standardization block	VAR	Integer8	rw	782-FGVNI
0x608C	Velocity_Dimension_Index Only display for standardization block	VAR	Unsigned8	rw	783-FGVDI
0x608D	Acceleration_Notation_Index Only display for standardization block	VAR	Integer8	rw	784-FGANI
0x608E	Acceleration_Dimension_Index Only display for standardization block	VAR	Unsigned8	rw	785-FGADI
0x608F	Position_Encoder_Resolution	VAR	Unsigned8	rw	786-FGPER
0x6090	Velocity_Encoder_Resolution	ARRAY	Unsigned32	rw	791-FGVEF
0x6091	Gear_Ratio	ARRAY	Unsigned32	rw	788-FGGR
0x6092	Feed_Constant	ARRAY	Unsigned32	rw	789-FGFC
0x6093	Position_Factor	ARRAY	Unsigned32	rw	790-FGPF
0x6094	Velocity_Encoder_Factor	ARRAY	Unsigned32	rw	791-FGVEF
0x6097	Acceleration_Factor	ARRAY	Unsigned32	rw	794-FGAF
0x607A	Target_Position	VAR	Integer32	rw	659-H607A

Table 5.3 Factor Group

The objects of the factor group can be computed and entered directly by the user, independently from standardization assistant of the DriveManager. However, the corresponding rotary position transducer settings must strictly be made.

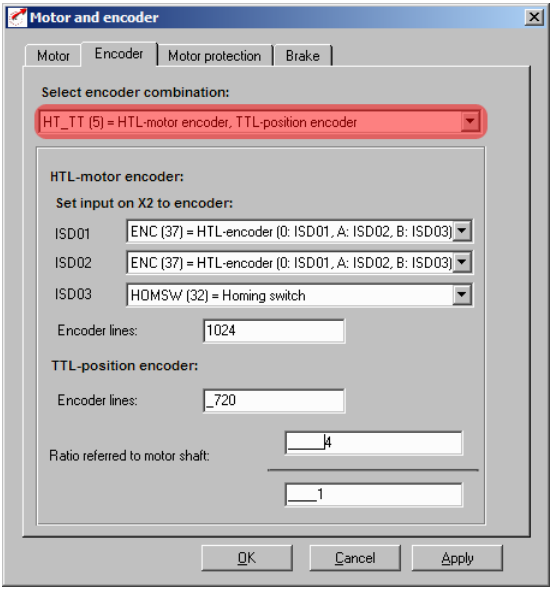
5.4.2 Dual rotary position transducer systems

The procedure for determining the standardization parameters for rotary speed and acceleration is the same as for the single rotary position transducer variant, because the speed regulation is accomplished via the motor shaft mounted rotary position transducer.

The adaptation of the position control to the second transducer is accomplished as follows:

Example. CDB:HTL transducer as primary transducer for speed regulation
TTL transducer for position control

When setting the HTL transducer one must make sure that the digital inputs ISD02 and ISD03 are parameterized acc. to their function.



The parameterization of the standardizations is initially performed as with the sing rotary position transducer system. The reference is automatically applied to the rotation transducer defined as position transducer. Thus the parameters of the factor group for speed and acceleration are correctly set.

5.4.3 Rotary position transducer (SSI or TTL) as position transducer

In order to adapt the positioning standardization the drive system must now be informed about the transmission ratio of the position transducer for evaluation.

The number of revolutions of the position transducer per motor revolution must be known. In an example the SSI-transducer performs 0.0437 revolutions per motor revolution.

Re. position transducer / motor revolutions	0,0437 / 1
Motor rev. /pos. transducer revs.	22,88 / 1
Setting the transmission ratio	Parameter: Motor shaft revolutions = 2288 (435-ECN01) Output shaft revolutions = 100 (436-ECDE1)

The numerator of the transmission ration may have a negative sign, in order to account for a counter-rotation of the transducer with respect to the motor.

5.4.4 Linear measuring system as position transducer

In general the same procedure as for the rotary transducer applies also in this case, with the exception that in this case no relation between rotary transducer / motor revolution can be visualized.

In this case the system calculates the number of increments the linear system delivers per motor revolution.

For SSI transducer systems the adjusted data capacity of the single turn information is additionally of importance.

SSI linear system:

Transducer increments / motor revolution, acc. to resolution of the position transducer	Example.: 375Inc. / 1 motor revolution
Configured single turn information	12Bit = 4096 Incr.
Transmission ratio	4096 / 375 = 10,92
Setting the transmission ratio	Parameter: Motor shaft revolutions = 1092 (435-ECN01) Output shaft revolutions = 100 (436-ECDE1)

6 Modes of operation

6.1 DS402 compatible modes of operation

The devices of families CDB/E/F support the DS402 modes of operation

Homing mode
Profile velocity mode and
Profile position mode.

The function ”INTERPOLATED POSITION MODE“ is under preparation.
In all these DS402 – modes of operation the controller is in position controlling mode.

Changing modes of operation takes place via the

CANopen object 6060h-modes of operation

This changeover is possible in status ”Operation Released” (motor energized).

The actual mode of operation is displayed in the CANopen object 6061h-modes of operation display.

These modes of operation are available in the preset solution "PCC_1 (12)“

6.1.1 Control word DS402

Object 6040h-CONTROLWORD

The object is also represented in parameter 573-H6040.
The CONTROLWORD contains bits for:

- the controlling of the state,
- the controlling of operating modes and
- manufacturer specific options.

The bits of the control word are defined as follows:

15 11	10 9	8	7	6 4	3	2	1	0
manufacturer specific	reserved	halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on
0	0	0	M	0	M	M	M	M

MSB LSB

Optional M - Mandatory

Table 6.1 Control word DS402

6.1.2 Status word bits

Bits 0 - 3 and 7:

DEVICE CONTROL COMMANDS are triggered in the CONTROLWORD by the following schematic:

Command	Bit of the controlword					Transitions
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3*
Switch on	0	1	1	1	1	3**
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	↑	X	X	X	X	15

bits marked X are irrelevant, * ... In the state SWITCHED ON the drive executes the functionality of this state., ** ... It exists no functionality in the state SWITCHED ON. The drive does not do any in this state.

Table 6.2 Device control commands

6.1.3 Mode specific bits

Depending on the active mode of operation (object "modes of operation display") the bits 4 – 6 are interpreted in different ways.

Bit	Operation mode		
	Profile position mode	Profile velocity mode	Homing mode
4	New set-point	reserved	Homing operation start
5	Change set immediately	reserved	reserved
6	abs/reel	reserved	reserved
8	Halt	Halt	Halt

Table 6.3 Mode specific bits in the controlword

The use of specific bits is explained in more detail in the chapters on modes of operation.

6.2 Status word DS402

Object 6041h-STATUSWORD

The content of the object is also represented in parameter 572-H6041.

The STATUSWORD shows the actual status of the drive. Bits are not locked. The STATUSWORD contains the following bits for:

- current state of the device,
- operating state of the mode and
- manufacturer specific options.

6.2.1 Status word bits

Bit	Description	M /O
0	Ready to switch on	M
1	Switched on	M
2	Operation enabled	M
3	Fault	M
4	Voltage enabled	M
5	Quick stop	M
6	Switch on disabled	M
7	Warning	O
8	Manufacturer specific	O
9	Remote	M
10	Target reached	M
11	Internal limit active	M
12 - 13	Operation mode specific	O
14 - 15	Manufacturer specific	O

Table 6.4 Bits in the status word

BITS 0 – 3, 5 AND 6:

These BITS show the STATUS of the controller:

BIT 4: VOLTAGE ENABLED

Power supply applied.

BIT 5: QUICK STOP

In status LOW this bit indicates that the controller is executing a QUICK-STOP. Bits 0, 1 and 2 of the STATUSWORD are set to 1 when the drive is ready for operation. The other bits indicate further states of the drive, such as e.g. execution of a Quick-Stop. In case of an error the FAULT bit is set.

BIT 7: WARNING

Warnings, such as temperature limits, are shown in bit 7. In case of warnings the device status does not change. More detailed information concerning the actual warning can be found in the FAULT CODE.

BIT 8:

Manufacturer specific, presently not used.

BIT 9: REMOTE

Presently not used.

BIT 10: TARGET REACHED

The bit is automatically set when a setpoint (SETPOINT) is reached. The setpoint depends on the OPERATING MODE. Further information in chapter 6. Changing the setpoint by the Master changes this bit.

In case of QUICK STOP OPTION CODE 5, 6, 7 or 8 this bit is set after termination of the QUICK STOP.

In case of a HALT request this bit is also set at standstill.

BIT 11: INTERNAL LIMIT ACTIVE

This bit is set when internal limits are reached. This bit is OPERATION MODE dependent - see chapter 6.

BIT 12 AND 13:

6.2.2 Mode specific bits

These bits are OPERATION MODE dependent - see chapter 6.

The following table provides an overview:

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

Table 6.5 Profile velocity mode bits of the status word

6.3 Profile Velocity mode

This mode of operation (Mode of Operation = 3) serves the control of the device with a speed setpoint acc. to the profile DS402. The internal control mode thereby remains at position control.

The units for setpoints and ramp values result from the settings in factor group. See also chapter 5.4 "Units and Standardizations".

Note: This operating mode is available with preset solutions PCC_1 (12).

The device supports the following objects for this mode of operation

Object No.	Object Name	Object Code	Type	Representation in device parameters
0x606C	Velocity actual value	VAR	Int32	656-H6044
0x60FF	Target velocity	VAR	Int32	639-H60FF
0x6094	Velocity encoder factor	VAR	Int32	791-FGVEF
0x6083	Profile acceleration	VAR	Int32	722-POACC
0x6084	Profile acceleration	VAR	Int32	723-PODEC
0x6085	Quick stop deceleration	VAR	Int32Q16	592-STOPR
0x6086	Motion profile type	VAR	Int16	597-MPTYP
0x607E	Polarity (not active)	-	-	-

Table 6.6 Velocity mode

The following structure serves as basis for this mode of operation:

6.3.1 Operation dependent bits in the control word

Name	Value	Description
Halt	0	Execute the motion
	1	Stop axle

Table 6.7 Profile velocity mode bits of the controlword

6.3.2 Operation dependent bits in the status word

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

Table 6.8 Profile velocity mode bits of the status word

6.4 Homing mode

This mode of operation (mode of operation = 6) serves for the referencing of a position controlled axis. The drive thereby performs a movement according to the programmed referencing type (homing method).

The various referencing types differentiate between the inclusion of hardware limit switches, reference cams and zero pulses of the transducer system. It is thereby to be considered that, in case of limit switch and zero pulse functionality, corresponding digital inputs must be parameterized to serve this function:

Limit switch function
/LCW – right HW-limit switch
/LCCW – left HW-limit switch
HOMSW - reference cam

Note: Preset solution PCC_1 (12) is activated.

The following objects are supported by the device for this mode of operation:

Object No.	Object Name	Object Code	Type	Attr.	Representation in device parameters
0x607C	Home_Offset	VAR	Integer32	Rw	729-HOOFF
0x6098	Homing_Method	VAR	Integer8	Rw	730-HOMTD
0x6099	Homing_Speeds	ARRAY	Unsigned32	-	727-HOSPD
0x609A	Homing_Acceleration	VAR	Unsigned32	Rw	728-HOACC

Table 6.9 Homing mode

The following control structure serves as basis for the function:

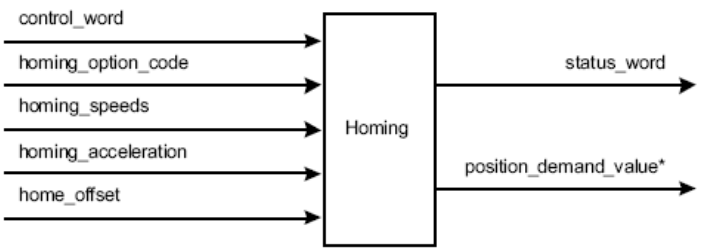


Fig. 6.1 Homing function

CDB/E/F supports all 35 homing methods defined in DS402.

Additional manufacturer specific methods:

The individual referencing types are described in the user manual for the device with respect to their function and movement sequence.

Home Offset:

The object HOME OFFSET is the difference between position 0 of the application and the HOME POSITION found by referencing and is represented in position units. At the end of referencing the HOME OFFSET is added to the actually detected HOME POSITION. All following absolute positions always refer to this new zero position.

In the DriveManager user interface the default reference travel can be set in the following mask. In the masks the movement sequences are graphically displayed for selection of the correct type.

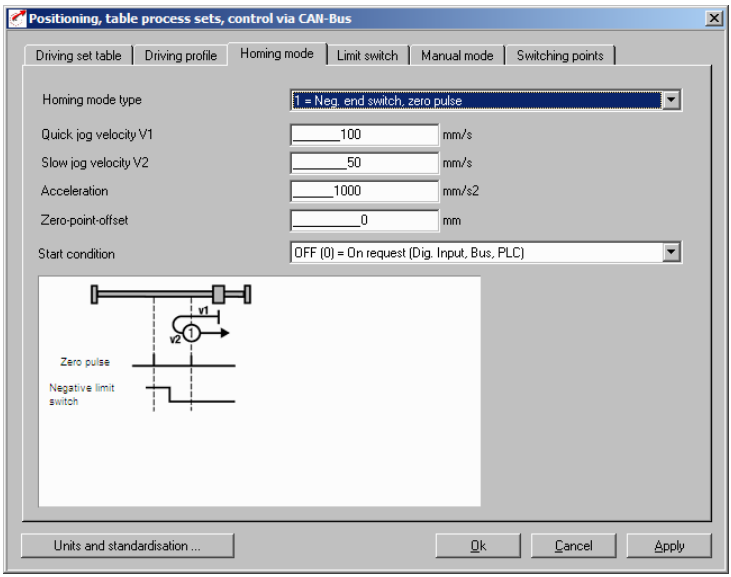


Fig. 6.2 Homing Method

6.4.1 Status word bits

Bit 4 – HOMING OPERATION START
Bit 8 - HALT

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

Table 6.10 Homing mode bits of the controlword

6.4.2 Status word bits

Bit 10 – TARGET REACHED
Bit 12 – HOMING ATTAINED
Bit 13 - HOMING ERROR

Name	Value	Description
Target reached	0	Halt = 0: Home position not reached Halt = 1: Axle decelerates
	1	Halt = 0: Home position reached Halt = 1: Axle has velocity 0
Homing attained	0	Homing mode not yet completed
	1	Homing mode carried out successfully
Homing error	0	No homing error
	1	Homing error occurred; Homing mode carried out not successfully; The error cause is found by reading the error code

Table 6.11 Homing mode bits of the status word

6.5 Profile position mode

In this mode of operation (Mode of Operation =1) the axis performs relative or absolute individual positioning movements. Preset solution PCC_1 (12) is to be selected.

Object No.	Object Name	Object Code	Type	
0x607A	Target_Position	VAR	Integer32	rw
0x607d	Software Position Limit	ARRAY	Integer32	rw
0x6081	Profile_Velocity	VAR	Unsigned32	rw
0x6083	Profile_Acceleration	VAR	Unsigned32	rw
0x6084	Profile_Deceleration	VAR	Unsigned32	rw
0x6085	Quick stop deceleration	VAR	Unsigned32	rw
0x6086	Motion_Profile_Type 0 linear ramp (trapezoidal profile) 3 jerk limited (time is set in the manufacturer specific parameter 596-JTIME)	VAR	Integer16	rw
0x60C5	Max acceleration (not implemented)			
0x60C6	Max. deceleration (not implemented)			

Table 6.12 Profile position mode

Parameter units are set via the standardization assistant or the objects from the Factor Group.

Software limit switch support:

If the target is beyond the range of the SW limit switch the travel command will not be processed. Bit 11 (limits) is in this case set in the status word, but not "Fault" state.

An information concerning the sense of rotation is additionally submitted via two manufacturer specific bits in object 60FD - input image (bit 16 - negative, 17 - positive).

Structure of mode of operation:

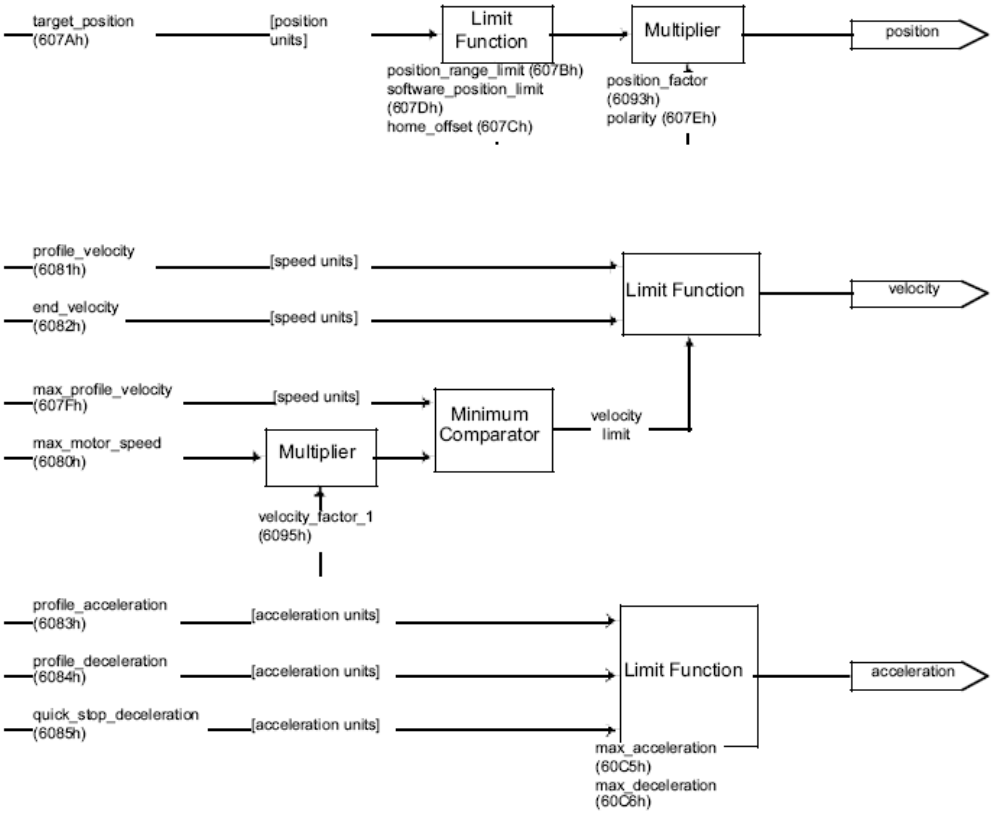


Fig. 6.3 Structure

Operation specific bits in CONTROLWORD:

Name	Value	Description
New set-point	0	Does not assume *target position*
	1	Assume *target position*
Change set immediately	0	Finish the actual positioning and then start the next positioning
	1	Interrupt the actual positioning and start the next positioning
abs / rel	0	*Target position* is an absolute value
	1	*Target position* is a relative value
Halt	0	Execute positioning
	1	Stop axle with *profile deceleration* (if not supported with *profile acceleration*)

Table 6.13 Profile velocity mode bits of the controlword

Operation specific bits in STATUSWORD:

Name	Value	Description
Target reached	0	Halt = 0: *Target position* not reached Halt = 1: Axle decelerates
	1	Halt = 0: *Target position* reached Halt = 1: Velocity of axle is 0
Set-point acknowledge	0	Trajectory generator has not assumed the positioning values (yet)
	1	Trajectory generator has assumed the positioning values
Following error	0	No following error
	1	Following error

Table 6.14 Profile velocity mode bits of the status word

6.5.1 Functional description

In this OPERATION MODE two different possibilities of specifying a target are supported

SET OF SET-POINTS:

After the setpoint position has been reached the drive immediately approaches the next target position, the axis does not stop at all when reaching the first target.

SINGLE SET-POINT:

The drive indicates to the Master when the target position is reached. The drive then receives a new setpoint. The drive stops at each setpoint position, before it continues to the next target position.

These two possibilities are controlled by means of the timing of bits NEW SET-POINT and CHANGE SET IMMEDIATELY in CONTROLWORD and the bit SET-POINT ACKNOWLEDGE in STATUSWORD. These bits enable triggering the following already while positioning is in progress. T

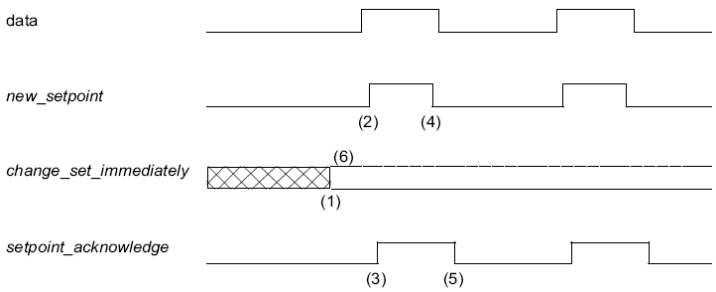


Fig. 6.4 Set-point transmission from a host computer

If bit ‘CHANGE SET IMMEDIATELY’ = "0" (full line Fig. 6.4), a SINGLE SET-POINT is expected from the drive (1).

Once the setpoint has been transmitted to the drive the Master activates the positioning by setting the bit ‘new set-point’ in CONTROLWORD (2). After recognizing and saving the new data the drive responds by setting the bit ‘set-point acknowledge' in STATUSWORD (3). Now the Master can delete the bit ‘new set-point’ (4). After this the drive signalizes that a new setpoint is accepted by deleting the bit ‘set-point acknowledge’ (5). In Fig. 6.5 the mechanism triggers a speed "0", after reaching the target position within time t1. The next target position to be reached within time t2 can be triggered after the message that the target position has been reached.

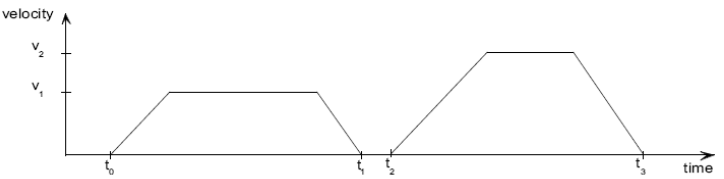


Fig. 6.5 Single set-point

If the bit ‘CHANGE SET IMMEDIATELY’ is set to "1" (dashed line in Fig. 6.4), the new target position is immediately accepted. In Fig. 6.6 the drive receives the 1st target position at time t0. At time t1 the drive receives the 2nd target position. The drive immediately continues its movement to the 2nd target position.

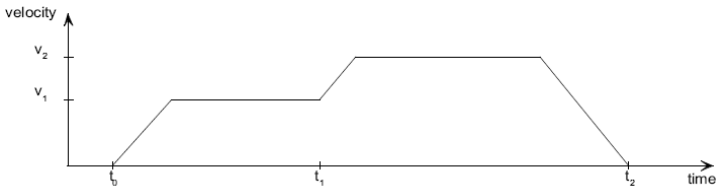


Fig. 6.6 Change set immediately

6.6 Table supported positioning (manufacturer specific)

Mode of operation –1 EasyDrive TablePos is planned for CDE3000/ CDB3000 mode of operation "PCC_2 = positioning, tables for travel sets and control via CANBus".

For the preset solutions PCT_2, PCC_2 and PCB_2 the travel set table is preset as setpoint source.

6.6.1 Table of travel sets

There are 16 travel sets (0-15). A travel set consists of:

1. Target position
2. Mode for absolute/relative/endless positioning
3. Speed
4. Start-up acceleration
5. Braking acceleration
6. Sequential order with parameterizable operation
7. Travel set dependent switching points, see chapter 5.3.2

A slip time in ms programmed in the travel profile serves as jerk limitation. It applies for all travel sets. The travel sets can only adjusted via the PC-interface DRIVEMANAGER or the field bus.

Note: The travel sets have the predefined standard units. Before parameterizing the travel sets you must therefore first set the units and the standardization, see chapter 5.4.

6.6.2 Travel set selection

Travel sets can be selected and activated via field bus. The number of the active travel set is indicated by a parameter, and, binary coded, via the outputs (if parameterized).

The binary valence (2_0, 2_1 , 2_2 , 2_3) results from the TABx-assignment. The setting TAB0 thereby has the lowest (2_0), the setting TAB3 the highest valence (2_3). A logic-1-level at the input activates the valence.

A separate release signal via field bus (trigger) is required to activate a travel set via terminal. A new travel command always interrupts an ongoing positioning.

The following parameters are used to select or display the active travel set:

278-TIDX (_RTAB) **Value range 0 - 15**	Travel set selection. Selection via inputs is described in this parameter.
776-ATIDX (_RTAB) **Value range 0 - 15**	Display parameter Shows the actually processed travel set.

With the HALT-Logic (/STOP) (terminal or bus) a progressing positioning can be interrupted either with the programmed or the quick stop ramp and subsequently continued again.

For further information concerning the function of the travel set table, especially the linking of travel sets, please refer to the user manual.

6.6.3 Utilization of preset mapping for RXPD01 and TXPD01:

657-R1SEL

= 21: Default setting Mapping RxPdo1 for positioning table
i. e. 1.MappedObject = 6040h (Parameter number:573)
CONTROLWORD
2.MappedObject = 223Eh (Parameter number:574)
Extended CONTROLWORD

Number of Objects = 2

= 23: Setting Mapping RxPdo1 is taken from parameter 585 RXMP1 and 587 RXPC1

all other PDOs have no preset mapping

658-T1SEL

= 21: Default setting Mapping TxPdo1 for positioning table

i. e. 1.MappedObject = 6041h (Parameter number:572)
STATUSWORD

2.MappedObject = 223Fh (Parameter number:575)
Extended STATUSWORD

3.MappedObject = 6064h (Parameter number:660)
Actual position value

Number of Objects = 3

= 23: Setting Mapping RxPdo1 is taken from parameter 584 TXMP1 and 586 TXPC1

All other PDOs have no preset mapping

6.6.4 RxPD01 EasyDrive-Table Pos

RXPDO1 DEFAULTMAPPING

The default mapping contains the following objects
6040h – CONTROLWORD
223Eh – extended control word

The device interprets the bits of both control words as follows:

Positioning, freely programmable PROGPOS	**Modes of operation –1**				
Control word 6040h	**Extended control word**	-	-	-	-
Bit function					
0 START control	0 1=Referencing start				
1 -	1 Positioning start				
2 /STOP	2 execute successive order				
3 E-EXT	3 1=Halt				
4 -	4 -				
5 -	5 -				
6 -	6 Tip +				
7 ERES	7 Tip -				
8 -	0 TAB 0 (fixed position 2^0)				
9 -	1 TAB 1 (fixed position 2^1)				
10 -	2 TAB 2 (fixed position 2^2)				
11 -	3 TAB 3 (fixed position 2^3)				
12 -	4				
13 OSD02	5 -				
14 OSD01	6 -				
15 OSD00	7 -				

Table 6.15 Easy-Drive control PDO

Functions of bits:

START Software control release, function only with hardware release and possibly reset "safety stop"
State 1 starts the output stage of the device. State 0 stops the drive according to the setting chosen in "SHUT DOWN OPTION CODE" and switches off the output stage.

/STOP Quick stop function, Low-active drive is braked to standstill according to the setting in "QUICK STOP OPTION CODE" and stops at speed 0 in a speed controlled manner. The controller release must be deactivated in order to leave this state (output stage off!).

E-EXT Triggering of error message E-EXT with the corresponding error reaction

E-RES Resetting of existing error message

OSDxx Direct setting and resetting of digital outputs on the device, only if function selectors are assigned to the outputs on the CAN bus. Example.: 240-FOS00= CAN

Start referencing State 1 starts parameterized referencing sequence according to homing type. State 0 quits progressing referencing

Start positioning High-flank starts selected travel set

Execute successive order High flank starts the successive order determined in the table of travel sets to the progressing travel set

Halt Halt function, 1 - interrupts the progressing travel set. 0 – continues travel set

Tipp x Step operation with parameterized manual operating speeds

Tabx Binary selection of travel set to be executed

6.6.5 TXPD01 EasyDrive-Table Pos

TXPDO1 Default mapping

The default mapping contains the following objects
6041h – STATUSWORD
223Eh – extended STATUSWORD
60xxh – Actual position in distance units

Positioning, freely programmable PROGPOS	modes of operation -1				
Status word	**Extended status word**				
0 ERROR	0 Reference point defined	Act Pos LW LB	Act Pos LW HB	Act Pos HW LB	Act Pos HW HB
1 -	1 -				
2 setpoint reached	2 travel command is executed				
3 limit value	3 target position reached				
4 output stage active	4 target position accepted				

Table 6.16 TXPD01 Easy-Drive

Positioning, freely programmable PROGPOS	modes of operation -1				
Status word	**Extended status word**				
5 speed 0	5 limit switch left				
6 quick stop	6 limit switch right				
7 control ready	7 servo lag				
8 ENPO	8 current table index PTAB0 (0...16)				
9 OSD00	9 PTAB1				
10 OSD01	10 PTAB2				
11 OSD02	11 PTAB3				
12 ISD03	12				
13 ISD02	13-				
14 ISD01	14-				
15 ISD00	15-				

Table 6.16 TXPD01 Easy-Drive

Functions of bits:

ERROR general device error

Setpoint reached Actual position inside parameterized position window

Limit value Speed and torque limitation active

Output stage active Motor energized

Speed 0 Actual speed in parameterized standstill window (axis stopped)

Quick stop Quick stop state active, to leave set quick stop bit and re-enter the controller release

Controller ready Device at standby without fault

ENPO State of hardware release terminal ENPO

OSDxx State of the corresponding digital output

ISDxx State of the corresponding digital input

Reference point defined Referencing completed correctly

Travel command is being executed A movement is currently being performed on the basis of a started travel command

Target position reached The target position for the started travel set has been reached

Target position accepted The target position of a new travel set was accepted

Limit switch left/right Parameterized limit switches were approached, reset error messages and move in opposite direction

Servo lag Servo distance bigger that parameterized servo distance window

PTABx current travel set(binary)

6.6.6 Control example

In the example the predefined mapping for the mode of operation is used. The status PDO is transmitted by the device in an event controlled manner. In the device the event control is triggered by means of the following settings:

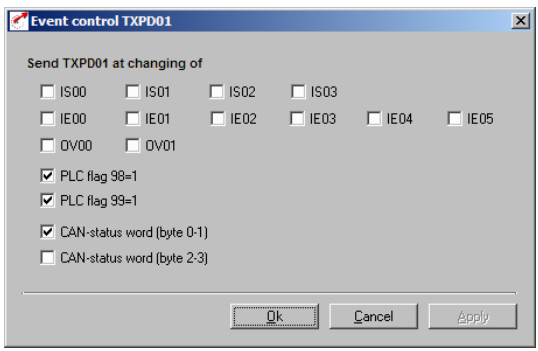


Fig. 6.7 Event control TXPD01

Time	Dir	ID		DLC	Data
[+] 9.406800	Tx	00	2	01 00	Go operational
| 9.415470	Rx	182	8	20 0d 00 00 00 00 00 00	Status
| 36.080610	Tx	202	8	04 00 00 00 00 00 00 00	Leave quick stop
| 37.953460	Tx	202	8	05 00 00 00 00 00 00 00	Controller release
| 38.058760	Rx	182	8	30 0d 00 00 00 00 00 00	
| 38.187860	Rx	182	8	b0 0d 00 00 00 00 00 00	
| 38.189850	Rx	182	8	b4 0f 08 00 00 00 00 00	Control active
| 51.827390	Tx	202	8	05 00 01 00 00 00 00 00	Start referencing
| 51.828570	Rx	182	8	b0 0d 00 00 00 00 00 00	
| 51.897470	Rx	182	8	90 09 00 00 00 00 00 00	
| 56.456770	Rx	182	8	90 09 01 00 00 00 00 00	
| 56.457680	Rx	182	8	94 0b 09 00 00 00 00 00	
| 56.707690	Rx	182	8	b4 0f 09 00 00 00 00 00	Quit referencing
| 68.321440	Tx	202	8	05 00 02 00 00 00 00 00	Start travel set 0
| 68.323330	Rx	182	8	b0 0d 15 00 00 00 00 00	
| 68.388230	Rx	182	8	90 09 15 00 00 00 00 00	
| 69.695280	Rx	182	8	94 0b 1d 00 5a 00 00 00	
| 69.968290	Rx	182	8	b4 0f 1d 00 5a 00 00 00	Position reached
| 72.125130	Tx	202	8	05 00 00 01 00 00 00 00	Select travel set 1
| 75.448460	Tx	202	8	05 00 02 01 00 00 00 00	Start travel set 1
| 75.450650	Rx	182	8	b0 0d 15 01 5a 00 00 00	
| 75.518550	Rx	182	8	90 09 15 01 5a 00 00 00	
| 76.707600	Rx	182	8	94 0b 1d 01 67 01 00 00	
| 77.048610	Rx	182	8	b4 0f 19 01 67 01 00 00	Position reached

6.7 Speed regulation (manufacturer specific)

The mode of operation "EasyDrive Basic" serves the purpose to operate the device in a purely speed controlled mode. A high-resolution rotary speed value can be transmitted in RXPDO1.

The mode of operation must be set to -2- EasyDrive Basic.

There is no referencing type available. The unit is fixed to min^{-1}

657-R1SEL

= 22: Default setting Mapping RxPdo1 for speed control

i. e. 1.MappedObject = 6040h (Parameter number:573)
Controlword
2.MappedObject = 2271h (Parameter number:625)
Speed setpoint

Number of Objects = 2

= 23: Setting Mapping RxPdo1 is taken from parameter 585 RXMP1 and 587 RXPC1. All other PDOs have no preset mapping

658-T1SEL

= 22: Default setting Mapping TxPdo1 for speed control

i. e. 1.MappedObject = 6041h (Parameter number:572)
STATUSWORD

2.MappedObject = 2272h (Parameter number:626)
Actual speed value

= 23: Setting Mapping RxPdo1 is taken from parameter 584 TXMP1 and 586 TXPC1 All other PDOs have no preset mapping

6.7.1 Control word EasyDrive Basic

The control word does not work according to a terminal copy A handshake is possible via the control by interpretation of the device status on grounds of the status word.

RXPD01	Mapping fix							
1			2		3		4	
HB	LB		HB	LB	HB	LB	HB	LB
Bit Nr.			Bit Nr.		Bit Nr.		Bit Nr.	
0	1 = Start, if ENPO is set		Setpoint HWHB	Setpoint HWLB	Setpoint LWHB	Setpoint LWLB		
1	--							
2	0 = Activate quick stop							
3	1 = Release external error of device							
4	--							
5	--							
6	--							
7	0 -> 1 = Reset actual error of the device							
8	Bit 0	Binary selection of table reference at parameter RSSL1 = (7) RTAB						
9	Bit 1							
10	Bit 2							
11	Bit 3							
12	--							
13	1 = Output OSD02 is activ, at Parameter FOS02 = OPTN							
14	1 = Output OSD01 is activ, at Parameter FOS01 = OPTN							
15	1 = Output OSD00 is activ, at Parameter FOS00 = OPTN							

Tabelle 6.17 RxPDO1 Easy-Drive

Bits 8 to 11 are only active in pre-set solution SCC_2 (4) = speed control, fixed number of revolutions, control via CAN-Bus" to select fixed number of revolutions in binary code. In this pre-set solution no direct speed reference can be transmitted.

Functions of bits:

START Software controller release, function only available with existing hardware release and possibly reset "Safety Stop" Status 1 starts the output stage of the device. State 0 stops the drive according to the setting chosen in "SHUT DOWN OPTION CODE" and switches off the output stage.

INV 1 – inverts the sign of the rotary speed setpoint

/STOP Quick stop function, Low-active drive is braked to standstill according to the setting in "QUICK STOP OPTION CODE" and stops at speed 0 in a speed controlled manner. The controller release must be deactivated in order to leave this state (output stage off!).

E-EXT Triggering of error message E-EXT with the corresponding error reaction

E-RES Resetting of existing error message

OSDxx Direct setting and resetting of digital outputs on the device, only if function selectors are assigned to the outputs on the CAN bus. Example.: 240-FOS00= CAN

The rotary speed setpoint is transferred as file type INT32Q16.

6.7.2 Status EasyDriveBasic

PDZ							
1		2		3		4	
HB	LB	HB	LB	HB			
Bit		Bit No.		Bit No.		Bit No.	
0	1 = general error	Actual value HWHB	Actual value HWLB	Actual value LWHB	Actual value LWLB		
1	Always 0						
2	1 = Setpoint reached (speed)						
3	1 = Setpoint limit is reached (limit for speed controller)						
4	1 = output stage active						
5	1 = speed 0						
6	1 = quick stop is active						
7	1 = ready for operation and controller initialized						
8	State of input ENPO (hardware release)						
9	State of output OSD00						
10	State of output OSD01						
11	State of output OSD02						
12	State of input ISD03						

Table 6.18 TxPDO1 Easy-Drive Basic

PDZ							
1		2		3		4	
HB	LB	HB	LB	HB			
Bit		Bit No.		Bit No.		Bit No.	
13	State of input ISD02						
14	State of input ISD01						
15	State of input ISD00						

Table 6.18 TxPDO1 Easy-Drive Basic

Functions of bits:

ERROR general device error

Setpoint reached Actual position inside parameterized position window

Limit value Speed and torque limitation active

Output stage active Motor energized

Speed 0 Actual speed in parameterized standstill window (axis stopped)

Quick stop Quick stop state active, to leave set quick stop bit and re-enter the controller release

Controller ready Device at standby without fault

ENPO State of hardware release terminal ENPO

OSDxx State of the corresponding digital output

ISDxx State of the corresponding digital input

The actual rotary speed is transferred as file type INT32Q16.

6.7.3 Control example

This example uses the mode of operation "EasyDrive Basic". The preset mapping R1SEL=22 is activated. The TXPDO1 is transmitted in an event controlled manner.

Settings for event control:

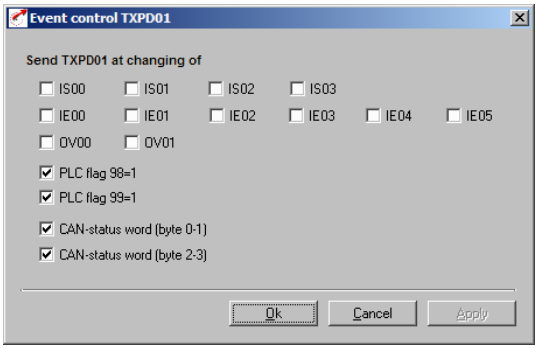


Fig. 6.8 Settings for event control

Time	Dir	ID		DLC	Data
[+] 5.549160	Tx	00	2	01 00	Go operational
| 5.556440	Rx	182	8	24 0f 00 00 00 00 00 00	Status
| 6.756500	Tx	202	8	04 00 00 00 00 00 00 00	Leave quick stop
| 7.756840	Tx	202	8	05 00 00 00 00 00 00 00	Controller release
| 7.758550	Rx	182	8	34 0f 00 00 00 00 00 00	
| 7.887610	Rx	182	8	b4 0f 00 00 00 00 00 00	Release controller
| 10.873060	Tx	202	8	05 00 00 00 65 00 00 00	Setpoint 100UpM
| 10.873780	Rx	182	8	b0 0d 00 00 00 00 00 00	
| 10.917760	Rx	182	8	90 09 6b 54 2b 00 00 00	Setpoint reached
| 11.227770	Rx	182	8	94 0b 56 23 66 00 00 00	
| 27.103600	Tx	202	8	05 00 00 00 c8 00 00 00	Setpoint 200UpM
| 27.104520	Rx	182	8	90 09 27 41 64 00 00 00	
| 27.468530	Rx	182	8	94 0b 48 b2 c8 00 00 00	Setpoint reached
| 35.388660	Tx	202	8	04 00 00 00 00 00 00 00	Stop controller
| 35.389920	Rx	182	8	00 09 fa 07 c9 00 00 00	
| 35.928860	Rx	182	8	24 0f 00 00 00 00 00 00	Drive stopped

6.8 Control via PLC-sequence control

Modes of Operation –3: EasyDrive ProgPos

For mode of operation CDE3000/CDB3000

- ”PCC_3 = Positioning, travel set specification via PLC, control via CAN-Bus” or
- "SCC_4 = speed regulation, setpoint via PLC, control via CAN-bus"

the MODE OF OPERATION –3 EasyDrive ProgPos is intended. In this mode of operation a PLC sequence program must be saved in the CDE3000/CDB3000, to be able to specify the position and speed setpoints. Further details see "User Manual

CDE3000/CDB3000”

The bus system is used to start and stop the PLC sequence program of the controller and to set flags or variables for the PLC.

The position setpoint is specified by means of the positioning commands example ”GO A H001 VH002” from the sequence program.

6.8.1 Utilization of preset mappings for RXPDO1 and TXPDO1:

657-R1SEL

= 25: Default setting Mapping RxPdo1 for positioning table

i. e. 1.MappedObject = 6040h (Parameter number:573)
CONTROLWORD

2.MappedObject = 223Eh (Parameter number:574)
Extended CONTROLWORD

3.MappedObject = 21CCh (parameter number 460,index98)
PLC-Variable H098

Number of Objects = 3

= 23: Setting Mapping RxPdo1 is taken from parameter 585 RXMP1 and 587 RXPC1

all other PDOs have no preset mapping

658-T1SEL

= 25: Default setting Mapping TxPdo1 for positioning table

i. e. 1.MappedObject = 6041h (Parameter number:572)
STATUSWORD

2.MappedObject = 223Fh (Parameter number:575)
Extended STATUSWORD

3.MappedObject = 6064h (Parameter number:660)
Actual position value

Number of objects = 3

= 23: Setting Mapping RxPdo1 is taken from parameter 584 TXMP1 and 586 TXPC1

all other PDOs have no preset mapping

RXPD01 DEFAULTMAPPING

The default mapping contains the following objects
6040h – CONTROLWORD
223Eh – extended control word
21CCh – PLC Integer variable H098

Positioning, freely programmable PROGPOS	**Modes of operation -3**				
Control-word 6040h	**Extended control word**				
Bit function	**Bit function**				
0 START control	0 1=Referencing start	PLC_H[98] LW LB	PLC_H[98] LW HB	PLC_H[98] HW LB	PLC_H[98] HW HB
1 -	1 PLC program sequence start/stop *)				
2 /STOP	2 -				
3 E-EXT	3 1=Halt, interrupt movement				
4 -	4 -				
5 -	5 -				
6 -	6 Tip +				
7 ERES	7 Tip -				
8 -	8 729[91] – PLC_M [90]				
9 -	9 729[91] - PLC_M [91]				
10 -	10 729[91] - PLC_M [92]				
11 -	11 729[91] - PLC_M [93]				
12 -	12 729[91] - PLC_M [94]				
13 OSD02	13 729[91] - PLC_M [95]				
14 OSD01	14 729[91] - PLC_M [96]				
15 OSD00	15 729[91] - PLC_M [97]				
*) depending on the set start conditions of the sequence program. Bit is only effective with setting "Bus ... " PCC_3(19) positioning, travel set specification via PLC, control via CAN-bus					

Table 6.19 RXPD01 Default mapping

Functions of bits:

START Software control release, function only with hardware release and possibly reset "safety stop" State 1 starts the output stage of the device. State 0 stops the drive according to the setting chosen in "SHUT DOWN OPTION CODE" and switches off the output stage.

/STOP Quick stop function, Low-active drive is braked to standstill according to the setting in ”QUICK STOP OPTION CODE“ and stops at speed 0 in a speed controlled manner. The controller release must be deactivated in order to leave this state (output stage off!).

E-EXT Triggering of error message E-EXT with the corresponding error reaction

E-RES Resetting of existing error message

OSDxx Direct setting and resetting of digital outputs on the device, only if function selectors are assigned to the outputs on the CAN bus. Example.: 240-FOS00= CAN

Start referencing State 1 starts parameterized referencing sequence according to homing type. State 0 quits progressing referencing

Start/stop program sequence State 1 starts PLC sequence program, state 0 quits progressing sequence program

Halt Halt function, 1 - interrupts the progressing positioning. 0 – continues positioning

Tipp x Step operation with parameterized manual operating speeds

PLC_Mxx specifies the states of the PLC flags M090 to M097.

TXPDO1 Default mapping

The default mapping contains the following objects
6041h – Statusword
223Eh – extended status word
60xxh – Actual position in distance units

Positioning, freely programmable PROGPOS	Modes of operation -3				
Status word 6041h	**Extended status word**				
0 ERROR	0 1=Reference point defined	Act Pos LW LB	Act Pos LW HB	Act Pos HW LB	Act Pos HW HB
1	1 1=PLC program sequence active				
2 setpoint reached (position)	2 -				

Table 6.20 TXPD01 Default mapping

Positioning, freely programmable PROGPOS	Modes of operation -3				
Status word 6041h	**Extended status word**				
3 limit value	3 -				
4 output stage active	4 -				
5 speed 0	5 limit switch left				
6 quick stop	6 limit switch right				
7 control ready	7 servo lag				
8 ENPO	8 729[81] – PLC_M [80]				
9 OSD00	9 729[82] - PLC_M [81]				
10 OSD01	10 729[83] - PLC_M [82]				
11 OSD02	11 729[84] - PLC_M [83]				
12 ISD03	12 729[85] - PLC_M [84]				
13 ISD02	13 729[86] - PLC_M [85]				
14 ISD01	14 729[87] - PLC_M [86]				
15 ISD00	15 729[88] - PLC_M [87]				

Table 6.20 TXPD01 Default mapping

Functions of bits:

ERROR general device error

Setpoint reached Actual position inside parameterized position window

Limit value Speed and torque limitation active

Output stage active Motor energized

Speed 0 Actual speed in parameterized standstill window (axis stopped)

Quick stop Quick stop state active, to leave set quick stop bit and re-enter the controller release

Controller ready Device at standby without fault

ENPO State of hardware release terminal ENPO

OSDxx State of the corresponding digital output

ISDxx State of the corresponding digital input

Reference point defined Referencing completed correctly

PLC sequence program active Sequence program being processed

Limit switch left/right Parameterized limit switches were approached, reset error messages and move in opposite direction

Servo lag Servo distance bigger that parameterized servo distance window

PLC_Mxx States of PLC flags M080 to M087

6.8.2 Control example

In this example the predefined mapping R1SEL=25 for mode of operation 3- Easydrive ProgPos is used. The transmission mode of TXPDO1 is set to asynchronous (FEhex). The event control is parameterized as follows:

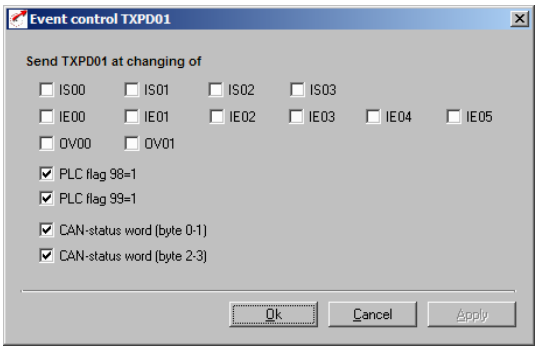


Fig. 6.9 Triggering example

Time	Dir	ID	DLC	Data
[+] 2.081170	Tx	002	01 00	Go operational
| 2.091780	Rx	182	8 24 0f 01 00 00 00 00 00	Status
| 4.046600	Tx	202	8 04 00 00 00 00 00 00 00	Leave quick stop
| 4.744210	Tx	202	8 05 00 00 00 00 00 00 00	Controller release
| 4.745910	Rx	182	8 34 0f 01 00 00 00 00 00	
| 4.875000	Rx	182	8 b0 0d 01 00 00 00 00 00	
| 4.876980	Rx	182	8 b4 0f 01 00 00 00 00 00	Controller released
| 7.482410	Tx	202	8 05 00 01 00 00 00 00 00	Start referencing
| 7.483230	Rx	182	8 b0 0d 00 00 00 00 00 00	
| 7.632120	Rx	182	8 90 09 00 00 05 00 00 00	
| 7.752120	Rx	182	8 b0 0d 00 00 08 00 00 00	
| 7.939130	Rx	182	8 b4 0f 00 00 00 00 00 00	
| 7.942160	Rx	182	8 90 09 01 00 ff ff ff ff	
| 7.952120	Rx	182	8 b0 0d 01 00 ff ff ff ff	
| 8.042120	Rx	182	8 b4 0f 01 00 ff ff ff ff	Quit referencing
| 18.205300	Tx	202	8 05 00 02 00 00 00 00 00	Start PLC sequence program*)
| 18.207600	Rx	182	8 b4 0f 03 00 00 00 00 00	PLC started

*) depending on the set start condition

6.8.3 LSS protocol

Execution of LSS-Slave implementation acc. to DS305 Version 1.1:

- LSS modes (Configuration-/Operation-Mode)
- Switch mode services
  Switch mode global
  Switch mode selective
- Configuration services
  Configure Node ID
  Configure bit timing parameters
  Activate bit timing parameters
  Store configured parameters
- Inquiry services
  Inquire LSS address
  Inquire Node ID
- Identification services
  LSS identify remote slaves
  LSS identify slave
  LSS identify non-configured remote slave
  LSS identify non-configured slave

6.9 I/O-representation, object 60FDH

Object 60FDh, digital inputs:

From device profile DS401 the object 60FDH is supported in order to realize a CANopen conform I/O-representation.

For the two analog inputs ISA0 and ISA1 of the devices two mappable manufacturer specific parameters (object 21A0 and 21A1) are made available. The standardization is directly in Volt.

Bit assignment of the object	Bit
di_negative_limit_switch	0
di_positive_limit_switch	1
di_home_switch	2
di_negative_sw_limit_switch	16
di_positive_sw_limit_switch	17
di_enable_save_hold_switch	18
di_enpo_state	19
di_save_hold_switch_state	20
di_state_led_yellow	21
di_state_led_red	22

Object 60FE, digital outputs:

When setting the manufacturer specific parameter "function selector for digital output" = CAN (13) the associated output can be influenced by this object.

Bit assignment of the object	Bit
OS00	16
OS01	17
OS02	18
OS03	25
OS04	26
OS05	27

7 EDS file, object directory

For the devices the is an EDS-File available for inclusion into the CAN-Master.

Excerpt from the EDS-File for the CDB3000, incl. object directory

```
[FileInfo]
FileVersion=0.1
FileRevision=0.1
Description=EDS for CDB 3000
CreationTime=09:00AM
CreationDate=19-01-04
CreatedBy=LUST Antriebstechnik GmbH
ModificationTime=08:38AM
FileName=cdb.eds

[OptionalObjects]
SupportedObjects=71
```

1=0x1003	2=0x1005	3=0x1006	4=0x1007	5=0x1008	6=0x1009	7=0x100A
8=0x100c	9=0x100d	10=0x1010	11=0x1011	12=0x1014	13=0x1015	14=0x1016
15=0x1017	16=0x1018	17=0x1400	18=0x1401	19=0x1402	20=0x1403	21=0x1600
22=0x1601	23=0x1602	24=0x1603	25=0x1800	26=0x1801	27=0x1802	28=0x1803

29=0x1a00	30=0x1a01	31=0x1a02	32=0x1a03	33=0x6040	34=0x6041	35=0x6044
36=0x605a	37=0x605b	38=0x605d	39=0x605e	40=0x6060	41=0x6061	42=0x6064
43=0x606c	44=0x607A	45=0x607c	46=0x607d	47=0x607E	48=0x6081	49=0x6083
50=0x6084	51=0x6085	52=0x6086	53=0x6089	54=0x608A	55=0x608B	56=0x608C
57=0x608D	58=0x608E	59=0x608F	60=0x6090	61=0x6091	62=0x6092	63=0x6093
64=0x6094	65=0x6097	66=0x6098	67=0x6099	68=0x609a	69=0x60fd	70=0x60fe
71=0x60ff						

7.1 Parameter list

For field bus applications it is very often desired to be able to configure the devices also via the field bus system.

The user interface DriveManager offers a tool to generate a parameter list for the active device.

This parameter list can be provided with a corresponding filter mask and printed out. The parameter values, which have been changed compared with the factory setting, can thereby be marked. With the filter options one should also select the information concerning the file type.

There is also another tool which enables parameter comparisons. Here one can compare the factory setting for the active unit with the actual settings. The result of this comparison is an extract of the actual parameter to be transmitted.

Appendix Glossary

CiA: User group of the CAN-Bus (CAN in Automation), generally defines a protocol for automation technology.

CAL: (CAN Application Layer) CiA protocol, mainly describes the way variables are transferred, but without defining their function and content.

Sub-quantities:

CMC: (CAN based Message Specification), represents the definitions described above, is accepted by most CAN-providers, LUST fulfils this definition.

NMT: (Network Management), required for Master in CAN-system, not implemented by LUST, because the drive controllers are always Slaves without "Control Function".

LMT: (Layer Management), see NMT

DBT: (Identifier Distributor), see NMT

CAN_{open}: based on CAL definition

corresponds with CiA Draft Standard 301

extends the CAL definition to the assignment of functions and units for predefined variables

This definition is elaborated by CiA and various user groups (MOTION for drive technology and I/O for Input/ Output Range) (e. g. Variable for torque in Nm).

Motion: User group under CiA for generation of a profile for the CANopen protocol for drive technology

I/O: User group under CiA for generation of a profile for the CANopen protocol for sensors and actors

General information on various protocol definitions

CAL: widely used in Europe

LUST currently has a protocol implemented, which can be addressed by a CAL-Master.

Compared with CAL (CCDA) the initialization has been simplified, e.g. addressing via jumpers which, however, has no effect on operation.

DeviceNet: mainly used in the USA (corresponds with the CAL definition)

SDS: has not gained popularity

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