GB

G2

CM-CAN2

User Manual

Communication Module for CAN_{open}

CDA3000/CDD3000/CTC3000 on CAN_{open} Field Bus Project Planning, Installation and Commissioning

LUST

LUST

Overview of documentation

Before purchase

Catalog

Selecting and ordering a drive system

With delivery (depending on supply package)

Operation Manual

Quick and easy initial commissioning

Operation Manual KeyPad KP200

Operation via KeyPad KP200

Application Manual

Adaptation of the drive system to the application

CAN_{Lust} Communication Module Manual

Project planning, installation and commissioning of the CDA3000/CDD3000/ CTC3000 on the field bus

CAN_{open} Communication Module Manual

Project planning, installation and commissioning of the CDA3000/CDD3000/ CTC3000 on the field bus

PROFIBUS-DP Communication Module Manual

Project planning, installation and commissioning of the CDA3000/CDD3000/ CTC3000 on the field bus

User Manual CM-CAN2

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Date: March 2003

Applicable as from software version V1.40 CDA3000

Applicable as from software version V1.10 CDD3000

Applicable as from software version V130.20 CTC3000

Subject to technical changes.

Dear User,

This manual is intended for you as a **project engineer, commissioning engineer or programmer** of drive and automation solutions on the CAN_{open} field bus. It is assumed that you are already familiar with this field bus on the basis of appropriate training and reading of the relevant literature.

We assume that your drive is already in operation – if not, you should first consult the Operation Manual.

Note: This manual applies to the CDA3000 inverter system, the CDD3000 servo system and the CTC3000 direct drive system. The bus interfaces of the CDD3000 and the CTC3000 are identical, so in the following you will see only the abbreviations CDA and CDD used.

How to use this manual

Pictograms

→ **Attention!** Misoperation may result in damage to the drive or malfunctions.

→ **Danger from electrical tension!** Improper behaviour may endanger human life.

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

→ **Note:** Useful information

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5 Control and reference input

1 General introduction

The term **"master"** as used in the following designates a higher-order controller which organizes the bus system.

The terms **"drive unit"** and **"slave"** as used in the following represent an inverter or servocontroller.

1.1 Measures for your safety

The CDA/CDD3000 drive units are quick and safe to handle. For your own safety and for the safe functioning of your device, please be sure to observe the following points:

Read the Operation Manual first!

- Follow the safety instructions!

Electric drives are dangerous:

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

Your qualification:

- In order to prevent personal injury and damage to property, only personnel with electrical engineering qualifications may work on the device.
- Knowledge of national accident prevention regulations (e.g. VBG 4 in Germany)
- Knowledge of layout and interconnection with the CAN-Bus field bus

During installation observe the following instructions:

- Always comply with the connection conditions and technical specifications.
- Electrical installation standards, such as cable cross-section, shielding, etc.
- Do not touch electronic components and contacts (electrostatic discharge may destroy components).

1.2 Introduction: CANopen

CANopen is an interconnection concept based on the CAN (Controller Area Network) serial bus system. CAN has many specific advantages, in particular multi-master capability, real-time capability, resistant response to electromagnetic interference and the high level of availability and low cost of controller chips. These advantages have resulted in CAN being introduced into widespread use in automation too.

In the past, manufacturer and application specific conventions were applied in the majority of CAN networks relating to the use and content of CAN telegrams. Lust Antriebstechnik, too, has defined its own usage of the CAN Application Layer (CAL) - CAN_{Lust}.

Simplified cross-manufacturer communication

The integration of any number of devices in a manufacturer-specific network involves substantial expense. CANopen was developed to solve this problem. In CANopen the use of CAN identifiers (message addresses), the time response on the bus, the network management (e.g. system start and user monitoring) and coding of the data contents is specified in a uniform way. CANopen makes it possible for devices from different manufacturers to communicate in a network at minimal cost.

CANopen uses a subset of the communication services offered by CAL to define an open interface. The selected CAL services are summarized in a “user guide”, as it were. This guide is designated the CANopen Communication Profile.

CANopen functionality of the CDA3000/CDD3000

The CANopen Communication Profile is documented in the CiA DS-301, and regulates “how” communication is executed. It differentiates between Process Data Objects (PDOs) and Service Data Objects (SDOs). The Communication Profile additionally defines a simplified network management system.

Based on the communication services of the DS-301, the device profile for variable-speed drive DS-402 was created. It describes the operation modes and device parameters supported.

In addition to the functions defined in the profiles there are more detailed manufacturer-specific add-ons. The DS-301 profile is implemented in the CDA3000/CDD3000. The DS-402 supports the obligatory elements such as control word, status word and operation modes. The CDA3000/CDD3000 parameters are a manufacturer-specific add-on.

The following sections will provide you with an overview of the CANopen functionality integrated into the CDA3000/CDD3000. There then follows the information necessary for commissioning.

1.3 System requirements

It is assumed you have a standard CANopen setup program and a CANopen interface driver. For the precise protocol definitions refer to the CAL specification.

With the aid of these objects it is possible to configure the actual CANopen communication very flexibly and adapt it to the specific needs of the user.

1.4 Further documentation

- Operation Manual, for commissioning of the drive unit
- Application Manual, for additional parameter setting to adapt to the application. The Application Manual can be downloaded as a PDF file from our website at http://www.lust-tec.de. Follow the Service link.
- Engineering Guide CDA3000

- CiA DS-301: CAL based Communication Profile for Industrial Systems

2 Mounting and connection

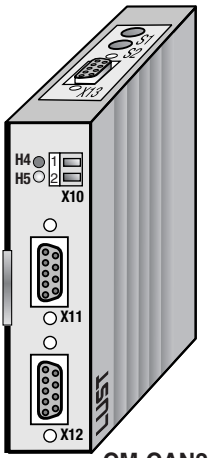
Attention: Do not insert or withdraw modules **in operation!**

2.1 Setting the address

Step	Action	Comment
1	Find out which address is assigned to the module you are installing.	Ask your project engineer.
2	**Select the mode of addressing:** • by bus address parameter or • by coding on connectors X11 and X12 or • by coding on connector X13 or • by coding switches S1 and S2.	See below
	Address setting finished; for further procedure see Installation.	

Four possible methods of address assignment

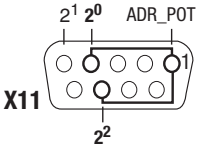
1. Bus address parameter 580-COADR:
   By way of parameter 580-COADR on the “Bus systems” screen of the DRIVEMANAGER user interface an address from 0 to 127 can be set. If the setting 0 is selected in parameter COADR, one of the following codings is enabled.
2. Connector coding via connectors X11 and X12:
   By way of the pins on connectors X11 and X12 labeled ADRx, the device address can be binary coded with PIN 1 in the connector by soldering-in jumpers. By means of the two connectors an address between 0 and 63 can be selected.



CM-CAN2

X10	Assignment
1	+24 V
2	GND (CAN_GND)

Example for addr. 5 Dec:



X11	Assignment
1	ADR_POT
2	CAN_LOW
3	CAN_GND
4	ADR0
5	ADR1
6	GND (CAN_GND)
7	CAN_HIGH
8	ADR2
9	+24 V

X12	Assignment
1	ADR_POT
2	CAN_LOW
3	CAN_GND
4	ADR3
5	ADR4
6	GND (CAN_GND)
7	CAN_HIGH
8	ADR5
9	+24 V

Table 2.1 Pin assignment with a connector coding example

Note: The 24V supply is connected-through at connectors X10, X11 and X12. The terminals of connectors X11 and X12 are interconnected internally 1 : 1.

3. Connector coding via connector X13:
By way of the pins on connector X13 labeled ADRx, the device address can be coded with PIN 1 in the connector by soldering-in jumpers. An address between 1 and 127 can be selected.

X13	Assignment
1	ADR_POT
2	ADR0
3	ADR1
4	ADR2
5	ADR3
6	ADR4
7	ADR5
8	ADR6
9	+24 V

Example for address 18 Dec:

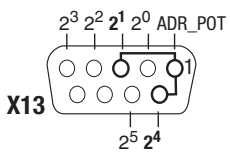


Table 2.2 Pin assignment X13 with an example of connector coding

4. Coding switches S1 and S2:
By way of the two coding switches on the top of the CM-CAN2 a hexadecimal address between 1 and 127 can be selected.

Example for address 18 Dec = 12 Hex

Figure 2.1 Example of use of the coding switches

Attention: The device address coded on the connector is only used if parameter 580-COADR is set **to 0**. All hardware codings of the three connectors and coding switches are internally linked by a logical OR operator.

2.2 Mounting

Mounting of the communication module on the drive unit is based on the design size:

Size	Mounting	Further ref.
BG1...5 (0,37 ... 15 kW)	Side, at least 35 mm mounting distance, if module is to be changed while fitted: Minimum clearance 50 mm	Section 2.2.1
BG6...8 (22 ... 90 kW)	On front, mounting package MP-UMCM required	Section 2.2.2

Table 2.3 Mounting the communication module

2.2.1 Size BG1...5

Precondition:

- It is assumed that the drive unit is installed and commissioned into operation with the aid of the Operation Manual.

Step	Action	Comment
1	Make sure the power supply to the drive unit is cut.	
2	Connect the CM-CAN2 to the drive unit as shown in Figure 2.2. Use only the slot at the top.	The module lock must engage audibly. The bottom slot is reserved for the UM-xxxx module.
	Mounting is complete. To continue see section 2.3 “Installation”.	

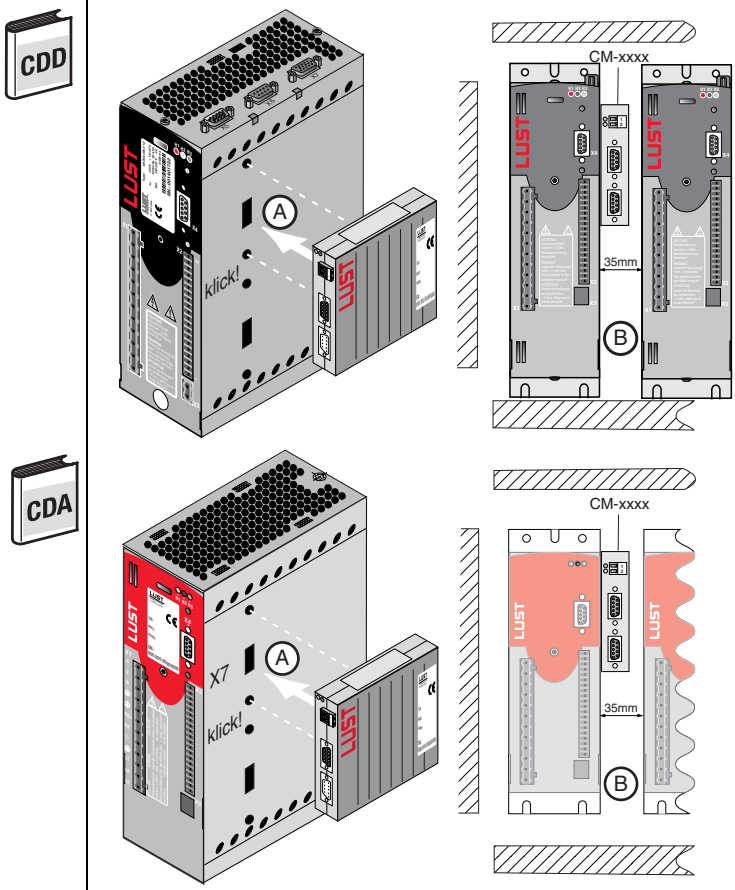


Figure 2.2 Mounting for BG1...5

2.2.2 Size BG6...8

Step	Action	Comment
1	Make sure the power supply to the drive unit is cut.	
2	Open the device cover.	
3	Click the module into the mounting bracket. For positioning and orientation refer to Figure 2.4 (A).	The bracket is part of the MP-UMCM mounting package (see Figure 2.3).
4	Bolt the bracket onto the bottom slot position - see Figure 2.4 (B).	The CM module is thereby placed on its head and the rear of the module is facing forward.
5	Connect the module by the ribbon cable as shown in Figure 2.4 (C).	The ribbon cable is part of the MP-UMCM mounting package (see Figure 2.3).
	Mounting is complete. To continue see section 2.3 “Installation”.	

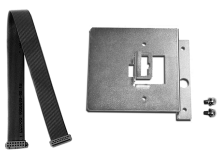


Figure 2.3 Mounting package

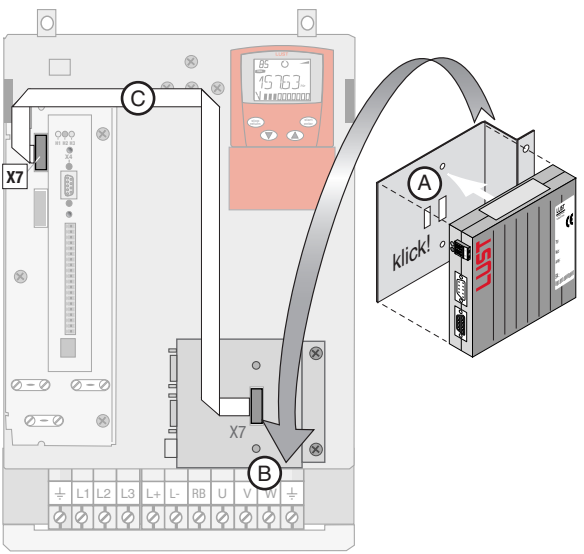


Figure 2.4 Mounting with size BG6...8

Attention: Module Do not insert or withdraw **modules** in operation!

2.3 Installation

Step	Action	Comment
1	Connect the module to the field bus. Use a cable conforming to the specification.	Use a bus termination plug (120 Ω) on the last module - see Figure 2.5.
2	Make sure the hardware enable is wired on the CDA3000 (X2/8) or CDD3000 (X2/7).	see section 2.3.1
3	Wire the supply voltage to X10, X11 or X12.	18 ...30 VDC, see section 2.1
4	Switch on the drive unit.	
	Installation is complete. To continue see section 3 “Commissioning and configuration”.	

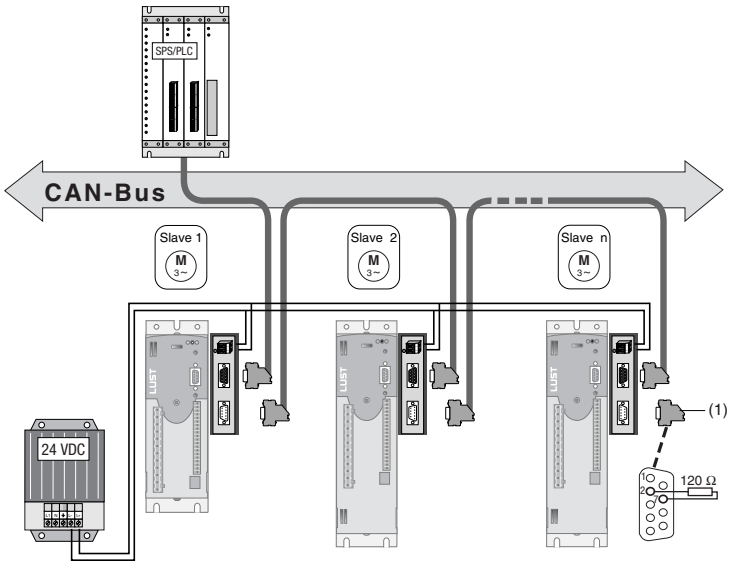


Figure 2.5 System connection.
(1) Bus termination plug

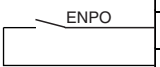
Characteristics	CM-CAN2
Voltage supply	24 V (18 ... 30 V), supply **optionally** via X10, X11 or X12
Voltage ripple	max. 3 Vss
Current consumption	max. 80 mA per user
Cable type	9-wire, surge impedance 120 Ω

Table 2.4 CAN bus connection specification

2.3.1 Hardware enable (ENPO)

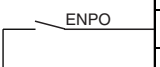
The drive units have an additional power stage hardware enable (ENPO) via control terminal
X2/8 CDA3000
X2/7 CDD3000
(also termed “controller enable”). This input must also be configured for operation over the field bus.

This control signal is high-active. When this control signal is removed the motor runs down uncontrolled (refer also to the description in the Operation Manual).



X2	Des.	Function
9	ISD00	Digital input 1
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	

Figure 2.6 Configuration of controller enable ENPO on the CDA3000



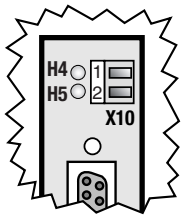
X2	Des.	Function
7	ENPO	Power stage hardware enable
6	DGND	Digital ground
5	U_V	Auxiliary voltage 24 V

Figure 2.7 Configuration of controller enable ENPO on the CDD3000

2.3.2 LED status display

For initial system diagnosis during commissioning, the communication module has two LEDs (H4 and H5).

These LEDs indicate three different bus states.



H4 red	H5 green	Bus state CM-CAN2
❍	❍	24V supply to module missing or drive unit is off.
❍	●	Operational status: SDO communication and PDO communication possible.
☸ 10Hz	☸ 10Hz	Initialization: Parameter description of drive unit is read-in from option module (approx. 20 sec.). The operation must not be interrupted, as initialization is carried out only once.
❍	☸ 10Hz	The communication module waits until the drive unit is ready.
❍	☸ 1Hz	Preoperational status: SDO communication possible.
●	☸ 1Hz	Error (in case of error NMT status Preoperational)

Table 2.5 LED status display

2.4 Transmission speeds

The CAN bus can be operated at the following Baud rates:

Transmission speed	Maximum line length across the complete network	
1000 kBaud	40 m	
500 KBaud	100 m	Factory setting
125 KBaud	450 m	
25 KBaud	1,000 m	

Table 2.6 Transmission speeds

When selecting the transfer rate it should, however, be ensured that the **line length** does not exceed the permissible line length for the transfer rate in question.

3 Commissioning and configuration

3.1 Commissioning sequence

Preconditions:

- The drive unit is wired as specified in the Operation Manual and first commissioning is complete. (To test CAN communication, it is sufficient to connect the mains voltage and activate the ENPO signal (hardware enable) at connector X2.)
- The communication module is plugged into option slot 2 (see section 2.2, “Mounting”).

Step	Action	Comment
1	Check the wiring. Make sure hardware enable ENPO (X2) is not connected.	
2	Switch on the supply voltage. The green LED H5 on the CM-CAN2 communication module flashes.	H5 flashes rapidly [10 Hz] on initial power-up for a period of approx. 10 s or slowly [1 Hz] when initialization is complete.
3	If the initialization completed correctly, for slot 2 under its “Actuals-Slots” menu item the DRIVEMANAGER displays CAN_{open}. Please check the parameter (see Figure 3.1).	If it does not show the value, refer to section 3.3.

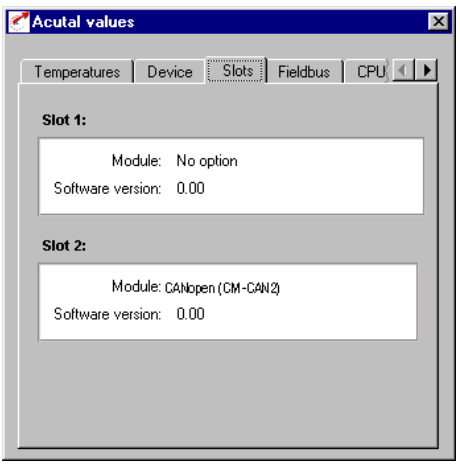


Figure 3.1 If the initialization is correct slot 2 shows: CAN_{open}

Step	Action	Comment
4	Configure the drive unit using the Application Manual.	(Inputs/outputs, software functions, ...)
5	Test the control quality and optimize the controller settings as necessary using the Operation Manual.	
6	Set the relevant preset solution according to the Application Manual.	For an initial test of CAN communication the following settings are required as a minimum: see Table 3.1.
7	Test the drive on the higher-order controller, see section 3.4.	
8	Finally, save the setting with the -> button.	see Figure 3.2 

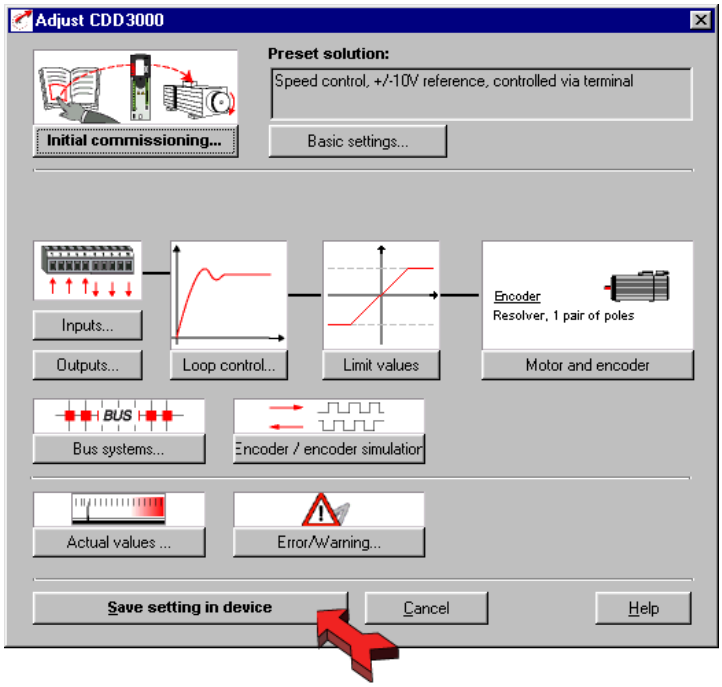


Figure 3.2 Saving settings

Parameter	Value	Comments
581-COBDR	Baud rate	Baud rate setting, factory setting = 500 kB, see section 4.3.2
580-COADR	Address	Device address, factory setting = 0, or HW coding
260 -CLSEL	(5) OPTN2	Assign control location to CANopen
280 -RSSL1	(7) FOPT2	Apply reference value from CANopen
150-SAVE	(1) START	Finally, save settings in device

Table 3.1 Minimum parameters to be set

For more detailed information on optimization of the software functions and control circuits refer to the device application manual.

3.2 Commissioning instructions

For a variety of reasons, it may be that a drive unit does not respond to a telegram:

- There is no reply if the telegram frame (baud rate, data length) on the master computer is not correct.
- There is no reply if a drive unit is addressed with the wrong bus address.
- There is no reply if the serial connection between the master computer and the drive unit is not correctly set up.
- There is no reply if the 24V supply to the communication module is missing or the cabling is faulty.
- There is no valid reply if several devices with the same device address are connected to the bus.

3.3 Errors in initialization

If the slot identifier (parameter 578-OPTN2) shows the value NONE, there is either a fault in the drive unit or in the communication module. To localize the defective component, you should first reset the drive unit to its factory defaults. To do so, either set parameter 4-PROG = 1 or press and hold down the two cursor keys on the KP200 control unit during the self-test period after power-on.

When the reset is complete, you can verify the value in parameter 578-OPTN2 = COPEN once again. If it still shows NONE, cut the mains power and plug the communication module into the other option slot to test it. If the module is not correctly detected there either, there is a hardware fault in the module or in the drive unit.

3.4 Test on higher-order controller

To activate changed settings the device must be switched off and back on again. When the power is connected, after an initialization period of a few seconds the device must transmit a one-off **boot-up message** (ID 80h + Node ID = 81h at device address 1). If this happens, the communication is OK.

Note: In transmissions the number of data bytes does not necessarily have to be taken into account, but it is advantageous.

3.5 Data handling

3.5.1 Saving settings

All configuration data can be backed-up on a SMARTCARD or with the DRIVEMANAGER as a file. A parameter set in the DRIVEMANAGER always comprises three files with the extensions *.00D, *.00T and *.00X. The DRIVEMANAGER file selection boxes only ever display the *.00D file.

3.5.2 Restoring factory defaults

There are two possible ways of restoring the factory defaults of the devices:

- Set parameter 04-PROG (subject area _86SY System) to 1. All device parameters (device configuration only, without motor and loop control parameters) up to user level 4 are reset to their factory defaults.
- Set parameter 04-PROG to 850. All device parameters up to user level 5 (Service) are reset to their factory defaults. That means including motor and loop control parameters.
- From the main window menu of the DRIVEMANAGER under “Active device” select “Reset to factory defaults”.
- Press and hold down both cursor keys on the KEYPAD KP200 control unit during power-on. All device parameters up to user level 5 are reset to their factory defaults.

Note: In both cases it takes around 10 seconds for the device to signal that it is ready again. During this time the device performs a self-test and changes all its settings to the factory setting. This setup is only retained when the data are saved in the device, however. Data backup is initiated by way of the DRIVEMANAGER user interface or by writing parameter 150-SAVE = 1 by way of the bus system.

Attention: Data backup takes a few hundred milliseconds. During that time the device must not be switched off, otherwise the settings will be lost.

Parameter 150-SAVE is automatically set to 0 by the device after the save operation. This process can be used for timeout monitoring of the function.

4 Setting the device parameters

4.1 Parameter channel (Service Data Objects)

The Service Data Object (SDO) permits write and read access to the object directory. This SDO is implemented according to the CAL specification by the Multiplexed Domain CMS object. The protocol is designed for the transfer of data of any length. For SDO transfer a so-called SDO Client is integrated into the device. Communication is by way of two reserved identifiers.

Receive SDO:	600 h
Transmit SDO:	580 h

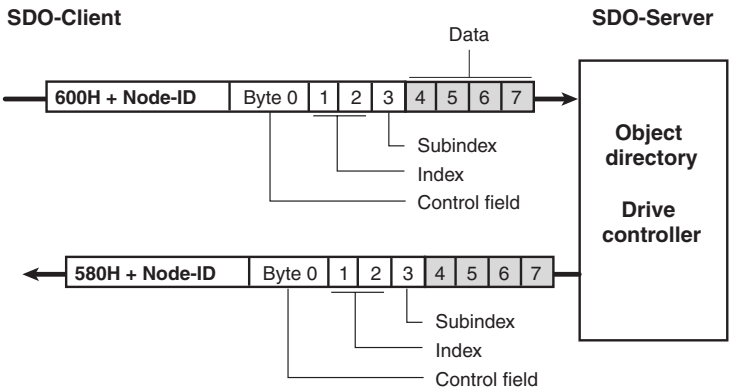


Figure 4.1 Example of an SDO data transfer in Expedited mode

The CAL specification makes a basic distinction between three protocol services:

- Download protocol (Write)
- Upload protocol (Read)
- Abort protocol (Error)

The upload and download protocols additionally differentiate between:

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

4.1.1 Data types

Note: By way of the DRIVEMANAGER user interface or the KEYPAD KP200 control unit many parameter settings are displayed in the form of value substitution texts.
Example: Parameter 150-SAVE = STOP

When writing and reading over the field bus the corresponding numerical values for these value substitution texts must be used. Both in the application manuals of the devices and in this document, these values are given in brackets () after the value substitution text.

Example: Parameter 152-ASTER = BUS_1 (9)

The drive units support the following parameter data formats:

Data type	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 scaling 1/65536, i.e. the Low word indicates the number of decimal places.
FIXPOINT16	0,00...3276,80	Fixed point number with scaling 1/20, i.e. increment size 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 characters, max. 100 bytes in 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 represented appropriate to their preceding sign as 32-bit variables in Intel format.

Data bytes 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	Post-point Low	Post-point High	Pre-point Low	Pre-point High
FIXPOINT16 *	See examples			
FLOAT32	IEEE format			
ERR_STRUC	Error number	Error location	TOP Low	TOP High
STRING	See examples			
* Filled out appropriate to preceding sign (00H or FFH) TOP = Time of Operation in full hours				

Table 4.2 Arrangement of data types in the data field

Examples

Data type	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 with 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 identifier)

Table 4.3 Examples of mapping of data types

For detailed information on string parameters see

4.2 Configuration of the drive unit by way of preset application data sets

For detailed information on preset solutions refer to section 4 of the relevant Application Manual.

CDA3000:

The choice can be made between three preset solutions = BUS_1(9) ... BUS_3(11) for operation on field bus systems. These solutions differ only in the function of digital inputs on the device. The control location and reference source are assigned to the field bus system. By way of parameter 152-ASTER this selection/setting can also be made over a bus.

CDD3000:

For operation on field bus systems the choice can be made between the following preset solutions:

- SCB_5(9) = Speed control, reference and control via field bus
- SCB_2(4) = Speed control, +/-10V reference, control via field bus
- SCB_3(6) = Speed control, fixed speeds, control via field bus
- SCB_2(3) = Speed control, pulse input, control via field bus
- PCB_4(16) = Positioning, fully programmable, control via field bus
- PCB_3(14) = Positioning, fixed positions, control via field bus
- PCB_2(12) = Positioning, reference and control via field bus
- PCB_1(11) = Electronic gearing, control via field bus

These solutions differ only in the function of digital inputs on the device. The control location and reference source are assigned to the field bus system. By way of parameter 152-ASTER this selection/setting can also be made over a bus.

On the CDA3000 the following parameters are automatically changed in the device on selection of the “BUS_1(9)” preset solution:

Parameter	Factory setting (FS)	Changed value	Function
151 -ASTPR	DRV_1	BUS_1(9)	Original application data set
152 -ASTER	DRV_1	BUS_1(9)	Current application data set
180 -FISA0	OFF	OPTN2	Function selector analog standard input ISA00
181 -FISA1	OFF	OPTN2	Function selector analog standard input ISA01
210-FIS00	STR	OPTN2	Function selector digital standard input ISD00
211-FIS01	STL	OPTN2	Function selector digital standard input ISD01
212-FIS02	SADD1	OPTN2	Function selector digital standard input ISD02
213-FIS03	OFF	OPTN2	Function selector digital standard input ISD03
240 -FOS00	BRK1	OPTN2	Function selector digital standard output OSD00
241 -FOS01	REF	OPTN2	Function selector digital standard output OSD01
242 -FOS02	S_RDY	OPTN2	Function selector digital standard output OSD02
260-CLSEL *	TERM	OPTN2	Control location selector
280-RSSL1 *	FMAX	FOPT2	Reference selector 1
289 -SADD1	10	0	Reference selector 2
* These parameters must be changed as a minimum in order to enable control via the bus system.			

Table 4.4 Presetting based on the example of CDA3000: BUS_1 (9)

After the automatic configuration the baud rate and device address also need to be set.

Note: If parameters from the above table are changed subsequently, parameter 152-ASTER is automatically set to OFF (0), to indicate a change in the preset solution. The original setting continues to be displayed in parameter 151-ASTPR.

Inputs and outputs are made available to the bus system as decentralized inputs/outputs by way of the function selector settings. That means outputs can be polled directly via the control word and states at inputs directly in the status word. By changing the relevant function selector device functions can also be assigned to inputs and outputs.

Note: The settings must be backed-up in the device before the reset. These changes only take effect after a mains reset.

4.3 Parameters for bus operation

Table 4.5 describes the parameters in the order in which they are must usefully verified and set.

The following pages present a more detailed description of the individual parameters.

Overview

Subject area	Parameter	Function	Value range	FS	Your set.	Unit
1. General bus settings						
_57OP	580-COADR	CANopen device address	0 ... 127	0		
	581-COBDR	CANopen baud rate	0 ... 7	2=500kB		
	575-CASCY	Sampling time for status message	1 ... 32000	80		ms
2. Definition of control location and reference channel						
_57OP	492 -CACNF	CAN configuration	0 ... 4	4		
_26CL	260 -CLSEL	Control location selector	TERM ... **OPTN2**	TERM(0)	OPTN2(4)	
_28RS	280 -RSSL1	Reference selector 1	OFF ... **FOPT2**	FMAX(11)	FOPT2(7)	
_57OP	573 -CACTR	CAN bus control word	0000 h ... FFFF h	0000 h		Hex
	572-CASTA	CAN bus status word	0000 h ... FFFF h	0000 h		Hex
_28RS	288 - FOPT2	Reference value of option slot 2	(non-editable)	0		Hz
3. Data backup						
_15FC	150-SAVE	Back-up device setup	STOP, **START(1)**	STOP(0)		
FS = Factory setting						

Table 4.5 Overview of CDA3000 bus parameters

4.3.1 CDA3000/ CDD3000 parameters for bus operation

Describes the parameters in the order in which they are must usefully verified and set.

The following pages present a more detailed description of the individual parameters.

On the DRIVEMANAGER user interface in version V3.00 and later the parameters are grouped in a dedicated screen for the bus systems:

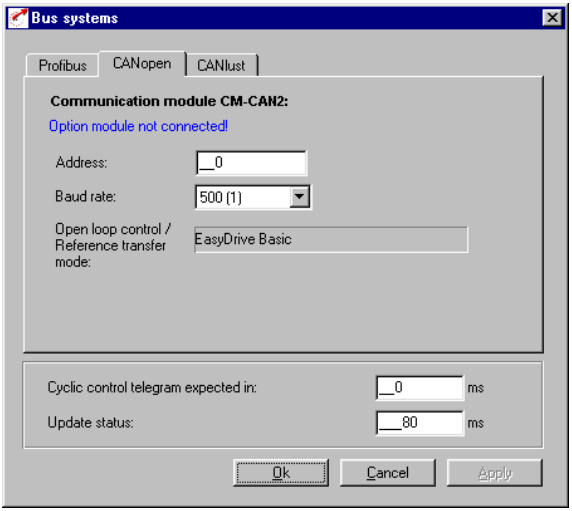


Figure 4.2 Parameters for bus operation

Subject area	Parameter	Function	Value range	FS	Your set.	Unit
1. General bus settings						
Bus systems	492 -CACNF	CAN configuration Type of control/ reference transfer	0 ... 8	4		
	580-COADR	CAN bus Device address	0 ... 99	0		
	581-COBDR	CAN bus baud rate	0 ... 7	2=500kB		
	575-CASCY	Sampling time for status message	1 ... 32000	80		ms
	570 -CAMOD	Option module function selection CAN_{LUST} (inactive, do not change!)	Slave/Master	Slave(0)		
2. Definition of control location and reference channel						
	260 -CLSEL	Control location selector	TERM ... **OPTN2**	TERM	OPTN2(4)	
	280 -RSSL1	Reference selector 1	OFF ... **FOPT2**	FMAX	FOPT2(7)	
	573 -CACTR	CAN bus control word	0000H ... FFFFH	0000H		Hex

Table 4.6 Overview of CDA3000/CDD3000 bus parameters

Subject area	Parameter	Function	Value range	FS	Your set.	Unit
	572-CASTA	CAN bus status word	0000H ... FFFFH	0000H		Hex
	288 - FOPT2	Reference value of option slot 2	(non-editable)	0		Hz
3. Data backup						
	150-SAVE	Back-up device setup	STOP, **START(1)**	STOP(0)		
FS = Factory setting						

Table 4.6 Overview of CDA3000/CDD3000 bus parameters

4.3.2 General bus settings

492-CACNF - CAN configuration

The parameter defines the type of activation via CAN. With the DRIVECOM state machine the resolution of the reference input and of the actual value can additionally be varied.

Note: The parameter is automatically set correctly when a preset solution is selected. DRIVECOM activation can be enabled by setting 1-3 **only** for the EasyDrive Basic solutions. See section 5, Device control.

Subject area	Value range	Factory setting	Unit	Data type	Memory type
_57OP	0...8	4		USIGN8	FLASH

Activation	Reference	Actual	CAC NF
No activation	No reference transfer	All words = 0	0
DRIVECOM state machine	16-bit reference speed (Q0)	16-bit actual speed (Q0)	1
DRIVECOM state machine	32-bit reference speed (Q16)	32-bit actual speed (Q16)	2
DRIVECOM state machine	32-bit reference speed (Q16)	16-bit actual speed (Q0) 16-bit actual torque (Q0)	3
EasyDrive Basic	32-bit reference speed (Q16)	32-bit actual speed (Q16)	4

Table 4.7 CAN configuration / CDA3000 control mode

Activation	Reference	Actual	CAC NF
No activation	No reference transfer	All words = 0	0
DRIVECOM state machine	16-bit reference speed (Q0)	16-bit actual speed (Q0)	1
DRIVECOM state machine	32-bit reference speed (Q16)	32-bit actual speed (Q16)	2
DRIVECOM state machine	32-bit reference speed (Q16)	16-bit actual speed (Q0) 16-bit actual torque (Q0)	3
EasyDrive Basic	32-bit reference speed (Q16)	32-bit actual speed (Q16)	4
EasyDrive ProgPos	ProgPos. Control bits, POMER[90-97], POVAR[98]	ProgPos status bits, POMER[80-87], actual position in distance units	5
EasyDrive TabPos	Control bits, P-to-P positioning, table index	Status bits, P-to-P positioning, actual position	6
EasyDrive DirectPos	Control bits, P-to-P positioning, position reference	Status bits, P-to-P positioning, actual position	7
EasyDrive Synchron (in preparation)	Control bits, electronic gearing	Status bits, electronic gearing, actual position	8

Table 4.8 CAN configuration / CDD3000 control mode

580-COADR - CANopen Device address

As described above, the device address can be assigned in four ways. The decisive factor is the setting of parameter 580 -COADR. If the parameter is set to the value 0, the device address is taken from the connector configuration after the system starts.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	0 ... 127	1	–	USIGN8	FLASH

Attention: If parameter 580-COADR is set to 0 and the address from the connector configuration also produces the value 0, the device then starts automatically with NodeID 1.

If the parameter is set to values between 1 and 127, the connector configuration is ignored. The inverter starts after the reset with the device address set in COADR (save the setting prior to the reset with parameter 150-SAVE).

581-COBDR -CANopen baud rate

The baud rate is set by parameter 581-COBDR.

Value range	Factory set.	Unit	Data type	Memory type
25 ... 500	500	KBaud	USIGN8	FLASH

581-COBDR value range	Transmission speed	Comments
1	1 MBaud	
2	500 KBaud	Factory setting
4	125 KBaud	
7	20 KBaud	

Table 4.9 Baud rate

Attention: A change of device address or baud rate only takes effect after the next reset (restart) of the inverter!
Before the reset save the settings in the device with parameter 150-SAVE = 1(START)!

575-CASCY - Sampling time of status message in ms

Parameter to configure the sampling time within which the drive unit independently transmits a status report.

Condition: Transmission types for **TXPDO1 = asynchronous** and event handling in device set to cyclic send.

Value range	Factory set.	Unit	Data type	Memory type
1 ... 32000	80	ms	USIGN16	FLASH

570-CAMOD - Option module function selection, CAN_{Lust}

Parameter to configure the function of CAN_{Lust}. The SLAVE setting permits control of the device via CAN. The MASTR setting permits connection of external I/O add-ons to the option module. This function is in preparation.

Value range	Factory set.	Unit	Data type	Memory type
0 (SLAVE) ... 1 (MASTR)	0 (SLAVE)		USIGN8	FLASH

4.3.3 Definition of control location and reference channel

260-CLSEL - Control location

The control location is selected by way of parameter 260-CLSEL. With CLSEL = OPT2 the control word for the device is formed from bytes 0 and 1 of RXPDO1.

The control location is set automatically when a preset solution is selected. It should not be changed subsequently, as this may significantly alter the response of the device on the bus.

Value range	Factory set.	Unit	Data type	Memory type
0 (TERM) ... 4 (OPTN2)	0 (TERM)	–	USIGN8	FLASH

Note: Reference and control values and the content of the control identifier are only evaluated in the “operational” state. The control mode and the structure of the control and status words is defined by way of the preset solution (EASYDRIVE, DRIVECOM).

280-RSSL1 - Reference selector

RSSL1 = FOPT2 causes the reference to be formed from the data bytes of RXDPO1.

On the CDD3000 the reference selector is set automatically when a preset solution is selected. It should not be changed subsequently, as this may significantly alter the response of the device on the bus.

Value range	Factory set.	Unit	Data type	Memory type
0 (FCON) ... 11 (FMAX)	11 (FMAX)	–	USIGN8	FLASH

Note: Reference and control values and the content of the control identifier are only evaluated in the “operational” CAN system state.

Other logical settings may also be selected as the reference source:

RSSL1	Function
(1) FA0	Analog input 0
(2) FA1	Analog input 1
(4) FPOT	MOP function, only in conjunction with appropriately configured inputs
(5) FDIG	Digital reference, see device operation manual
(7) FOPT2	Reference from option slot 2, here CAN_{LUST}
(8) TBSEL	Table references incl. acceleration and braking ramps, selection of table position via bits in the control word or directly in parameter TBSEL or via inputs with function FFTBx
(9) FFIX1/2	Fixed frequency *
(10) FMIN1/2	Minimum output frequency *
(11) FMAX1/2	Maximum output frequency *
* Switchable with characteristic data set switchover, e.g. via bits in the control word	

Table 4.10 Settings for reference selector 280-RSSL1 on CDA3000

RSSL1	Function
(1) RA0	Analog input 0
(2) RA1	Analog input 1
(4) FDIG	Digital reference, see device operation manual
(6) ROPT2	Reference from option slot 2, here CAN_{LUST}
(7) RFIX	Speed table references incl. acceleration and braking ramps, selection of table position via bits in the control word or directly in parameter TBSEL or via inputs with function FFTBx
(8) PTAB	Position table references
(9) PMOD	ProgPos positioning and sequence control

Table 4.11 Settings for reference selector 280-RSSL1 on CDD3000

Online switching between the reference sources is only possible by way of appropriately parameterized digital inputs (see functions of digital inputs in the relevant Application Manual).

573-CACTR - Control word

The control word (data byte 0+1) received via RXPDO1 is entered in parameter 573-CACTR. During commissioning the parameter can be used to check reception of the data. The parameter is for display purposes only.

Value range	Factory set.	Unit	Data type	Memory type
0000 H ... FFFF H	0000 H	–	USIGN16	RAM actual value

572-CASTA - Status word

The status of the preset state machine is entered in parameter 572 CASTA. The data content of the parameter corresponds to data bytes 0 and 1 in TXPDO1. The parameter is for display purposes only.

Value range	Factory set.	Unit	Data type	Memory type
0000 h ... FFFF h	0000 h	–	USIGN16	RAM actual value

288-FOPT2 - Reference from option slot 2

The reference value received via the control identifier is entered in parameter FOPTx. The data content of the parameter corresponds to the reference data bytes of RXPDO1. The interpretation of the value is dependent on the selected operation mode. The parameter is for display purposes only.

Value range	Factory set.	Unit	Data type	Memory type
-32764 ... 32764	0	Hz	INT32Q16	RAM actual value

4.3.4 Data backup

150-SAVE - Back-up device setup

Parameter to back-up the complete device setup to the Flash memory. All parameters are first held only in the RAM. So that the parameters are available again after power-off, they must be backed-up. To do so, parameter 150-SAVE is set to 1 after all other parameters have been set. The save operation takes a few hundred milliseconds. During that time the device must not be switched off, otherwise the settings will be lost. Parameter 150-SAVE is automatically set to 0 by the device after the save operation. This process can be used for timeout monitoring of the function.

Value range	Factory set.	Unit	Data type	Memory type
0 (STOP) ... 1 (START)	0 (STOP)	–	USIGN8	RAM control value

4.4 Examples of SDO handling

By way of the Receive SDO (COB IDs: 600 h + Node ID) the CANopen objects and the parameters of the drive controller can be accessed.

In a data transfer protocol a maximum of 4 data bytes can be transferred in Expedited mode. This means all device parameters, apart from String parameters, can be written to with a single transfer protocol.

String parameters can be written to using the Multiplexed Domain protocol.

Where can I find the device parameters?

All device parameters are addressed by way of a parameter number. The drive controller has parameter numbers between 1 and 999.

In addition to the standard objects, the CAN_{open} profile additionally provides a range for manufacturer-specific entries. This range lies between 2000 h and 5FFF h. If you then want to read or write parameter 303-FMAX1 (maximum frequency 1) of the device, the object index is formed from 2000 h + parameter number (Hex).

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

The entries in the “Control field” area are generated by the CAN_{open} driver. They are only included to fully document the examples cited. The entries are dependent on the transferred data.

Examples:

1. Read standard parameter 390-TYPE [INT32] at CAN address 1
Parameter number 390 (186 h) is addressed as a CAN object under the object number 2186 h.

Enquiry	SDO ID: 601 h	40	86	21	0	0	0	0	0
Reply	SDO ID: 581 h	43	86	21	0	08	7D	0	0

=> Device type 7D08 h = 32008, i.e. CDA32.008

2. Read standard parameter 406-REFF at CAN address 1
Parameter number 406 (196 h) is addressed as a CAN object under the object number 2196 h.

Enquiry	SDO ID: 601 h	40	96	21	0	0	0	0	0
Reply	SDO ID: 581 h	42	96	21	0	0	0	0	0

3. Read object 1008 h-Device Name at CAN address 1
Standard object 1008 h represents device parameter 130-NAME (data type STRING). In the following example this string parameter has more than 4 characters (“spindle drive 1”) and is read in a Multiplexed Domain protocol.

Abs. Time	SDO	ID	data	
Introduction of the Multiplexed Domain protocol: 16 characters are to be transmitted.				
6.0011	Tx	602	[1008,00]	Initiate Upload Rq.
6.0426	Rx	582	[1008,00]	Initiate Upload Rsp Bytes: 00000010
The first 7 characters “Spindle” are transmitted.				
6.0434	Tx	602		Upload Segment Rq. T0
6.0441	Rx	582	53 70 69 6E 64 65 6C	Upload Segment Rsp T0 C0 “Spindle”
The next 7 characters “drive” are transmitted				
6.0449	Tx	602		Upload Segment Rq. T1
6.0456	Rx	582	61 6E 74 72 69 65 62	Upload Segment Rsp T1 C0 “drive”
The characters “1” are transmitted in the last telegram.				
6.0464	Tx	602		Upload Segment Rq. T0
6.0472	Rx	582	20 31	Upload Segment Rsp T0 C1 “.1”(0)(72)(69)(65)(62)

Table 4.12 Example of SDO handling

4. Write parameter 270-FFIX1 = 10.5 Hz = 0A8000 h (Int32Q16)

Write	SDO ID: 601 h	23	0E	21	0	0	80	0A	0
Reply	SDO ID: 581 h	60	0E	21	0	0	0	0	0

10,5 * 65536 => 00 0A 80 00 h

Note: After the transfer the written parameter values are stored only in the RAM of the drive controller. Consequently, before the device is switched off a data backup must be executed to make sure they are available again when the device is switched back on. This is done by writing parameter 150-SAVE with the value 1(START).

Write	SDO ID: 601 h	23	96	20	00	1	0	0	0
Reply	SDO ID: 581 h	60	96	20	0	0	0	0	0

The data backup takes a few hundred milliseconds. During that time the inverter controller must not be switched off, otherwise all settings will be lost!

The controller can check the data backup process by monitoring parameter 150-SAVE. The setting is automatically switched to 0 by the drive controller when the process is complete.

4.5 Downloading parameter data sets

Problem:

A unified valid data set - that is, not just individual parameters - needs to be transferred from the master computer to the device. On every transfer of an individual parameter the drive controller checks whether the parameter matches its existing data set.

The check of the new parameter value in part adds existing parameter values. This means it is possible that the drive controller may reject a parameter, even though it originates from a valid parameter data set, because the parameter is not yet complete in the device. Possible error messages are:

Error		Cause
E-PLS	Plausibility error	Parameter settings mutually implausible (control parameters)
E-PAR	Parameter setting error	Parameter settings mutually exclusive in the reference structure

Since a simple error reset may not eliminate the cause of the error, it may be necessary to reset to the factory defaults.

Remedy:

The new parameter data set of the master computer is transferred to the drive controller without individual checking of the parameter values. When the upload is finished the drive controller checks the now complete new data set for plausibility. If the data are not logical, the entire data set is rejected and the old data set is reactivated.

This procedure requires a handshake, which is described in more detail in the following.

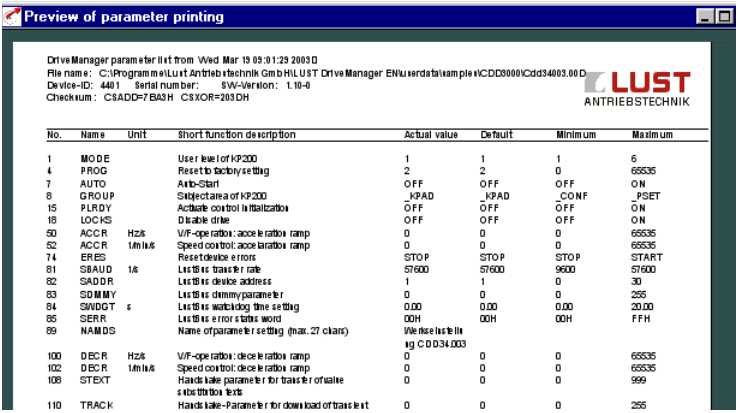
Note: In this action only parameters having the attribute “CardWriteable” are changed. Consequently, the upload of a parameter data set by way of the serial interface runs in the same way as by way of the SMARTCARD. If, during the upload, a Select telegram is transmitted to a parameter without the “CardWriteable” attribute, the drive controller responds to the telegram with “Acknowledge” but does not adopt the new parameter value.

Handshake to upload a complete parameter data set

1. Register upload with parameter 80-SLOAD = -1
   - A write operation to this parameter is only possible when the system is at a standstill. After the write operation the drive controller is secured against being switched back on until the download is finished.
2. Transfer complete parameter data set
   - With several Select telegrams the individual parameters are transferred from the master computer to the drive controller. The servocontroller initially accepts the new parameter values without carrying out a plausibility check.
3. Terminate upload with parameter 80-SLOAD = -2
   - When all parameter data have been transmitted, the master computer sets SLOAD to the value (-2). This signals the end of the data transfer to the drive controller. The servocontroller then begins checking its entire data set for plausibility. If the data set is valid, the parameters are accepted with the attribute “CardWriteable” into the EEPROM. The drive is enabled again and can be started. The parameter 80-SLOAD is set according to the result of the parameter check.
4. Poll parameter 80-SLOAD with timeout (10 s)
   - If SLOAD becomes 0 within the timeout the transfer was completed correctly. The parameters are accepted into the EEPROM with the attribute “CardWriteable”. The drive is enabled again and can be started.
   - If SLOAD = (-1) within the timeout, the drive controller is still busy verifying and saving. If SLOAD > 0, the drive controller has rejected the data set. The value of SLOAD then corresponds to the number of the first parameter of which the value is invalid.

Note: If the connection is interrupted during transfer, or if the timeout expires, the transfer must be repeated or the drive controller restarted. If the plausibility test is disabled, protocols are always acknowledged positively, even if parameter access was not possible. As a result, the master download is not interrupted by error messages. Consequently, inadmissible parameter changes are not executed.

The parameter list can be printed from the DRIVEMANAGER:



No.	Name	Unit	Short function description	Actual value	Default	Minimum	Maximum
1	MODE		User level of KP200	1	1	1	6
4	PROG		Reset to factory setting	2	2	0	65535
7	AUTO		Auto-Start	OFF	OFF	OFF	ON
8	GROUP		Subject area of KP200	_KPAD	_KPAD	_CONF	_PSET
15	PLRDY		Activate control initialization	OFF	OFF	OFF	ON
16	LOCKS		Disable drive	OFF	OFF	OFF	ON
50	ACCR	Hz/s	V/F-operation: acceleration ramp	0	0	0	65535
52	ACCR	1/min/s	Speed control: acceleration ramp	0	0	0	65535
74	ERES		Reset device errors	STOP	STOP	STOP	START
81	SBAUD	1/s	Lustbus transfer rate	57600	57600	9600	57600
82	SADDR		Lustbus device address	1	1	0	30
83	SDMMY		Lustbus dummy parameter	0	0	0	255
84	SWDGT	s	Lustbus watchdog time setting	0.00	0.00	0.00	20.00
85	SERR		Lustbus error status word	00H	00H	00H	FFH
89	NAMDS		Name of parameter setting (max. 27 chars)	Werkseinstellung CDD34.003			
100	DECR	Hz/s	V/F-operation: deceleration ramp	0	0	0	65535
102	DECR	1/min/s	Speed control: deceleration ramp	0	0	0	65535
108	STEXT		Handshake parameter for transfer of value substitution texts	0	0	0	999
110	TRACK		Handshake-Parameter for download of translist	0	0	0	255

5 Control and reference input

Real-time data exchange between CAN_{open} nodes is executed by high-priority PDO transfer. This is a purely CAN communication with no protocol overhead, in which the broadcast properties are retained in full. In contrast to SDO transfer, data may be exchanged between two slaves without any request from the master.

The PDOs may optionally be transferred event-controlled or synchronous. These communication properties can be set in the relevant PDO communication parameters.

For control of the devices via CAN there are two different modes, which are switched dependent on the selected “preset solution”.

5.1 Mapping function on the CDD3000

Mapping of parameters is only possible on the CDD3000. It should be noted that only RXPDO2 and TXPDO2 can be used. RXPDO1 and TXPDO1 are static. Mapping works as defined in the CANopen communication profile DS301.

For information on parameters, such as data length and parameter numbers, see section 4.

1. Event-controlled TXPDO transmission (CDD3000 only)

Note: Event control is only active when the relevant “transmission type” is set to asynchronous (FE hex).

Parameters '148-TXEV1' and '149-TXEV2'

TX Event 1

Event resulting in transmission of TXPDOs 1.

TX Event 2

Event resulting in transmission of TXPDOs 2.

All events listed in the following table have equal rights and can be logically linked by an “or” function. The parameters are bit-coded.

Bit position	Event
0	Cyclic with sampling time from parameter 575-CASCY
1	Input ISD00 activated
2	Input ISD01 activated
3	Input ISD02 activated
4	Input ISD03 activated
5	Input ISD04 activated
6	Input ISD00 activated
7	Input IED01 activated
8	Input IED02 activated
9	Input IED03 activated
10	Virtual output 248-OV00 activated **)

Bit position	Event
11	Virtual output 249-OV01 activated **)
12	ProgPos (flag 98 set) *)
13	ProgPos (flag 99 set) *)
14	CAN status word CASTA changed
15	SZUE status word STAT changed ***)

*) Flag is deleted after evaluation of event.

**) Virtual output parameters are set in the same way as standard outputs, but have no terminal connection. They can be used to trigger an event. Events are created at the High and Low edges of the signal respectively.

***) SZKE = System state monitoring

Note: Bit 14: CAN status word changed:
In case of changes in data byte 0+1 of the status information an event is triggered. In this connection refer to the following descriptions of the individual preset solutions.

If the inputs are used to trigger an event, one event is triggered at the High edge and one at the Low edge.

The two flags (only in preset solution PCB_4(16)= positioning, fully programmable, ...) … can trigger an event from a sequence program. The event is triggered when the flags are set to 1 (SET M98=1). The flags are automatically reset.

Bit 15 groups together all the internal status messages of the device as an event.

5.2 Device control

The following section describes the application-specific selection of the control configuration.

5.2.1 Control functions

Control functions can be optimally adapted to the relevant application. Consequently, several control formats are offered. The appropriate formats can be selected by the master during the setup phase over the bus, or by adjusting the relevant device parameters.

The drive units' state machine has a sampling time of 1 ms. All control commands and reference values are processed within that sampling time by the drive unit.

Note: Control PDOs can only be transmitted in a minimum sampling time of > 1ms by the master, otherwise protocols could not be processed in the device. An error message: E-OP2 xxx is delivered, see section 7 “Error rectification”.

There are two different modes of controlling the devices over the CAN bus.

1st control mode

In the first control mode the key functions of the device can be activated directly by way of a LUST-specific control word. This mode is termed “**EasyDrive control mode**” in the following. Digital control functions such as “controller enable, characteristic data set selection or states of digital outputs” can be activated directly in the control word by bits.

2nd control mode:

In the second control mode the drive unit is controlled via the **DRIVECOM state machine**. In this control mode the control functions such as controller enable and error handling are activated by a state machine described in the DRIVECOM profile. Functions such as characteristic data set selection, user mode selection, table references and activation of digital outputs are provided by way of the bits not assigned in the profile.

On the CDD3000 the configuration of the control signals is additionally adapted to the device's selected preset solution. This is done by setting the matching preset solution in the device.

On the CDA3000/CDD3000 the following preset solutions are available:

Application	Device preset solution: Preset solution via DRIVEMANAGER Parameter 151-ASTER	Designation Control mode (492-CACNF)
Speed control: General rotational or translational drives	BUS_1(9)=Field bus operation, control and reference via bus BUS_2(10)=Field bus operation, manual mode with analog reference BUS_3(11)=Field bus operation, manual mode with analog reference, limit switches CDA3000	*EasyDrive Basic* or *DRIVECOM*
	SCB_5(9) = Speed control, reference and control via field bus . SCB_2(4)=Speed control, +/-10V reference, control via field bus SCB_3(6)=Speed control, fixed speeds, control via field bus SCB_2(3)=Speed control, pulse input, control via field bus	4= EasyDrive Basic (factory setting) 1-3 = DRIVECOM
Position control, fully programmable Single-axis positioning tasks with sequence control	PCB_4(16)= Positioning, fully programmable, control via field bus	*EasyDrive ProgPos* 5
Position control, fixed positions: Table positioning in simple single-axis positioning tasks	PCB_3(14)= Positioning, fixed positions, control via field bus	*EasyDrive TabPos* 6
Position control, direct position input: Simple positioning with direct input of new target position as reference	PCB_2(12)= Positioning, reference and control via field bus	*EasyDrive DirectPos* 7
Electronic gearing Synchronism of two axes or activation via stepper motor interface (in preparation)	PCB_1(11)= Electronic gearing, control via field bus	EasyDrive Synchron 8

The preset solution is selected by choosing the “Preset solution” option from the DRIVEMANAGER Settings window menu during configuration of the device and prior to commissioning of the field bus system.

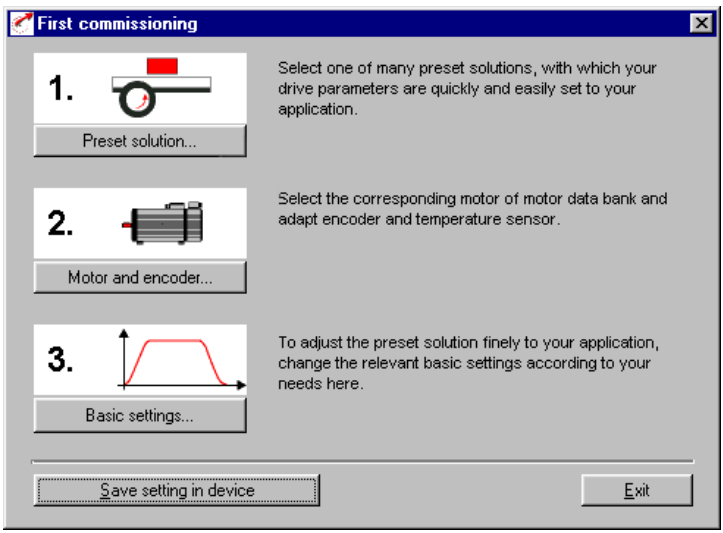


Figure 5.1 Setting the desired preset solution on the CDD3000.

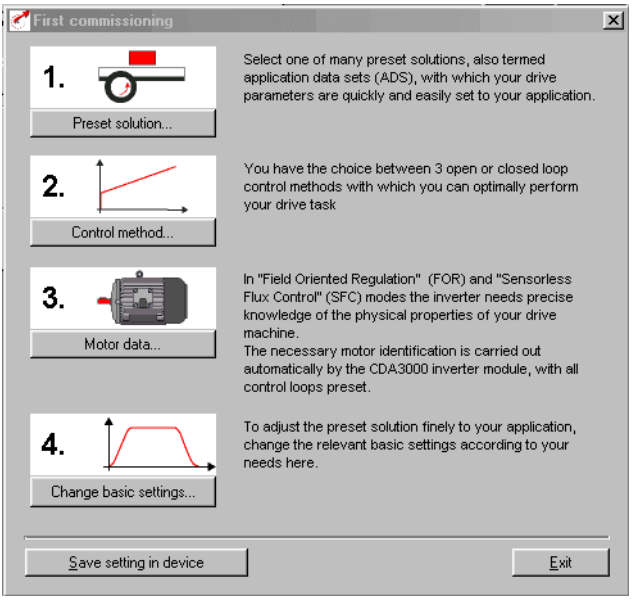


Figure 5.2 Setting the desired preset solution on the CDA3000.

Note: As well as being programmed in DRIVEMANAGER, the preset solution can also be selected via the bus system. For this, the value in brackets as shown in the table above is written to parameter 151-ASTER. A change causes an immediate change in the control and I/O configuration of the device. Changes must be saved in the device see “Data backup”. The functionality is not switched online. The device must always perform a mains reset following a change.

RXPD01 Static	Data bytes		
	Byte 0 and 1	Byte 2 and 3	Byte 4 and 5
200h	Control word, regardless of preset solution	Reference	

Table 5.1 CDA3000 control functions

RXPD01 Static	Data bytes			
	Byte 0 and 1	Byte 2 and 3	Byte 4 and 5	Byte 6 and 7
200h	Control word, regardless of preset solution	Control word, specific in preset solution	Additional data, dependent on preset solution	

Table 5.2 CDD3000 control functions

5.3 Reference data formats

Note: The unit of the reference value is dependent on the device type and the selected preset solution. On the CDA3000 the rotating field frequency is selected, and on the CDD3000 the torque, speed or position, depending on control mode.

Control word: See description of control word

Reference: Reference frequency for loop control

With CACNF=1: -> Value range: -32767 to +32768
Byte 2 = Reference Low byte
Byte 3 = Reference High byte

With CACNF=2 -4: -> Value range: -32767.999 to +32768.999
Byte 2 = Reference Low Word Low Byte
Byte 3 = Reference Low Word High Byte
Byte 4 = Reference High Word Low Byte
Byte 5 = Reference High Word High Byte

Example: Reference = 20.5 Hz

Reference data in Hex:

Byte	2	3	4	5
Contents	0	80	14	0
	$0.5 = 2^{-1}$		20 = 14 H	

Note: The value to be written is calculated by multiplying the actual reference by the factor 2^{16}.
e.g. $20.5 * 2^{16} = 1343488 = 148000$hex

5.3.1 Status messages

Function: Status/actual value
Data direction: Drive unit -> Master

Status messages are transmitted in the “operational” system state.

TXPD01 Static	Data bytes		
	Byte 0 and 1	Byte 2 and 3	Byte 4 and 5
180h	Status word, regardless of preset solution	Actual	

Table 5.3 CDA3000 status functions

TXPD01 Static	Data bytes			
	Byte 0 and 1	Byte 2 and 3	Byte 4 and 5	Byte 6 and 7
180h	Status word, regardless of preset solution	Status word, specific in preset solutions	Additional data, dependent on preset solution	

Table 5.4 CDD3000 status functions

5.4 Actual value data formats

Note: The unit of the actual value is dependent on the device type and the selected preset solution. On the CDA3000 the rotating field frequency is selected, and on the CDD3000 the torque, speed or position, depending on control mode.

Status word: See description of status word

Reference: Actual frequency for loop control

With CACNF=1 + 3: -> Value range: -32767 to +32768
Byte 2 = Actual Low byte
Byte 3 = Actual High byte

With CACNF=2 -4: -> Value range: -32767.999 to +32768.999
Byte 2 = Actual Low Word Low Byte
Byte 3 = Actual Low Word High Byte
Byte 4 = Actual High Word Low Byte
Byte 5 = Actual High Word High Byte

Example: Actual value = 20.5 Hz

Actual value data in Hex:

Byte	2	3	4	5
Contents	0	80	14	0
	$0.5 = 2^{-1}$		20 = 14 H	

Note: The actual value is calculated by dividing the absolute value readout by the factor 2^{16}.
e.g. 148000hex = 1343488 / 2^{16} = 20.5

RXPD01

With the aid of the RXPD01 it is possible to control the inverter and input references. The data content of this RXPD01 differs depending on the setting of the preset solution.

TXPD01

You can get status information on the device by way of the TXPD01.

5.5 PDO transmission types

In connection with the PDO transfer, various transmission types are defined in CAN_{open} profile DS301. The transmission type and event control can be set separately for all supported RXPDOs and TXPDOs.

The drive controller supports the following transmission types:

acyclic synchronous Type No. 0 h

Meaning: The acyclic synchronous transmission type represents the transmission of a PDO in conjunction with a Sync object, i.e.
RXPDOs are only evaluated on receipt of a Sync object in the device; TXPDOs are only transmitted following receipt.

cyclic synchronous Type No. 1-F0 h

Meaning: The difference between this and the acyclic synchronous transmission type is that RXPDOs are only evaluated after receipt of 1-F0 h Sync objects and TXPDOs are only transmitted every 1-F0 h Sync objects.

asynchronous Type No. FE h

Meaning: RXPDOs are evaluated immediately on receipt;
TXPDOs are transmitted by a device-specific event. The Sync object is irrelevant to this mode of transfer.

Note: The status information of the TXPDO1 is regularly updated. Parameter 575-CASCY determines the refresh rate of the status and actual value information in ms. For the synchronous transmission type parameter
575-CASCY can be set to 1ms.

Meanings of the transfer types based on the example of the static RXPDO1 and TXPDO1:

Value	RXPDO1	TXPDO1
00h	On receipt of RXPDO1/ the drive controller adopts the control word and reference value only after the next Sync object (response time approx. 1ms).	The current status word and actual value are only transmitted in the form of the TXPDO1 on receipt of the next Sync object.
1-F0h	On receipt of RXPDO1/2 the drive controller adopts the control word and reference value only after 1 -F0h Sync objects (response time approx. 1ms).	The current status word and actual value are only transmitted in the form of the TXPDO1/2 on receipt of 1-F0h Sync objects.
FEh	On receipt of RXPDO1/2 the drive controller adopts the control word and reference value immediately (response time approx. 1ms).	TXPDO1/2 is transmitted according to the event control setting (see section 5.1).

5.6 EasyDrive-Basic, control of speed-controlled CDA3000, CDD3000 drives

In EasyDrive control mode, specific functions of the device are activated with the individual control bits. Thus, for example, the STR (Start Clockwise) function can be selected by setting just one control bit. It is also possible here to transfer unassigned control terminals to the control for other process tasks.

EasyDrive Basic is active on the CDA3000 in the following preset solutions:

- BUS_1(9)=Field bus operation, control and reference via bus
- BUS_2(10)=Field bus operation, manual mode with analog reference
- BUS_3(11)=Field bus operation, manual mode with analog reference, limit switches

This activation configuration is active on the CDD3000 in the following preset solutions:

- SCB_5(9)=Speed control, reference via field bus, control via field bus

The following preset solutions use only the digital control information of data bytes 0 and 1. The reference channel via field bus is not active. The reference is then set via a terminal (analog or digital), as described in the Application Manual.

- SCB_2(4)=Speed control, +/-10V reference, control via field bus
- SCB_3(6)=Speed control, fixed speeds, control via field bus
- SCB_2(3)=Speed control, pulse input, control via field bus

Control word		
Data bytes 0 and 1		
Bit	**Function**	**Signal**
0	START, enable control	1 = Controller enable, only in conjunction with contact ENPO = 1
1	INV, invert reference	1 = Inverts the preceding sign of the current reference
2	STOP, emergency stop	0->1 = Device executes emergency stop
3	E-EXT, set device to error state	1 = Trigger external error in device
4	FFTB0, select table reference (significance 2^0) *	Binary selection of a table reference [1] ONLY CDA3000
5	FFTB1, select table reference (significance 2^1) *	
6	FFTB2, select table reference (significance 2^2) *	
7	ERES, reset error	0->1 = Reset current device error
8	CUSEL, data selection **	0 = Characteristic data set 1, 1 = Characteristic data set 2 [2] ONLY CDA3000
9	UM0, select user mode (significance 2^0) ***	Binary selection of active user mode [3] Only CDA3000
10	UM1, select user mode (significance 2^1) ***	
11	vacant	
12	vacant	
13	Reference status OSD02 if 242 -FOS02=OPTN2	1 = Output OSD02 = high
14	Reference status OSD01 if 241 -FOS01=OPTN2	1 = Output OSD01 = high
15	Reference status OSD00 if 240 -FOS00=OPTN2	1 = Output OSD00 = high
Data bytes 2 and 5		
Byte	Function	Signal
2	32-bit reference, LW LB	Reference CDA: Hz, data format INT32Q16[1] CDD/CTC: rpm, data format INT32Q16[1]
3	32-bit reference, LW HB	
4	32-bit reference, HW LB	
5	32-bit reference, HW HB	
[1] see Table 4.2		

Table 5.5 EasyDrive Basic control word on CDA3000 and CDD3000

* - CDA3000, only if 280-RSSL1=(7) TBSEL
* - CDD3000, only if 280-RSSL1=(7) RFIX
** - CDA3000, only if 651-CDSSL=(6) OPTN2
*** - CDA3000, only if 166-UDSSL=(3) OPTN2

Status word		
Data bytes 0 and 1		
Bit	**Function**	**Signal**
0	ERROR, device in error state	1 = General error
1	CAN status	0 = (System Stop) 1 = (System Start)
2	REF, reference reached	1 = Reference reached
3	LIMIT, reference limitation active	1 = Reference limited by FMIN or FMAX
4	ACTIV, power stage activated	1 = Power stage active
5	ROT_0, speed 0Hz	1 = Speed 0 or rpm
6	BRK, device executes braking	1 = Device executes DC braking Only CDA3000
7	C-RDY, ready to start and control initialized	1 = Device ready to start, initialization OK, after **changing parameters not changeable online the initialization is executed on the next controller enable!**
8	ENPO, Status of input ENPO	Status of input ENPO (hardware enable)
9	Actual status output OSD00	Status of output OSD00 (prog. Default=OPTN2)
10	Actual status output OSD01	Status of output OSD01 (prog. Default=OPTN2)
11	vacant	–
12	Actual status ISD03, irrespective of 213-FIS03	Status of input ISD03 (prog. Default=OPTN2)
13	Actual status ISD02, irrespective of 212-FIS02	Status of input ISD02 (prog. Default=OPTN2)
14	Actual status ISD01, irrespective of 211-FIS01	Status of input ISD01 (prog. Default=OPTN2)
15	Actual status ISD00, irrespective of 210-FIS00	Status of input ISD00 (prog. Default=OPTN2)
Data bytes 2 and 5		
Byte	Function	Signal
2	32-bit actual, LW LB	Actual value: CDA: Hz, data format INT32Q16[1)] CDD/CTC: rpm, data format INT32Q16[1)]
3	32-bit actual, LW HB	
4	32-bit actual, HW LB	
5	32-bit actual, HW HB	
[1)] see Table 4.2		

Table 5.6 EasyDrive Basic status word on CDA3000 and CDD3000

Additional notes on:

1 General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

2) CDA3000:

Corresponds to activation by way of terminal in accordance with application data set DRV_5 or ROT_3; see Application Manual. The activation in this case is delivered only via the control word of the CAN bus. In the reference structure of the CDA3000 the function is activated by setting 280 -RSSL1 = TBSEL (7). Direct reference input is then not possible.

CDD3000:

Corresponds to activation by way of terminal in accordance with the speed control application data sets; see Application Manual. The activation in this case is delivered only via the control word of the CAN bus. In the reference structure of the CDD3000 the function is activated by setting 280-RSSL1 = RFIX (7). Direct reference input is then not possible.

2) CDA3000 only: Function only active with setting 651-CDSSL = (6) OPTN2. The bit can be used to switch between characteristic data sets 1 and 2. For more detailed information on characteristic data set switchover refer to the Application Manual.

3) The CDA3000 offers the facility to store 4 complete parameter data sets (user modes). You can switch between the user data sets by setting 166-UDSSL = (3) OPTN2 by way of the CAN control word. The switch-over can only be made in STANDBY (power stage not active). The switch-over takes about 2 seconds.

Note: For more information on the setting and availability of these functions refer to the Application Manual.

5.6.1 Activation of a CDA3000

EasyDrive Basic control mode

Preconditions:

1. CM-CAN2 communication module connected
2. Activate the desired preset solution for bus operation with parameter 152-ASTER = BUS_1, BUS_2 or BUS_3 or
3. set the following explicit minimum presetting of the parameters: Minimum presetting of device parameters:

- Parameter 260-CLSEL = (5) OPTN2
- Parameter 280-RSSL1 = (7) FOPT2
- Parameter 581-COBDR = (2) 500 Set baud rate
- Parameter 580-COADR = 1 Device address
- Parameter 492-CACNF = 4 EasyDrive Basic control mode
  Save settings in device - 150-SAVE = (1) BUSY

4. Mains reset to reinitialize
5. Wire control contact hardware enable ENPO

Action	ID	data	Comments
Log on system	81h	No	The CDA transmits this identifier once.
Start system	For all CDAs: 00h	01 00	The master sends “System Start”. With this command the control commands stored in the control word of the CDA are activated.
Transmit RXPDO	For CDA1: 201h For CDA2: 202h etc.	00 00 00 00 00 00 00	The master transmits the RXPDO to the CDA.
Transmit RXPDO	For CDA1: 201h For CDA2: 202h etc.	01 00 00 0000A 00	Example: CDA 1 is to rotate clockwise at 10 rpm
Status message	For CDA1: 881h For CDA1: 882h etc.	96 01 00 00 0A 00	Example: CDA 1 rotates clockwise at 10 rpm.

Table 5.7 Example: EasyDrive Basic CDA3000

5.6.2 Parameter setting

Action	ID	data	Comments
Poll parameter	601h	68 01 05 XX XX XX XX 00	Poll parameter to be displayed as continuous actual value (parameter 360-DISP)
Reply from CDA	581h	68 01 00 96 01 00 00 00	Message: Parameter 360-DISP = 406 (406-REFF Current reference frequency)
Send parameter	601h	68 01 02 0E 00 00 00 00	Set parameter 360-DISP to 14-MIST (actual torque)
Reply from CDA	581h	68 01 00 0E 00 00 00 00	Checkback from CDA after successful data transfer

Table 5.8 Example: Parameter setting

5.6.3 Activation of a CDD3000

EasyDrive Basic control mode

Preset:

- Load motor data via DRIVEMANAGER user interface
- Set preset solution SCB_5(9)=Speed control, reference and control via field bus via DRIVEMANAGER user interface
- Optimize controller as per Operation Manual
- In DRIVEMANAGER menu under “Bus systems” adapt following values:
  - Set baud rate (parameter 581-COBDR = 500)
  - Device address (parameter 580-COADR = 1)
  - Control mode: Terminal emulation (parameter 492-CACNF = 4)
- Data backup (parameter 150-SAVE=1)
- Mains reset to reinitialize
- Wire control contact hardware enable ENPO

The following parameters must be set as a minimum in order to enable field bus activity (set automatically by presetting):

- Parameter 402-CLSEL = FOPT2
- Parameter 419-RSSL3 = FOPT2
- Parameter 581-COBDR = 500 Set baud rate
- Parameter 580-COADR = 1 Device address
- Parameter 492-CACNF = 4 (speed-controlled) Control mode Terminal emulation

Action	Who is transmitting	ID on bus	Data bytes	Comments
Log on system	CDD 1	81h	None	The CDD transmits this identifier once.
Start system	Master	For all CDDs: 00h	01 00	The master sends “System Start”. With this command the control commands stored in the control word of the CDD are activated.
Transmit RXPDO	Master	For CDD 1: 201h For CDD 2: 202h etc.	01 00 00 00 0A 00	Example: CDD 1 is to rotate clockwise at 10 rpm
Status message	CDD	For CDD1: 181h For CDD2: 182h etc.	96 01 00 00 0A 00	Example: CDD 1 rotates clockwise at 10 rpm

5.7 DRIVECOM, control with DRIVECOM state machine, CDA3000, CDD3000

To control a drive unit in the second control mode over CAN, the state machine defined in DRIVECOMprofile no. 20 of January 1994 for INTERBUS-S must be followed. Reference input is based on the setting of the control mode (CAN configuration) in parameter 492 -CACNF = 1 ... 3.

DRIVECOM is possible on the CDA3000 in the following preset solutions:

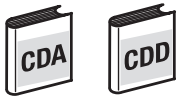
- BUS_1(9)=Field bus operation, control and reference via bus
- BUS_2(10)=Field bus operation, manual mode with analog reference
- BUS_3(11)=Field bus operation, manual mode with analog reference, limit switches

This activation configuration is possible on the CDD3000 in the following preset solutions:

- SCB_5(9)=Speed control, reference via field bus, control via field bus

The following preset solutions use only the digital control information of data bytes 0 and 1. The reference channel via field bus is not active. The reference is then set via a terminal (analog or digital), as described in the Application Manual.

- SCB_2(4)=Speed control, +/-10V reference, control via field bus
- SCB_3(6)=Speed control, fixed speeds, control via field bus
- SCB_2(3)=Speed control, pulse input, control via field bus



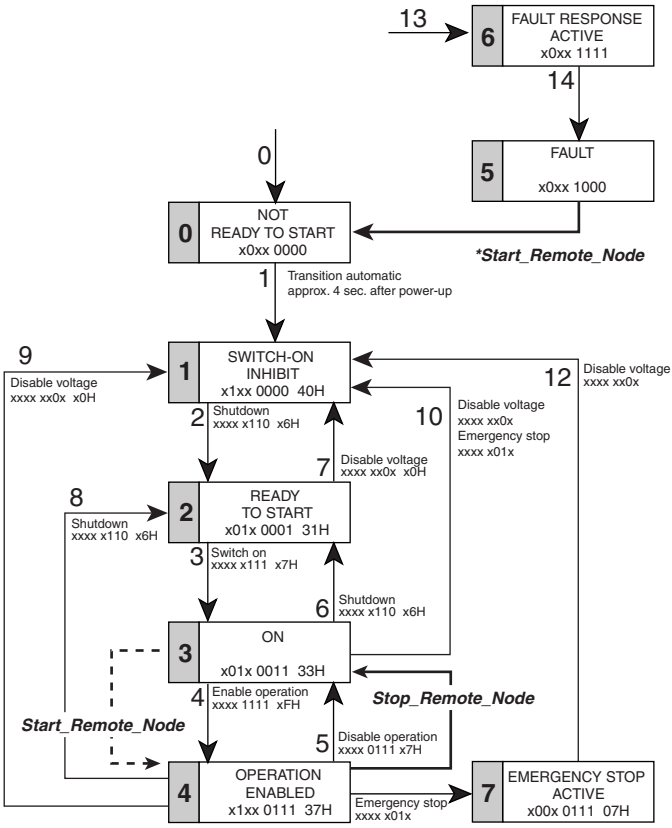


Figure 5.3 DRIVECOM state machine with 492-CACNF = 1 ...3 on CDA3000 and CDD3000

Control word		
Data bytes 0 and 1		
Bit	**Function**	**Signal**
0	Activate	See following state table
1	Disable power	
2	Emergency stop	
3	Enable operation	
4	FFTB0, select table reference (significance 2^0) *	Binary selection of a table reference [1] Only CDA3000
5	FFTB1, select table reference (significance 2^1) *	
6	FFTB2, select table reference (significance 2^2) *	
7	Reset fault	0->1 = Reset current device error
8	CUSEL, data selection **	0 = Characteristic data set 1, 1 = Characteristic data set 2 [2] Only CDA3000
9	UM0, select user mode (significance 2^0) ***	Binary selection of active user mode [3] Only CDA3000
10	UM1, select user mode (significance 2^1) ***	
11	vacant	vacant
12	vacant	vacant
13	Reference status OSD02 if 242 -FOS02=OPTN2	1 = Output OSD02 = high
14	Reference status OSD01 if 241 -FOS01=OPTN2	1 = Output OSD01 = high
15	Reference status OSD00 if 240 -FOS00=OPTN2	1 = Output OSD00 = high
Data bytes 2 and 5		
Byte	Function	Signal
2	32-bit reference, LW LB	Reference CDA: Hz, data format INT32Q16[1] CDD/CTC: rpm, data format INT32Q16[1]
3	32-bit reference, LW HB	
4	32-bit reference, HW LB	
5	32-bit reference, HW HB	
[1] see Table 4.1		

Table 5.9 DRIVECOM control word in control mode (492-CACNF) = 1 ... 3

* CDA3000, only if 280-RSSL1=(7) TBSEL
CDD3000, only with 280-RSSL1=(7) RFIX
** CDA3000 - only if 651-CDSSL=(6) OPTN2
*** CDA3000, only if 166-UDSSL=(3) OPTN2

Status word		
Data bytes 0 and 1		
Bit	**Function**	**Signal**
0	Ready for start	See state table
1	On	
2	Enable operation	
3	Error	
4	Power disabled	1 = Voltage disabled, function not implemented
5	Emergency stop	See state table
6	Switch-on inhibit	
7	Warning	1 = Warning delivered
8	CAN status	0 = System Stop 1 = System Start
9	Remote	1 = Parameter setting possible
10	Reference reached	1 = Reference reached
11	Limit value	1 = F_{min} F_{max} limitation active
12	Status of input ISD03	Parameterizable, default = BUS
13	Status of input ISD02	
14	Status of input ISD01	
15	Status of input ISD00	
Data bytes 2 and 5		
Byte	Function	Signal
2	32-bit reference, LW LB	Actual value: CDA: Hz, data format INT32Q16[1)] CDD/CTC: rpm, data format INT32Q16[1)]
3	32-bit reference, LW HB	
4	32-bit reference, HW LB	
5	32-bit reference, HW HB	
1) see Table 4.1		

Table 5.10 DRIVECOM status word in control mode (492-CACNF) = 1 ... 3

* CDA3000, only if 280-RSSL1=(7) TBSEL
CDD3000, only with 280-RSSL1=(7) RFIX
** CDA3000 - only if 651-CDSSL=(6) OPTN2
*** CDA3000, only if 166-UDSSL=(3) OPTN2

Additional notes on:

1 General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

2) CDA3000:

Corresponds to activation by way of terminal in accordance with application data set DRV_5 or ROT_3; see Application Manual. The activation in this case is delivered only via the control word of the CAN bus. In the reference structure of the CDA3000 the function is activated by setting 280-RSSL1 = TBSEL (7). Direct reference input is then not possible.

CDD3000:

Corresponds to activation by way of terminal in accordance with the speed control application data sets; see Application Manual. The activation in this case is delivered only via the control word of the CAN bus. In the reference structure of the CDD3000 the function is activated by setting 280-RSSL1 = RFIX (7). Direct reference input is then not possible.

2) CDA3000 only: Function only active with setting 651-CDSSL = (6) OPTN2. The bit can be used to switch between characteristic data sets 1 and 2. For more detailed information on characteristic data set switchover refer to the Application Manual.

3) The CDA3000 offers the facility to store 4 complete parameter data sets (user modes). You can switch between the user data sets by setting 166-UDSSL = (3) OPTN2 by way of the CAN control word. The switchover can only be made in STANDBY (power stage not active).

Note: For more information on the setting and availability of these functions refer to the Application Manual.

Bit combinations of the DRIVECOM state machine

Device control commands

The following bit combinations of control bits 0-3 and 7 form the device control commands for the state transitions of the state machine:

	Control bit					
Command	**7**	**3**	**2**	**1**	**0**	**Transitions**
SHUTDOWN	X	X	1	1	0	2, 6, 8
POWER-UP	X	X	1	1	1	3
DISABLE POWER	X	X	X	0	X	7, 9, 10, 12
EMERGENCY STOP	X	X	0	1	X	11
DISABLE OPERATION	X	0	1	1	1	5
ENABLE OPERATION	X	1	1	1	1	4
RESET FAULT	0 > 1	X	X	X	X	15

Device status

The bits of the DRIVECOM status word presented below indicate the current system state:

	Status bit					
Status	**6**	**5**	**3**	**2**	**1**	**0**
NOT READY	0	X	0	0	0	0
SWITCH-ON INHIBIT	1	X	0	0	0	0
READY	0	1	0	0	0	1
ON	0	1	0	0	1	1
OPERATION ENABLED	0	1	0	1	1	1
FAULT	0	X	1	0	0	0
FAULT RESPONSE ACTIVE	0	X	1	1	1	1
EMERGENCY STOP ACTIVE	0	0	0	1	1	1

Table 5.11 Bit combinations of the DRIVECOM state machine

5.7.1 Example: Control mode, DRIVECOM state machine

Preconditions:

1. CANopen communication module (CM-CAN2) connected
2. Activate the desired application data set for bus operation with parameter 152-ASTER = BUS_1, BUS_2 or BUS_3 (subject area _15FC Initial commissioning) or
3. explicitly make the following minimum parameter presetting.

Minimum device parameter presetting:

- Parameter 260-CLSEL = (5) OPTN2
- Parameter 280-RSSL1 = (7) FOPT2
- Parameter 581-COBDR = (2) 500 Set baud rate
- Parameter 580-COADR = 1 Device address
- Parameter 492-CACNF = 2 DRIVECOM control mode

4. Save settings in device - 150-SAVE = (1) BUSY
5. Mains reset to reinitialize
6. Wire control contact hardware enable ENPO

Action	ID	Data	Comments
Log on system	81h	None	The CDA transmits this identifier once.
Start system	For all CDAs: 00h	01 00	The master sends “System Start”. With this command the control commands stored in the control word of the CDA are activated.
Send control identifier	For CDA1: 201h for CDA2: 202h etc.	00 00 00 00 00 00 00 00	The master transmits the RXPD0
Transmit RXPD0	For CDA1: 201h for CDA2: 202h etc.	00 00 00 00 0A 00 00	Example: CDA 1 is to dwell in the “Ready for start” state. Reference value 10 rpm clockwise applied.
Status message	For CDA1: 181h for CDA2: 182h etc.	40 02 00 00 00 00 00	Example: CDA 1 signals “Ready” state.
Transmit RXPD0	For CDA1: 201h for CDA2: 202h etc.	06 00 00 00 0A 00 00	Example: CDA 1 is to switch from “Ready” to “On”. Reference value 10 rpm clockwise applied.
Status message	For CDA1: 181h for CDA2: 182h etc.	31 02 00 00 00 00 00	Example: CDA 1 signals “On” state.

Table 5.12 Example: DRIVECOM state machine

Action	ID	Data	Comments
Transmit RXPDO	For CDA1: 201h for CDA2: 202h etc.	0F 00 00 00 0A 00 00	Example: CDA 1 is to switch from “On” to “Operation enabled”. Reference value 10 rpm clockwise applied.
Status message	For CDA1: 181h for CDA2: 182h etc.	37 02 00 00 0A 00 00	Example: CDA 1 rotates clockwise at 10 rpm and signals “Operation enabled”.

Table 5.12 Example: DRIVECOM state machine

5.7.2 CDD3000: Control mode: DRIVECOM state machine

Preset:

- Load motor data via DRIVEMANAGER user interface
- Activate speed control preset solution via DRIVEMANAGER user interface
- Optimize controller
- Adapt following parameters in DRIVEMANAGER menu under “Bus systems”:
  Parameter 489-COBDR = 500 Set baud rate
  Parameter 580-COADR = 1 Device address
  Parameter 492-CACNF = **2** DRIVECOM state machine control mode
- Mains reset to reinitialize
- Wire control contact hardware enable ENPO

Action	Who is transmitting	ID on bus	Data bytes	Comments
Log on system	CDD 1	81h	None	The CDD transmits this identifier once.
Transmit RXPDO	Master	For CDD1: 201h For CDD2: 202h etc.	00 00 00 00 00 00	The master sends the RXPDO to the CDD to terminate the system logon. The transmitted data are only relevant when “System Start” is set.
Start system	Master	For all CDDs: 00h	01 00	The master transmits “GO operational”. With this command the control commands stored in the control word of the CDD are activated.
Status message	CDD	For CDD1: 181h For CDD2: 182h etc.	40 02 00 00 00 00	Example: CDD 1 signals “Ready” state.

Transmit RXPDO	Master	For CDD1: 201h For CDD2: 202h etc.	06 00 00 00 0A 00	Example: CDD 1 is to switch from “Ready” to “On”. Reference value 10 rpm clockwise applied.
Status message	CDD	For CDD1: 181h For CDD2: 182h etc.	31 02 00 00 00 00	Example: CDD 1 signals “On”
Transmit RXPDO	Master	For CDD1: 201h For CDD2: 202h etc.	0F 00 00 00 0A 00	Example: CDD 1 is to switch from “On” to “Operation enabled”. Reference value 10 rpm clockwise applied.
Status message	CDD	For CDD1: 181h For CDD2: 182h etc.	37 02 00 00 0A 00	Example: CDD 1 rotates clockwise at 10 rpm and signals “Operation enabled”

Parameter setting

Action	Who is transmitting	ID on bus	Data bytes	Comments
Poll parameter	Master to CDD1	601h	25 03 05 XX XX XX XX 00	Query torque scaling parameter (parameter 805-SCALE)
Reply from CDD	CDD1	581h	25 03 00 64 00 00 00 00	Message: Parameter SCALE = 100 %
Send parameter	Master to CDD1	601h	25 03 02 50 00 00 00 00	Setting of parameter 805 = 80 %
Reply from CDD	CDD1	581h	25 03 00 50 00 00 00 00	Checkback from CDD after successful data transfer

5.8 EasyDrive ProgPos

Fully programmable positioning and sequence control CDD3000

General introduction:

Preset solution: PCB_4(16)=Positioning, fully programmable, control via field bus

The “ProgPos” position and sequence control mode requires a sequence program to be installed on the servocontroller to control the movement solution. The sequence program can be influenced by way of digital inputs or by altering variables (codes H00 - H99) or flags (codes M00 - M99). In the control protocol the use of flags M90-97 and variable H98 is fixed. If the control process requires more variables, mapping of the second control identifier or the parameter channel can be used for the purpose. The same applies to status information. See also section 5.1 “Mapping function on the CDD3000” and the relevant example in that section.

The following device parameters are important in value transfer for position control:

Function	Parameter	Value range
Variables H00 – H99	728-POVAR (subindex 0-99)	32-bit signed
Flags M00 – M99	729-POMER (subindex 0-99)	0 – 1
Table positions T00 – T15	727-POTAB (subindex 0-15)	32-bit signed

For all other parameters refer to the Application Manual.

Special features:

When configuring the servocontroller note that the configuration comprises a parameter set and a sequence program. The parameter set must in all cases be stored in the device before the sequence program is accepted.

Further documentation on using the mode:

· CDD3000 Application Manual

Control functions:

EasyDrive ProgPos control word		
Data bytes 0 -1		
Bit	**Function**	**Signal**
0	START, enable control	1 = Controller enable only in conjunction with contact ENPO=1
1	-	-
2	STOP, emergency stop	0->1 = Device executes emergency stop
3	E-EXT	1 = Trigger external error in device
4-6	-	-
7	ERES, reset error	0->1 = Reset current device error
8-11	-	-
12	Target status OSD03	1 = Output OSD03 = high if 243- FOS03=OPTN2(13)
13	Target status OSD02	1 = Output OSD02 = high if 242- FOS02=OPTN2(13)
14	Target status OSD01	1 = Output OSD01 = high if 241- FOS01=OPTN2(13)
15	Target status OSD00	1 = Output OSD00 = high if 240- FOS00=OPTN2(13)
Data byte 2		
Bit	Function	Signal
0	Enable automatic mode	1= Activate automatic mode, sequence program can be run
1	Start sequence prg. /start ref.run	0->1= In man.mode referencing, in automatic mode start program
2	/update	1 = Interrupts sequence program, ongoing positioning job is terminated
3	/feed hold	1 = Interrupts sequence program and ongoing positioning job
4+5	-	Vacant
6	Jog+	1 = Jog at slow jog speed In pos. direction (only in manual mode)
7	Jog-	1 = Jog at slow jog speed In neg. direction (only in manual mode)
Data byte 3		
Bit	Function	Signal
0-7	Flags M90 to M97	Target status flags 90 -97 (parameter 729-POMER, element 90 - 97)
Data bytes 4 -7		
Byte	Function	Signal
4	Variable H98, LW LB	32-bit reference of variable H98 (parameter 728-POVAR, element 98) Format: Intel Example: Value 100000 = A0 86 01 00
5	Variable H98, LW HB	
6	Variable H98, HW LB	
7	Variable H98, HW LB	

Table 5.13 EasyDrive ProgPos control word on CDD3000 with setting PCB_4(16)=Positioning, fully programmable, control via field bus

EasyDrive ProgPos status word		
Data bytes 0 -1		
Bit	**Function**	**Signal**
0	ERROR	1 = General error, device in error state
1	CAN status	0 = (System Stop), 1 = (System Start)
2	REF, reference reached	1 = Reference reached, (position)
3	LIMIT, reference limitation active	1 = Reference value limited via preset maximum speed
4	ACTIV, power stage activated	1 = Power stage active, current applied to motor
5	ROT_0, speed 0Hz	1 = Speed < as preset standstill window
6	-	-
7	C-RDY	1 = Device ready to start, initialization OK,after changing parameters not changeable online the initialization is executed on the next controller enable!
8	ENPO, Status of input ENPO	Status of input ENPO (hardware enable)
9	Actual status output OSD00	Status of output OSD00, parameterizable
10	Actual status output OSD01	Status of output OSD01, parameterizable
11	Vacant	
12	Actual status ISD03	Status of input ISD03, irrespective of 213-FIS03
13	Actual status ISD02	Status of input ISD02, irrespective of 212-FIS02
14	Actual status ISD01	Status of input ISD01, irrespective of 211-FIS01
15	Actual status ISD00	Status of input ISD00, irrespective of 210-FIS00
Data byte 2		
Bit	Function	Signal
0	Reference point defined	1 = Ref.point defined, positioning jobs possible
1	Automatic mode active	1 = Sequence program can be started
2	Sequence program active	1= Sequence program running
3	-	-
4	/feed hold	1= Feed hold set, see below
5	/update	1= Update set, see below
6	Synchronism	1= Axis running synchronous to master axis (electronic gearing)
7	Tracking error	1= Lag distance greater than preset tolerance
Data byte 3		
Bit	Function	Signal
0-7	Flags M80 to M87	Actual status flags M80-87 (parameter 729-POMER, element 80-87)
Data bytes 4 -7		
Byte	Function	Signal
4	Actual position in distance units LW LB	32-bit actual value of position control parameter 754-POAIP Format:Intel / e.g.: 100000 = A0 86 01 00hex
5	Actual position in distance units LW HB	
6	Actual position in distance units HW LB	
7	Actual position in distance units HW HB	

General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

729-POMER[xx]: Flag parameters in CDD3000. Used to transfer information into and out of the sequence program to the PLC.

728POVAR[xx]: Variables parameters in CDD3000. Used to transfer information into and out of the sequence program to the PLC.

The following terms are described in more detail in the Application Manual.

* Manual mode / Automatic mode: In manual mode the manual “referencing and jog” functions can be used. In automatic mode the drive can be moved by way of the sequence program. If automatic mode is quit during a positioning job, the movement is aborted and the axis stopped by an emergency stop.

** Sequence program: The sequence program is started in the controller when DB2 bit10 is set in the status.

*** Reference point defined: As soon as referencing is complete DB2 bit 8 is set in the status.

**** Update: The update controls processing of the lines of the sequence program. When the update bit is set the program processing is interrupted.

***** Feed hold: Feed hold controls processing of the driving profile generator. When the feed hold bit is set the current positioning command is interrupted, the drive brakes on the braking ramp down to a standstill. When freed hold is restored the interrupted positioning job is resumed.

5.8.1 Example: Easy-Drive ProgPos activation

Task:

Load a sequence program into the servo axle and activate it over CAN.

In this process, the positioning is to be controlled by the status of a flag between the absolute position 0 and a freely adjustable position.

Presets:

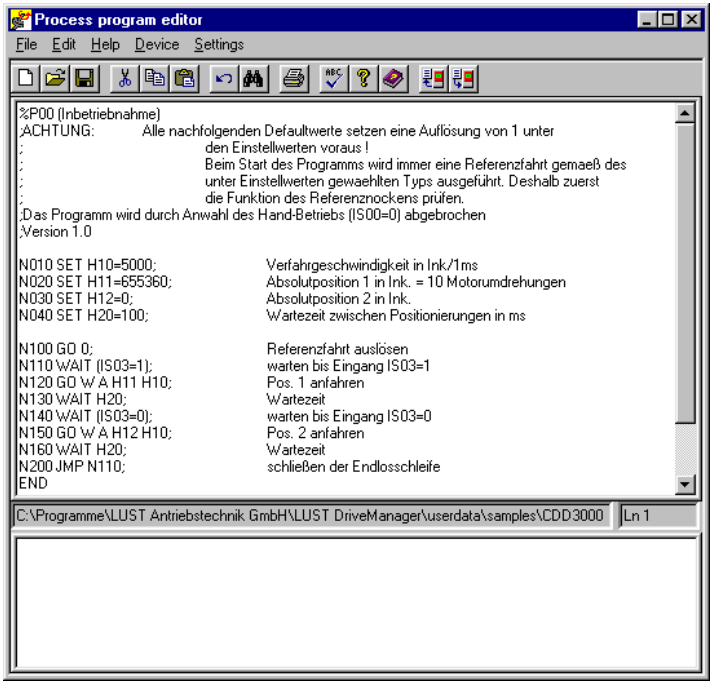
- Load motor data set via DriveManager user interface
- Activate “PCB_4(16)=Positioning, fully programmable, control via field bus” mode from Drivemanager user interface
- Adapt following parameters under “Bus systems” menu option:

489-CLBDR = 500Set baud rate

571-CLADR = 1Device address

- Load sequence program into servocontroller; see Application Manual
- Back up data in device
- Mains reset to activate changed settings
- Wire control contact hardware enable ENPO

Example sequence program “doku_bsp.prg”:



Flag M90 triggers the positioning operations with an edge change.

Variable H98 contains the freely selectable reference position. Unit = increments

Note: The transfer mode of the status message can be set by parameter 148-TXEV1. In this regard see section 5.3.1 Cyclic transmission is activated as the factory default. In the Easy-Drive ProgPos preset solution acyclic transmission in the event of changes to the CAN status (148-TXEV1 = 4000hex) may sometimes be beneficial. The virtual outputs, too, can additionally be used as event triggers, e.g. the reference point defined message.

The facility to use ProgPos flags (M98 and M99) as event triggers means an event can also be generated directly from the sequence program.

By an appropriately tailored setting, this mechanism can be used to set up a handshake with the PLC.

By way of parameter 149-TXEV2 the event control parameters for the second status message can be set.

The drive can now be started with input ENPO set, with the following control sequence:

	ID(hex)	Data bytes	Comments
Master	DD	01	System start
Master	296	01 00 00 00 00 00 00 00	Controller enable (START), power stage is activated
CDD	372	B6 01 00 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 01 00 00 00 00 00	Automatic mode activated
CDD	372	B6 01 02 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 03 00 00 00 00 00	Start sequence program
CDD	372	B6 01 07 00 00 00 00 00	Device status message sequence prog. running, reference point defined (I/Os ignored)
Master	296	01 00 03 00 00 00 0A 00	POMER[90] = 0 ;POVAR[98] = 655360 incr., target position = 10 motor revolutions (absolute)
CDD	372	B6 01 07 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 03 01 00 00 0A 00	POMER[90] = 1, Start positioning POVAR[98] = 655360 incr.
CDD	372	B6 01 07 00 00 00 0A 00	Device status after position reached, some status bits change in the meantime
Master	296	01 00 03 00 64 00 00 00	POMER[90] = 1, Start positioning POVAR[98] = 100 incr.
CDD	372	B6 01 07 00 00 00 0A 00	Device status after position reached, some status bits change in the meantime
Master	297	01 00 00 00 00 00 00 00	Disable automatic mode, ongoing movement is aborted, axis stops under position control
CDD	372	B6 01 09 00 00 00 00 00	Device status message (I/Os ignored)
Master	297	00 00 00 00 00 00 00 00	Cancel controller enable
CDD	372	A6 01 01 00 00 00 00 00	Power stage off

Table 5.14 Control sequences

5.8.2 Loading and deleting the positioning program of the positioning and sequence control

A positioning program can be downloaded line-by-line to the ProgPos software by writing to the string parameter 551-POCMD-ProgPos Direct command input in manual mode.

Example program:

%P00 (Commissioning)	
N010 SET H10=5000;	Positioning speed in inc/5ms
N020 SET H11=655360;	Absolute position 25.40 mm inc. = 10 motor revs
N030 SET H12=0;	Absolute position 2 in inc.
N040 SET H20=100;	Waiting time between positioning operations in ms
N100 GO 0;	Trigger referencing
N110 JMP (M90=1) N110;	wait until M90=1
N120 GO W A H11 H10;	Approach pos. 1
N130 WAIT H20;	Waiting time
N140 JMP (M90=0) N140;	wait until M90=0
N150 GO W A H12 H10;	Approach pos. 2
N160 WAIT H20;	Waiting time
N200 JMP N110;	Close endless loop
END	

Table 5.15 Example program

The example program generated above is transferred line-by-line as a string via the parameter channel to the servocontroller. The comments separated by semicolons are eliminated in the process. The write operation is to parameter 751-POCMD.

That is to say, the following strings are transmitted as data:

1. String	“%P00 (Commissioning)”
2. String	“N010 SET H10=5000”
3. String	“N020 SET H11=655360”
14. String “END”	Servo detects end of program transmission
15. String “%SAV”	Back-up program code in Flash. The execution time is dependent on the program length (approx. 1.000 ms).

Table 5.16

Note: The program sets being transferred must have no comments or semicolons at the end, otherwise the transfer will be rejected by the device.

If a sequence program is to be overwritten, the original must first be deleted from the device memory. To this end the following string is transmitted:

"%CLPxx"
↳ xx = Program number 00-99

If the string “xx” is actually inserted for the program number, all sequence programs in the servocontroller are deleted!

Attention: Sequence programs can only be transmitted with the sequence control in manual mode!

5.9 EasyDrive TabPos

Position control with table positions, CDD3000

General introduction:

Preset solution: PCB_3(14)= Positioning, fixed positions, control via field bus

See Application Manual for procedure to activate “Position control with table positions” mode.

31 positioning sets are available, and can be edited on the DRIVEMANAGER user interface in table form. The parameters can also be changed by way of the parameter channel. For this the following parameters need to be written to:

Function	Parameter	Value range
Target positions	555-PDPOS (subindex 0-31)	32-bit signed
Mode (absolute/relative)	556-PDMOD (subindex 0-31)	0 – 1
Velocity	557-PDSPD (subindex 0-31)	31-bit unsigned
Startup acceleration	558-PDACC (subindex 0-31)	32-bit unsigned
Braking acceleration	559-PDDEC (subindex 0-31)	32-bit unsigned

Attention: The sequence of the individual activation signals must be followed.

For further documentation on using the mode refer to the Application Manual.

EasyDrive TabPos control word		
Data bytes 0 -1		
Bit	Function	Signal
0	START	1 = Controller enable only in conjunction with contact ENPO=1
1	-	-
2	STOP, emergency stop	0->1 = Device executes emergency stop
3	E-EXT	1 = , Set device to error state, trigger external error on device
4-6	-	-
7	ERES	0->1 = Reset current device error
8-11	-	-
12	Target status OSD03	1 = Output OSD03 = high if 243- FOS03=OPTN2
13	Target status OSD02	1 = Output OSD02 = high if 242- FOS02=OPTN2
14	Target status OSD01	1 = Output OSD01 = high if 241- FOS01=OPTN2
15	Target status OSD00	1 = Output OSD00 = high if 240- FOS00=OPTN2
Data byte 2		
Bit	Function	Signal
0	Automatic	Switches between manual and automatic mode
1	Start referencing/Start driving job	1= In manual mode: Referencing, In automatic mode: Start driving job
2	Execute job immediately	1= Ongoing driving job is overwritten immediately with the new job
3	/feed hold	1= Interrupts ongoing position job
4+5	-	Vacant
6	Jog+	1= Jog at slow jog speed in pos. direction
7	Jog-	1= Jog at slow jog speed in neg. direction
Data byte 3		
Bit	Function	Signal
0-4	Table index 0 – 31	Binary selection of driving job via table index
5-7	-	Vacant
Data bytes 4 -7		
Byte	Function	Signal
4-7	-	Vacant

Table 5.17 EasyDrive control word on CDD3000, EasyDrive TabPos mode

EasyDrive TabPos status word		
Data bytes 0 -1		
Bit	Function	Signal
0	ERROR	1 = Device in error state
1	CAN status	0 = (System Stop), 1 = (System Start)
2	REF, reference reached	1 = Reference reached
3	LIMIT,	1 = Reference limitation active, reference value is limited via speed limitation
4	ACTIV	1 = Power stage active, current applied to motor
5	ROT_0, speed 0Hz	1 = Speed < preset standstill window
6	-	-
7	C-RDY	1 = Device ready to start, initialization OK,after changing parameters not changeable online the initialization is executed on the next controller enable!
8	ENPO	Status of input ENPO (hardware enable)
9	Output OSD00	Status of output OSD00
10	Output OSD01	Status of output OSD01
11	Vacant	
12	Actual status ISD03	Status of input ISD03, irrespective of 213-FIS03
13	Actual status ISD02	Status of input ISD02, irrespective of 212-FIS02
14	Actual status ISD01	Status of input ISD01, irrespective of 211-FIS01
15	Actual status ISD00	Status of input ISD00, irrespective of 210-FIS00
Data byte 2		
Bit	Function	Signal
0	Reference point defined	1 = Reference point defined, positioning jobs possible
1	Automatic	1 = Positioning mode active, table positions can be approached
2	Positioning active	1= Driving job in progress
3	-	-
4	/feed hold	1= Feed hole set, see below
5+6	-	Vacant
7	Tracking error	1= Lag distance greater than preset tolerance
Data byte 3		
Bit	Function	Signal
0-4	Current table index	Index of table position currently being approached
5-7	-	Vacant
Data bytes 4 -7		
Byte	Function	Signal
4	Actual position in distance units LW LB	32-bit actual value of position control parameter 754-POAIP Format: Intel Example: 100000 = A0 86 01 00hex
5	Actual position in distance units LW HB	
6	Actual position in distance units HW LB	
7	Actual position in distance units HW HB	

Table 5.18 EasyDrive status word on CDD3000, EasyDrive TabPos mode

General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

The following terms are described in more detail in the Application Manual.

*** Reference point defined: As soon as referencing is complete DB2 bit 8 is set in the status.

***** Feed hold: Feed hold controls processing of the driving profile generator. When the feed hold bit is set the current positioning command is interrupted, the drive brakes on the braking ramp down to a standstill. When freed hold is restored the interrupted positioning job is resumed.

Overwrite job immediately: If the bit is set in the control protocol an ongoing positioning job is overwritten. That means the movement is not interrupted, but is continued to the new target position. If the bit is not set the ongoing positioning is completed and stopped for an evaluation cycle (approx. 1 ms).

5.9.1 Example: Easy-Drive TabPos activation (CDD3000 only)

Presets:

- Load motor data set via DRIVEMANAGER user interface
- Activate “PCB_3(14)=Positioning, fixed positions, control via field bus” preset solution from DRIVEMANAGER user interface
- Set baud rate and device address
- Data backup
- Mains reset to activate changed settings

The drive can now be started with input ENPO set, with the following control sequence:

	ID(hex)	Data bytes	Comments
Master	DD	01	System start
Master	296	01 00 00 00 00 00 00 00	Controller enable (START), power stage is activated
CDD	372	B6 01 00 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 02 00 00 00 00 00	Start referencing
CDD	372	B6 01 01 00 00 00 00 00	Device status message, reference point defined (I/Os ignored)
Master	296	01 00 01 00 00 00 00 00	Automatic mode activated
CDD	372	B6 01 03 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 01 01 00 00 00 00	Select tab.position 1
CDD	372	B6 01 07 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 03 01 00 00 00 00	Start absolute positioning
CDD	372	B6 01 07 00 00 00 0A 00	Device status message, axis in position (I/Os ignored)
Master	296	01 00 01 02 00 00 00 00	Select tab.position 2
CDD	372	B6 01 07 00 00 00 0A 00	Device status message (I/Os ignored)
Master	296	01 00 03 02 00 00 00 00	Start positioning
CDD	372	B6 01 07 00 64 00 0A 00	Device status after position reached, some status bits change in the meantime

5.10 EasyDrive DirectPos

Position control with direct target position input, CDD3000

General introduction:

Preset solution: PCB_2(12)=Positioning, reference and control via field bus

This mode allows only the driving profile generator to be used for position control. The transferred target position is not checked in the device. Ramps are set in the device by way of parameters. Limit switch evaluation via digital inputs can be configured by parameters.

Special features:

The sequence of the individual activation signals must be followed.

The target position is always set in a unit scaleable by the user.

Reference: 1 revolution of the motor shaft = 65536 increments (2^{16})

The positioning speed is always set in a unit scaleable by the user.

Reference: 3000 rpm on motor shaft = 3277 increments per ms

The positioning speed can be set in two ways:

- One-off, fixed setting for all positioning operations or rarely varying speeds - via parameter 562-OISMX (maximum positioning speed)
- For varying speed references - by using the second control identifier. For this, the parameter must be mapped into the control identifier. See section 5.1 “Mapping function on the CDD3000”.

Further documentation on using the mode:

- CDD3000 Application Manual

The following table sets out the control functions:

EasyDrive DirectPos control word		
Data bytes 0 -1		
Bit	Function	Signal
0	START	1 = Controller enable only in conjunction with contact ENPO=1
1	-	-
2	STOP, emergency stop	0->1 = Device executes emergency stop, see below
3	E-EXT	1 = Trigger external error on device, set device to error state
4-6	-	-
7	ERES, reset error	0->1 = Reset current device error
8-11	-	-
12	Target status OSD03	1 = Output OSD03 = high if 243- FOS03=0PTN2
13	Target status OSD02	1 = Output OSD02 = high if 242- FOS02=0PTN2
14	Target status OSD01	1 = Output OSD01 = high if 241- FOS01=0PTN2
15	Target status OSD00	1 = Output OSD00 = high if 240- FOS00=0PTN2
Data byte 2		
Bit	Function	Signal
0	Automatic	Switches between manual and automatic mode
1	Start referencing/Start driving job	0->1 = In manual mode: Start referencing. In automatic: Start driving job
2	Execute job immediately	1= Ongoing driving job is overwritten immediately with new positioning job
3	/feed hold	1= Interrupts ongoing positioning job, see below
4	Absolute / relative	1= Target position is interpreted in absolute terms
5	Velocity mode	1= Drive without target position specification (endless positioning)
6	Jog+	1= Jog at slow jog speed in pos. direction (in manual mode)
7	Jog-	1= Jog at slow jog speed in neg. direction (in manual mode)
Data byte 3		
Bit	Function	Signal
0-7	-	Vacant
Data bytes 4 -7		
Byte	Function	Signal
4	Target position LW LB	Target position in scaled units Format: Intel Example: 100000 = A0 86 01 00hex
5	LW HB	
6	HW LB	
7	HW LB	

Table 5.19 EasyDrive control word on CDD3000 with EasyDrive DirectPos mode

EasyDrive DirectPos status word		
Data bytes 0 -1		
Bit	Function	Signal
0	ERROR	1 =, Device in error state
1	CAN status	0 = (System Stop), 1 = (System Start)
2	REF, reference reached	1 = Reference reached
3	LIMIT	1 =, Reference limitation active, reference value limited via speed limitation
4	ACTIV	1 = Power stage active
5	ROT_0, speed 0Hz	1 = Speed < preset standstill window
6	BRK	1 = Device executes DC braking, CDA3000 only
7	C-RDY	1 = Device ready to start, initialization OK,after changing parameters not changeable online the initialization is executed on the next controller enable!
8	ENPO	Status of input ENPO (hardware enable)
9	Output OSD00	Status of output OSD00
10	Output OSD01	Status of output OSD01
11	Vacant	
12	Actual status ISD03	Status of input ISD03, irrespective of 213-FIS03
13	Actual status ISD02	Status of input ISD02, irrespective of 212-FIS02
14	Actual status ISD01	Status of input ISD01, irrespective of 211-FIS01
15	Actual status ISD00	Status of input ISD00, irrespective of 210-FIS00
Data byte 2		
Bit	Function	Signal
0	Reference point defined	1 = Reference point defined, positioning jobs possible
1	Automatic	1 = Positioning jobs can be executed
2	Positioning active	1= Driving job in progress
3	-	-
4	/feed hold	1= Feed hold set, see below
5+6	-	Vacant
7	Tracking error	1= Lag distance greater than preset tolerance
Data byte 3		
Bit	Function	Signal
0-7	-	Vacant
Data bytes 4 -7		
Byte	Function	Signal
4	Actual position in scaled units LW LB	Actual value of position control Format: Intel Example: 100000 = A0 86 01 00hex
5	Actual position in scaled units LW HB	
6	Actual position in scaled units HW LB	
7	Actual position in scaled units HW HB	

Table 5.20 EasyDrive status word on CDD3000 with EasyDrive DirectPos mode

General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

The following terms are described in more detail in the Application Manual.

*** Reference point defined: As soon as referencing is complete DB2 bit 8 is set in the status.

***** Feed hold: Feed hold controls processing of the driving profile generator. When the feed hold bit is not set the current positioning command is interrupted, the drive brakes on the braking ramp down to a standstill. When freed hold is restored the interrupted positioning job is resumed.

Overwrite job immediately: If the bit is set in the control protocol an ongoing positioning job is overwritten. That means the movement is not interrupted, but is continued to the new target position. If the bit is not set the ongoing positioning is completed and stopped for an evaluation cycle (approx. 1 ms).

5.10.1 Example: Easy-Drive DirectPos activation (CDD3000 only)

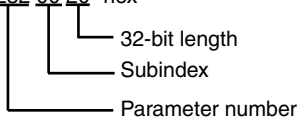
Presets:

- Load motor data set via DriveManager user interface
- Activate “ PCB_2(12)=Positioning, reference and control via field bus” preset solution from DriveManager user interface
- Set baud rate and device address
- Mapping of velocity reference into second control identifier. Parameter 562-OISMX contains the velocity reference (maximum value +/- 20480, data type INT32Q16, unit incr./ms).

Procedure:

Parameter 587-RXMPC = 0

Parameter 585-RXMAP[Index 0] = 0232 00 20 hex



Parameter 587-RXMPC = 1

- Data backup
- Mains reset to activate changed settings

The drive can now be started with input ENPO set, with the following control sequence:

	ID(hex)	Data bytes	Comments
Master	DD	01	System start
Master	296	01 00 00 00 00 00 00 00	Controller enable (START), power stage is activated
CDD	372	B6 01 00 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 02 00 00 00 00 00	Start referencing
CDD	372	B6 01 01 00 00 00 00 00	Device status message, reference point defined (I/Os ignored)
Master	296	01 00 01 00 00 00 00 00	Automatic mode activated
CDD	372	B6 01 03 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 01 00 00 00 0A 00	Specify target position, 655360 increments
CDD	372	B6 01 07 00 00 00 00 00	Device status message (I/Os ignored)
Master	304	44 04 00 00 00 00 00 00	Specify reference velocity via control ID 2: Example: 1000 rpm = 1092 inc./ms = 444hex
CDD	372	B6 01 07 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 03 00 00 00 0A 00	Start absolute positioning
CDD	372	B6 01 07 00 00 00 0A 00	Device status message, axis in position (I/Os ignored)
Master	296	01 00 01 00 64 00 00 00	Specify target position, 100 increments
CDD	372	B6 01 07 00 00 00 0A 00	Device status message (I/Os ignored)
Master	304	6D 00 00 00 00 00 00 00	Specify reference velocity via control ID 2: Example: 100 rpm = 109 inc./ms = 6Dhex
Master	296	01 00 13 00 64 00 00 00	Start relative positioning
CDD	372	B6 01 07 00 64 00 0A 00	Device status after position reached, some status bits change in the mean-time

5.11 CDD3000, synchronism (electronic gearing)

In preparation

General introduction:

Preset solution: PCB_1(11)=Electronic gearing, control via field bus

The procedure to activate “Position control with table positions” mode is as described in the Application Manual.

Special features:

The sequence of the individual activation signals must be followed.

The programmable transmission ratio can be recorded by mapping the numerator or denominator into the second control ID into the fast data channel.

Further documentation on using the mode:

- CDD3000 Application Manual

The table on the following page sets out the control functions:

EasyDrive Synchron control word (in preparation)		
Data bytes 0 -1		
Bit	Function	Signal
0	START, enable control	1 = Controller enable where contact ENPO=1
1	-	-
2	STOP, emergency stop	0->1 = Device executes emergency stop
3	E-EXT, set device to error state	1 = Trigger external error in device
4	-	-
5	-	-
6	-	-
7	ERES, reset error	0->1 = Reset current device error
8	-	-
9	-	-
10	-	-
11	-	-
12	Target status OSD03	1 = Output OSD03 = high if 243- FOS03=OPTN2
13	Target status OSD02	1 = Output OSD02 = high if 242- FOS02=OPTN2
14	Target status OSD01	1 = Output OSD01 = high if 241- FOS01=OPTN2
15	Target status OSD00	1 = Output OSD00 = high if 240- FOS00=OPTN2
Data byte 2		
Bit	Function	Signal
0	Enable synchronism	Switches between manual and synchronized mode
1	Start synchronism/Start driving job	1= In man.mode referencing. In synchronous mode – engage
2	-	Vacant
3	-	Vacant
4	Register offset +	Triggering of programmable register offset in positive direction
5	Register offset -	Triggering of programmable register offset in negative direction
6	Jog+	1= Jog at slow jog speed in pos. direction
7	Jog-	1= Jog at slow jog speed in neg. direction
Data byte 3		
Bit	Function	Signal
0-7	-	Vacant
Data bytes 3 -7		
Byte	Function	Signal
4-7	-	Vacant

Table 5.21 EasyDrive control word on CDD3000 with EasyDrive Synchron setting

EasyDrive Synchron status word (in preparation)		
Data bytes 0 -1		
Bit	Function	Signal
0	ERROR, device in error state	1 = General error
1	CAN status	0 = preoperational, 1 = operational
2	REF, reference reached	1 = Reference reached
3	LIMIT, reference limitation active	1 = Reference limited by FMIN or FMAX
4	ACTIV, power stage activated	1 = Power stage active
5	ROT_0, speed 0Hz	1 = Speed 0
6	BRK, device executes braking	1 = Device executes braking
7	C-RDY, ready to start and control initialized	1 = Device ready, initialization OK
8	ENPO, Status of input ENPO	Status of input ENPO (hardware enable)
9	Actual status output OSD00	Status of output OSD00
10	Actual status output OSD01	Status of output OSD01
11	vacant	
12	Actual status ISD03	Status of input ISD03
13	Actual status ISD02	Status of input ISD02
14	Actual status ISD01	Status of input ISD01
15	Actual status ISD00	Status of input ISD00
Data byte 2		
Bit	Function	Signal
0	Reference point defined	1 = Reference pt. def. Positioning possible
1	Synchronous mode is active	1 = Slave drive can be engaged
2	Synchronism active	1= Axis is engaged
3	-	-
4	-	Vacant
5	-	Vacant
6	-	Vacant
7	Tracking error	1= Lag distance greater than tolerance
Data byte 3		
Bit	Function	Signal
5-7	-	Vacant
Data bytes 3 -7		
Byte	Function	Signal
4	Actual position in distance units LW LB	32-bit actual value of position control parameter 754-POAIP Format: Intel Example 100000 = A0860100hex
5	Actual position in distance units LW HB	
6	Actual position in distance units HW LB	
7	Actual position in distance units HW HB	

Table 5.22 EasyDrive status word on CDD3000 with EasyDrive Synchron setting

General control functions:

START: Controller enable. With state 1 the power stage of the device is started (on CDA3000 in VFC mode only on conjunction with reference > 0). With state 0 the drive is stopped via the parameterizable STOP ramp and the power stage then disabled. When the stop ramp is disabled (=0) the drive runs down uncontrolled. The response of cancellation of the controller enable can be changed on the CDA3000 by way of the “DC braking” function see Application Manual.

On the CDD3000 braking is always executed according to the preset stop ramp or, if the stop ramp is disabled, under torque control.

STOP: Emergency stop in operation. Drive is braked to a stop according to programmed STOP ramp and then remains stopped under speed control at speed 0 (except CDA3000 in VFC mode). To quit this state the controller enable must be disabled (power stage off!).

The following terms are described in more detail in the Application Manual.

*** Reference point defined: As soon as referencing is complete DB2 bit 8 is set in the status.

***** Feed hold: Feed hold controls processing of the driving profile generator. When the feed hold bit is not set the current positioning command is interrupted, the drive brakes on the braking ramp down to a standstill. When freed hold is restored the interrupted positioning job is resumed.

Synchronism: The axis is configured as a slave axis. Incremental encoder signals of a master (encoder simulation of another CDD3000 or directly encoder signals) are connected to the second encoder input. When engaged, the slave follows the master position angle-synchronously at a programmable transmission ratio (parameter 474-EC2LN, Master encoder lines per revolution; 480-VRNOM, Numerator transmission ratio; 481-VRDEN, Denominator transmission ratio). In the disengaged state the axis stops under position control.

Register offset: See description in Application Manual

5.11.1 Example: Easy-Drive Synchron activation

Presets:

- Load motor data set via DriveManager user interface
- Activate “PCB_1(11)=Electronic gearing,..” preset solution from DRIVEMANAGER user interface
- Set baud rate and device address
- Mains reset to activate changed settings

The drive can now be started with input ENPO set, with the following control sequence:

	ID(hex)	Data bytes	Comments
Master	DD	01	System start
Master	296	01 00 00 00 00 00 00 00	Controller enable (START), power stage is activated
CDD	372	B6 01 00 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 02 00 00 00 00 00	Start referencing
CDD	372	B6 01 01 00 00 00 00 00	Device status message reference point defined (I/Os ignored)
Master	296	01 00 01 00 00 00 00 00	Automatic mode activated, engage possible
CDD	372	B6 01 03 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 03 00 00 00 00 00	Start synchronism
CDD	372	B6 01 07 00 00 00 00 00	Device status message (I/Os ignored)
Master	296	01 00 01 00 00 00 00 00	Stop synchronism, axis remains position controlled
CDD	372	B6 01 03 00 00 00 00 00	Device status message (I/Os ignored)
Master	297	00 00 00 00 00 00 00 00	Cancel controller enable
CDD	372	A6 01 01 00 00 00 00 00	Power stage off

Note: In this solution, too, mapping of additional control data (see section 5.1 “Mapping function on the CDD3000”) into the second control ID may be useful. The transmission ratio is given as an example.

Example: Parameter 480-VRNOM (INT32) Numerator of transmission ratio

Procedure: Parameter 587-RXMPC = 0

Parameter 585-RXMAP[Index 0] = 01E0 00 20 hex

Parameter 587-RXMPC = 1

6 Profile support in detail

6.1 Time response, PDO and SDO

Communication object	Type	Response time (ms)	Comments
PDO	RXPDO	max. 1-2	Time by which the data of the RXPDOs are processed. If the master transmits the RXPDO faster than a 1ms cycle, the device cannot process the telegram and triggers an error.
	TXPDO	max. 1-2	Time after internal events until PDOs are transmitted.
SDO	Download protocol (init download domain.req)	max. 20	Max. time until reply telegram (init download domain.con) is transmitted.
	Upload protocol (init download domain.req)	max. 20	Time until reply telegram (init upload domain.com) is transmitted.

Table 6.1 Time response, PDO and SDO

Attention: Long-term infringement of the minimum RXPDO sampling times results in an internal message overflow and triggering of an error (see section 7.1).

Note: The times are typical values. Depending on the operating state, the time may be extended. During data backup in particular, a delay of up to 200 ms may occur.

6.2 DS301 boot-up

The drive controller supports Minimum Capability Device behaviour in the network. After power-up the drive controller enters the **Pre-Operational** parameter-setting state. In this state the master can only communicate with the drive controller via SDOs. The network status when the drive controller is parameterized appropriately has a direct influence on the subsequent DRIVECOM state machine; that is to say, the device cannot be enabled (i.e. the drive cannot be started) in the **Pre-Operational** state.

Note: Fundamentally, the PreOperational state is a parameter-setting state and the Operational state is an operating state.

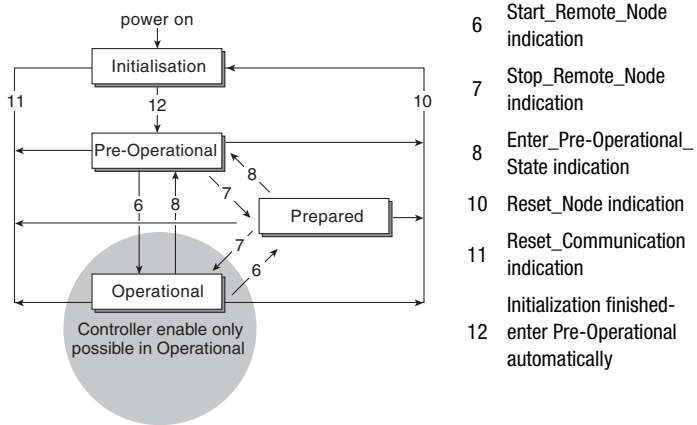
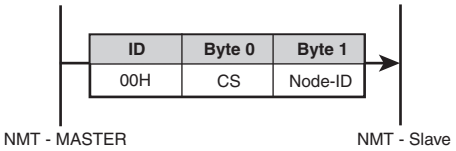


Figure 6.1 Capability Device behaviour

In the Prepared state a CANopen slave can no longer participate in communication via SDO or PDO. This state offers CANopen slaves the possibility, in the event of serious errors, to opt out of the communication process without disturbing the network.

Telegram structure of NMT services:



CS = Command Specifier

Figure 6.2 Telegram structure of NMT services.

No. in Figure 6.1	NMT service	Command Specifier (CS in Figure 6.2)
6	Start_Remote_Node indication	01 h
7	Stop_Remote_Node indication	02 h
8	Enter_Pre-Operational_State indication	80 h
10	Reset_Node indication	81 h
11	Reset_Communication indication	82 h

Table 6.2 NMT services: Meaning of byte 0 in the NMT telegram

Node ID = 00 h all slaves

6.2.1 Bus message after system start

After successful parameter setting of the device address and baud rate, the drive controller transmits a boot-up message over the CAN bus after every reset. This boot-up message has the same identifier as the emergency message, but contains no data.

ID	dlc
80 h + Node-ID	0

dlc = **d**ata **l**ength **c**ode

6.2.2 Influence of the DRIVECOM state machine on CANopen NMT

The network status of the CANopen module has a direct influence on the device's internal DRIVECOM state machine. Likewise, the internal state machine can switch the network status to Pre-Operational in ***case of error***.

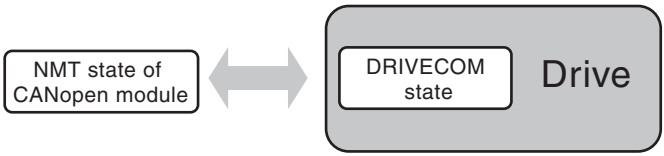


Figure 6.3 Influence of the DRIVECOM state machine on CANopen NMT

The two state machines communicate in the form of events. The influence of the DRIVECOM state machine on the NMT status is relatively easy to explain:

If the NMT status is Operational when a device error occurs, the DRIVECOM state machine switches the device to Pre-Operational. This state is only quit the next time the NMT command “Go operational” is delivered.

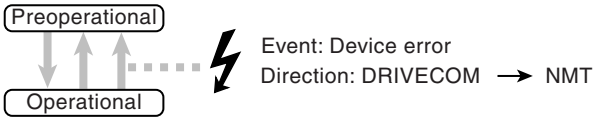


Figure 6.4 CANopen NMT

6.2.3 Influence of CANopen NMT on the DRIVECOM State machine

As already mentioned, it is possible to change DRIVECOM states by transmitting a control word via RXPDO1. The transfer can logically only be executed in the NMT state: Operational. Additionally, the network services (see DS-301)

1. Start_Remote_Node and
2. Enter_Pre_Operational_State

trigger the following transitions dependent on the current DRIVECOM status:

a. In the Fault state a Start_Remote_Node telegram triggers resetting of an error.

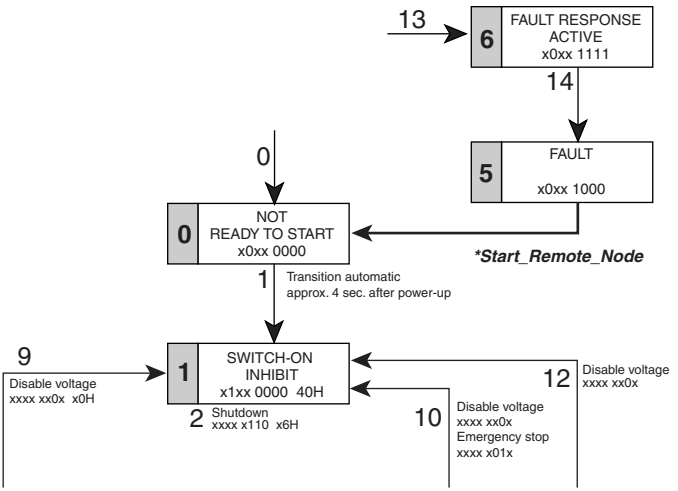


Figure 6.5 Influence of CANopen NMT on the DRIVECOM state machine (a)

b. In the ***4 OPERATION ENABLED*** state a Stop_Remote_Node telegram produces a transition to state 3 ON (control disabled). A subsequent Start_Remot_Node automatically returns to state 4;

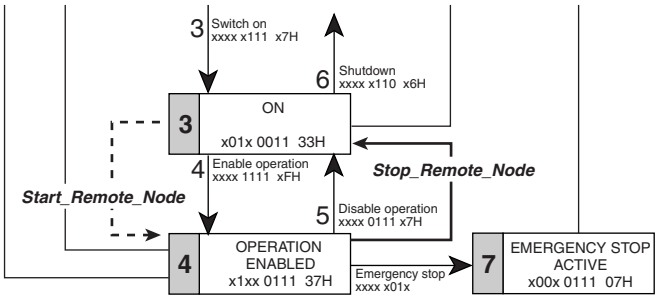


Figure 6.6 Influence of CANopen NMT on the DRIVECOM state machine (b)

All other DRIVECOM states are independent of the NMT status.

6.3 Sync object

The primary predefined CANopen communication object is the Sync object. The Sync object enables the NMT master to synchronize the slaves in the network. When the PDO communication parameters are appropriately set, the Sync object can ensure, for example, that the reference for the drive controller is accepted and the actual value is transmitted quasi simultaneously (see section 5.5).

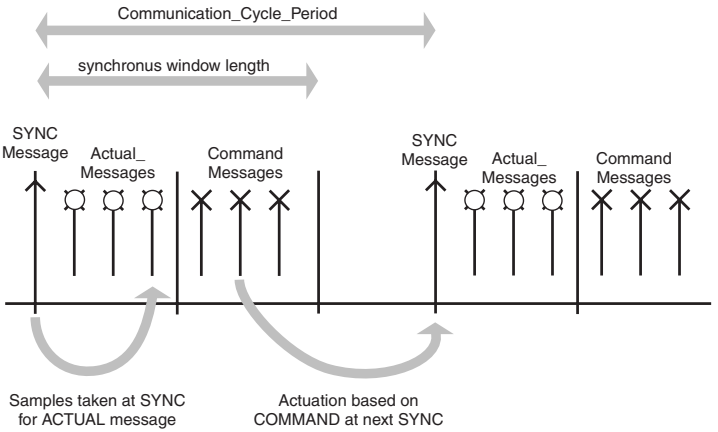


Figure 6.7 Sync object

Telegram structure of the Sync object:

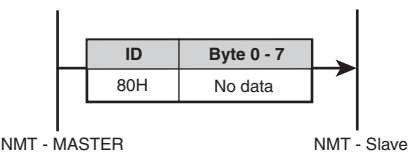


Figure 6.8 Telegram structure of the Sync object

Note: The sampling time of the CAN status can be determined by way of parameter 575-CASYC (see section 4.3.2).

6.4 Emergency object

When an error occurs the drive controller transmits its errors in the form of an emergency message (profile DS-301) with an emergency error code defined in DS-402. The error number of the drive controller is also entered in the manufacturer-specific data field.

Byte:	0	1	2	3	4	5	6	7
Bit:	0 ... 15		16 ... 23	24 ... 39		40 ... 47	48 ... 63	
Profile	**Device Profile DS402**			**Drive controller**				
Content:	Emergency error code as per DS402		Error register (object 1001 h)	Error number		Error location	Operating hours meter (in full hours)	

Table 6.3 Emergency object

ID = 80 h+ Node-ID

dlc **d**ata **l**ength **c**ode = 8

For further information on error handling, resetting of errors and the meanings of the error numbers refer to section 7.

6.5 Node Guarding

To monitor the slaves the DS301 defines Node or Life guarding. The master polls the devices connected to the bus using a remote frame at a defined sampling time (guard time). In response to this polling, the slave transmits a telegram containing the internal NMT status (Operational, Pre-Operational). This allows the master to check whether the slave state matches the master state.

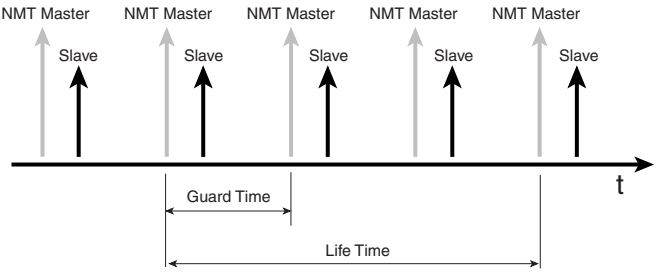


Figure 6.9 Node Guarding

In contrast, the slave can only monitor the master by means of so-called Life Guarding. If the master does not transmit a remote frame within the preset lifetime, the slave (drive controller) must assume there is a fault in the network and triggers a guarding error.

6.5.1 Monitoring by Node/Life Guarding

Two objects in the object directory are responsible for setting up Node/ Life guarding.

Draft 301	100C h	VAR	guard time	Unsigned16	rw	0
Draft 301	100D h	VAR	life time factor	Unsigned16	rw	0

By writing the object 100C h the NMT master can notify the slave of the so-called guard time. The Unsigned16 value of the object is given in ms. The guard time multiplied by the so-called life time factor (object 100D h) indicates the max. sampling time (life time) for the master and slave.

Node Guarding is started by the first remote telegram from the master. The drive controller replies by transmitting its NMT status and a toggle bit.

If the lifetime is exceeded the drive controller switches to error state (NMT status Pre-Operational) and transmits an emergency message with the error location **91 Error Guarding CAN-Master.**

Guarding is activated immediately on first receipt of the remote ID.

Data content / toggle bit:

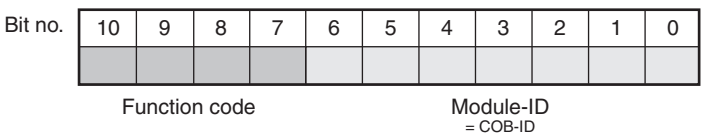
CANopen status	Remote ID	Data content	
Pre-Operational	700 h + Node ID	7F h | FF h	Alternating
operational	700 h + Node ID	05 h | 85 h	Alternating

Table 6.4 Monitoring by Node/Life Guarding

6.6 Default setting of communication objects

The settings of the standardized objects of the CANopen profile (COB ID of emergency, SYNC, transmission types of PDOs etc.) correspond to a so-called Predefined Connection Set. This a preconfiguration intended to provide the user with a fast commissioning process. The following table shows the delivery condition ex factory:

COB identifier



Object	Function code	COB ID		Communication parameter from index
NMT	0000	0	0 h	-
Sync	0001	128	80 h	1005 h
Emergency	0001	129-255	81-FF h	-
PDO1(tx)	0011	385-511	181-1FF h	1800 h
PDO1(rx)	0100	513-639	201-27F h	1400 h
SDO(tx)	1011	1409-1535	581-5FF h	-
SDO(rx)	1100	1537-1663	601-1FF h	-
Node Guard	1110	1793-1919	701-1FF h	100E h

Table 6.5 Default setting of communication objects

6.7 Object directory DS-301/ DS-402

The central instance of all CANopen nodes, like in other field bus protocols, is the so-called object directory. Each CANopen device must know the so-called object directory. In this directory, in addition to the standardized entries the objects relevant to the device must also be accessible.

The following table gives an overview of the profile support of the drive controller:

Profile	Index	Object	Name	Type	Acc.	M/O
Draft 301	1000 h	VAR	device type	Unsigned32	ro	M
Draft 301	1001 h	VAR	error register	Unsigned8	ro	M
Draft 301	1003 h	ARRAY	predefined error field	Unsigned32	ro	O
Draft 301	1004 h	ARRAY	number of PDOs supported	Unsigned32	ro	O
Draft 301	1005 h	VAR	COB-ID Sync message	Unsigned32	rw	O
Draft 301	1006 h	VAR	communication cycle period	Unsigned32	rw	O
Draft 301	1007 h	VAR	synchronous window length	Unsigned32	rw	O
Draft 301	1008 h [1)]	VAR	manufacturer device name	Vis-String	ro	O
Draft 301	100A h [3)]	VAR	manufacturer software version	Vis-String	ro	O
Draft 301	100B h	VAR	node-ID	Unsigned32	ro	O
Draft 301	100C h	VAR	guard time	Unsigned32	rw	O
Draft 301	100D h	VAR	life time factor	Unsigned32	rw	O
Draft 301	100E h	VAR	node-guarding identifier	Unsigned32	rw	O
Draft 301	100F h	VAR	number of SDOs supported	Unsigned32	ro	O
Draft 301	1010 h	ARRAY	store parameters	Unsigned32	rw	O
Draft 301	1011 h	VAR	restore default parameters	Unsigned32	rw	O
Draft 301	1014 h	VAR	COB-ID emergency message	Unsigned32	rw	O
Draft 301	1018 h	RECORD	Vendor-ID	Unsigned32	ro	M
Draft 301	1200 h	RECORD	server SDO Parameter	SDO-Parameter	rw	O
Draft 301	1400 h	RECORD	receive PDO comm.parameter	PDOCommPar	rw	O
Draft 301	1600 h	ARRAY	receive PDO mapping parameter	PDOMapping	rw	O
Draft 301	1800 h	RECORD	transmit PDO comm-parameter	PDOCommPar	rw	O
Draft 301	1A00 h	ARRAY	transmit PDO mapping-parameter	PDOMapping	rw	O
manufacturer specific	2000 h - 23E8 h		inverter parameter			
Draft 402	6040 h 4)	VAR	controlword	integer16	rw	M
Draft 402	6041 h 5)	VAR	statusword	Unsigned16	ro	M

Table 6.6 Object directory DS-301/DS-402

Profile	Index	Object	Name	Type	Acc.	M/O
Draft 402	6060 h [6)]	VAR	modes_of_operation	integer8	wo	M
Draft 402	6061 h [7)]	VAR	modes_of_operation_display	integer8	ro	M

[1)] Content same as device parameter 390-TYPE
[3)] Content same as device parameter 92-REV
[4)] Content same as device parameter 573_CACTR
[5)] Content same as device parameter 572-CASTA
[6)] Content same as device parameter 152-ASTER
[7)] Content same as device parameter 152-ASTER

M = Mandatory
O = Optional

Table 6.6 Object directory DS-301/DS-402

Note: For more information on the object directory and on creating an EDS file refer to section 6.9.

6.8 Default setting of DS301/402 objects

Index	Sub-index	Read value
1000	00	0x0192
1001	00	0x00
1003	00	0x01
	01	0x00
1004	00	0x00030002
	01	0x00000000
	02	0x00030002
1005	00	-
1006	00	0x00000000
1007	00	0x00000000
1008	00	Device type
100A	00	Current software version of device
100B	00	0x02 (at addr.2)
100C	00	-
100D	00	-
100E	00	0x702 (at addr. 2)
100F	00	0x01
1014	00	0x40000082
1018	00	0x16
1400	00	0x04
	01	0x202
	02	0xFE
	03	0x00
	04	0x01

Index	Sub-index	Read value
1600	00	0x02
	01	0x21eb0010 (491)
	02	0x21f10020 (497)
1800	00	0x04
	01	0x182
	02	0xa
	03	0x4
	04	0x4
1A00	00	0x2
	01	0x21ea0010
	02	0x21900020
1A01	00	0x01
	01	0x22490008
6040	00	-
6041	00	-
6060	00	-
6061	00	

Table 6.7 Default setting of DS301/402 objects

6.9 EDS device file

DS-301 defines the content of a so-called EDS (Electronic Data Sheet) file. This text file contains all device-specific data and parameters in terms of their data type, value range and access attributes. A number of setup tools for CANopen networks use this file for graphical visualization of the individual CAN_{open} nodes.

6.9.1 How do I create the EDS device file?

The DRIVEMANAGER setup tool has a secondary menu, Create EDS File, under its Tools menu. Then you can in turn choose whether to create the EDS file from an existing device database stored on hard disk or floppy (parameter set) or the currently connected device. You can then copy the newly created EDS file to the relevant directory of your CAN_{open} setup tool.

6.10 Saving the CANopen settings

The user-specific settings made in the object directory (objects 1000 h to 1A00 h) can be stored permanently and are then available every time the device starts up.

The object 1010 h with subindex 0x02 delivers this functionality.

Draft 301	**1010 h**	ARRAY	**store parameters**	Unsigned32	rw	0

To prevent unwanted settings from being saved accidentally, the save operation is triggered by a defined code.

Save code 0x65766173

The save operation can be triggered by the following SDO access:

SDO transfer mode	Index	Subindex	Value
- write	1010 h	02 h	0x65766173

ID	Data bytes	Description
SDO(rx)	23 10 10 02 73 61 76 65	Download protocol (write) Master >drive controller
SDO(tx)	60 10 10 00 00 00 00 00	Drive controller> master

Note: The save operation disables the drive controller's communication capability for approx. 0.5 seconds, which means with guarding active the master would not detect an error.

6.11 Restoring factory defaults

The factory setup (Predefined Connection Set) of the communication settings mentioned above can be restored by SDO write access to object 1011 h.

Draft 301	**1011 h**	ARRAY	**restore default parameters**	Unsigned32	rw	0

Here, too, a save code is used for safety.

Save code 0x64616f6c

The factory defaults can be restored by the following SDO access:

SDO transfer mode	Index	Subindex	Value
- write	1011 h	02 h	0x64616f6c

ID	Data bytes	Description
SDO(rx)	23 11 10 02 6c 6f 61 64	;Download protocol (write) Master >drive controller
SDO(tx)	60 11 10 00 00 00 00 00	;Drive controller> master

Note: The save operation disables the drive controller's communication capability for approx. 0.5 seconds, which means with guarding active the master would not detect an error.

7 Error rectification

7.1 Troubleshooting

All errors detected by the inverter are transmitted once over the CAN bus in the form of an emergency message. They are signaled by flashing of the red LED H1 on the inverter.

Byte:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Bit:	0 ... 15		16 ... 23	24 ... 39		40 ... 47	48 ... 63	
Profile	**Device Profile DS402**			**Drive controller**				
Error	Emergency error code as per DS402		Error register (object 1001 h)	Error number		Error location	Operating hours meter (in full hours)	
Warning (CDA3000 only)	00 h	FF h	01 h	FF h	Warning Low Byte	Warning High Byte		

Table 7.1 Emergency codes

ID = 80 h+ Node-ID

dlc **d**ata **l**ength **c**ode = 8

The decisive factors for rapid localization are the error code and error location. In bytes 3 and 4 of the emergency telegram you will find the error code, which represents a first categorization of the cause of the error (see Table 7.1). The precise cause of the error is specified by the error location in byte 5. Bytes 6 and 7 contain the internal operating hours meter of the device (parameter 87-TOP).

CAN_{open} errors - i.e. incorrect configurations, bus disturbances etc. - are indicated by error code 0xFF00.

Note: When an error occurs, the inverter automatically switches to the *Pre-Operational state*. The active drive is stopped by an emergency stop, the DRIVECOM state machine switches to Ready. In case of error shutdown the power stage is generally shut off, i.e. braking functions such as ramping or DC braking are not executed!

Note: The LED status indicators are explained in section 2.3.2.

7.2 Resetting an error

The drive controller offers several different ways of resetting an error.

7.2.1 Error acknowledgment via bus system

By the transition from the Pre-Operational to the Operational state any current errors are reset. Resetting of the error is signaled by transmission of the following emergency message:

ID	Data bytes	;Description
Emergency	00 00 00 00 00 00 xx xx	;Emergency message acknowledgment error

xx xx Operating hours meter

If the cause of the error is not eliminated, the drive controller returns to the Pre-Operational NMT state after transmission of another emergency message.

Another possibility is offered by the object 6040 h control word**:**

Draft 402	6040 h	VAR	controlword	Integer16	rw	M

The error is also reset by setting object 6040 h to the value 0x0080 (SDO download protocol, since PDO transfer only possible in the Operational state).

7.2.2 Error acknowledgment, general

- by a rising signal edge at the control input ENPO
- by a rising edge at a programmable digital input with setting of the function selector to ERES
- by writing the value 1 to parameter 74-ERES by way of the control unit or bus system

Overview of all CDA3000 error messages

Error no.	Error	Description
1	E-CPU	Hardware or software error
2	OFF	Power failure
3	E-OC	Current overload shut-off
4	E-OV	Voltage overload shut-off
5	E-OLI	IxIxt shut-off
6	E-OLM	Ixt shut-off
7	E-OTM	Motor overheating
8	E-OTI	Drive unit overheating
9	E-PLS	Plausibility error in parameter or program sequence
10	E-PAR	Faulty parameter setting
11	E-FLT	Floating point error
12	E-PWR	Power pack not recognized
13	E-EXT	External error message (input)
14	E-USR	Reserved for modified software
15	E-OP1	Error in module in option slot 1
16	E-OP2	Error in module in option slot 2
17	-	-
18	E-SIO	Error in serial interface
19	E-EEP	Faulty EEPROM
20	E-WBK	Wire break
21	E-SC	Auto-tuning
22	E-PF	Power failure
23	E-RM	Encoder evaluation defective
24	E-FDG	Transmission error in reference coupling
25	E-LSW	Limit switches reversed
26	E-OL5	Ixt shut-off below 5 Hz to protect power stage

Table 7.2 Error message in the CDA3000

Overview of all CDD3000 error messages

Error no.	Error	Description
1	E-CPU	Hardware or software error
2	OFF	Power failure
3	E-OC	Current overload shut-off
4	E-OV	Voltage overload shut-off
5	E-OLI	Ixlxt shut-off
6	E-OLM	Ixt shut-off
7	E-OTM	Motor overheating
8	E-OTI	Drive unit overheating
9	E-PLS	Plausibility error in parameter or program sequence
10	E-PAR	Faulty parameter setting
11	E-FLT	Floating point error
12	E-PWR	Power pack not recognized
13	E-EXT	External error message (input)
14	E-USR	Reserved for modified software
15	E-OP1	Error in module in option slot 1
16	E-OP2	Error in module in option slot 2
17	-	-
18	E-SIO	Error in serial interface
19	E-EEP	Faulty EEPROM
20	E-WBK	-
21	E-SC	-
22	E-PF	-
23	E-RM	-
24	E-FDG	-
25	E-LSW	D-HWE/limit switches interchanged
26	E-OL5	Ixt shut-off below 5 Hz to protect power stage
30	E-ENC	Error in encoder monitoring
31	E-TIM	Runtime monitoring
32	E-FLW	Tracking error
33	E-WDG	Watchdog RS232
34	E-VEC	Internal memory error

Table 7.3 CDD3000 error messages

Error no.	Error	Description
35	EBRK	Error at output OSD03: 1.Wire break 2. Short 3. Overload
36	E-POS	210: Positive hardware limit switch approached 211: Negative hardware limit switch approached 212: Positive software limit switch approached 213: Negative software limit switch approached 214: Reference point not defined 215: Error accessing optional hardware Possible remedies: If this error is repeated please contact your local Service Partner.
		216: Selected program not available 217: Jump to non-existent record number 218: Called subroutine not available 219: Target position outside positioning range 220: Division by zero
		221: Max. subroutine nesting depth exceeded 222: Timeout in manual mode 223: Target position not reached 224: No feed hold 225: Selection (Automatic/Referencing/Jog mode) not permitted, control location conflict 226: Index overflow (indexed addressing)
		230: Max. servo speed exceeded 232: No controller enable (ENPO) 233: Error in parameter access of position and sequence control Possible remedies: If this error is repeated please contact your local Service Partner. 234: Error processing a Touchprobe positioning command 235: Impermissible command during axle movement 236: Hardware limit switches interchanged
37	E-FLH	Error in flash memory
38	E-HW	Hardware limit switch approached
39	E-HWE	Hardware limit switches interchanged
40	E-WRN	The preset maximum torque (parameter TCMMX) is greater than \n the maximum torque attainable with the motor or the device

Table 7.3 CDD3000 error messages

Note: For a detailed list of all error messages together with remedial measures refer to the relevant Application Manual.

7.3 Emergency error codes table

7.3.1 Standard error messages of the CDA3000

For the error messages of the CDA3000 refer to the “Warning messages” and “Error messages” sections of the Application Manual.

Error text	Error no. (dec.)	Emergency error code	Error register	Description
NoError	0	0x0000	1/generic error	Error acknowledgment
E-CPU	1	0x5220	1/generic error	Hardware or software error
E-OFF	2	0x3100	1/generic error	Power failure
E-OC / OverCurrent	3	0x2340	1/generic error	Current overload shut-off
E-OV /OverVoltage	4	0x3110	1/generic error	Voltage overload shut-off
E-OLM/ Ixt	5	0x2310	1/generic error	Ixt shut-off
E-OLI / IxIxt	6	0xff00	1/generic error	I²xt shut-off
E-OTM / OverTemperatureMotor	7	0x4300	1/generic error	Motor overheating
E-OTI / OverTemperatureInverter	8	0x4200	1/generic error	CDA overheating
E-PLS / DataPlausibility	9	0x6100	1/generic error	Faulty EEPROM
E-PAR /ParameterValue	10	0x6320	1/generic error	Faulty parameter setting
E-FLT / Float	11	0x6100	1/generic error	Floating point error
E-PWR / NoPowerModule	12	0x5400	1/generic error	Power pack not recognized
E-EXT / External	13	0x9000	1/generic error	External error message
E-USR	14	0x6200	1/generic error	Modified software
E-OP1 /Option1	15	0x7000	1/generic error	Module in Option1
E-OP2 /Option2	16	0x7000	1/generic error	Module in Option2
E-SIO / WatchDog	18	0x7510	1/generic error	Watchdog
E-FLH / Flash	19	0x5530	1/generic error	Error in FLASH memory
E-WBK / Wire break	20	0x5440	1/generic error	Encoder evaluation defective
E-SC / Auto-tuning	21	0xff00	1/generic error	
E-PF / PowerFail	22	0x5400	1/generic error	Power failure
E-RM / InitRunMode	23	0xff00	1/generic error	Encoder evaluation defective
E-FDG	24	0xff00	1/generic error	Reference coupling
E-LSW	25	0x8612	1/generic error	Limit switches swapped
	255	0xFF00	1/generic error	Warning

Table 7.4 Assignment of emergency error codes

7.3.2 Description of communication errors

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Respon-seno.
16	E-0P2	170	Error in module at option slot 2	Check module and identifier	STOP *
		171	Error at option slot 2: BUS-OFF state detected.	Check contacting of module. If the error still occurs after switching off and back on again, the device or the module is faulty.	
		172	Error at option slot 2: Transmit protocol could not be sent.	Check contacting of module and master function. If the error still occurs after switching off and back on again, the device or the module is faulty.	
		173	Error at option slot 2: Module not responding.	Check contacting of module. If the error still occurs after switching off and back on again, the device or the module is faulty.	

* The error response is programmable (see Application Manual). The factory set default response is STOP, i.e. disable power stage.

Table 7.5 CDA3000 errors

Error text	Error location number at option slot 2	Emergency error code	Error register	Description of error
E-0P2	180	0xFF00	0x07	EEprom write error
E-0P2	181	0xFF00	0x07	EEprom read error
E-0P2	182	0xFF00	0x07	Initialization error
E-0P2	183	0x8100	0x11	CDA <>module communication error
E-0P2	184	0x8100	0x11	Bus-Off CANopen network
E-0P2	185	0x8100	0x11	Error counter overflow
E-0P2	186	0x8100	0x11	Node Guarding error
E-0P2	187	0x8100	0x11	RX-QUEUE overflow

Table 7.6 Communication errors

Appendix Glossary

CiA: ("CAN in Automation"). CAN bus user group, generally defines a protocol for automation.

CAL: (CAN Application Layer) CiA protocol, primarily describes the way in which variables are transmitted without defining their function or content.

Subsets:

CMC:(CAN based Message Specification). Sets out the definition described above. Is accepted by most CAN suppliers. LUST conforms to this definition.

NMT: (Network Management). Required for masters in the CAN system. Not implemented by Lust because drive controllers are always slaves and have no "control function".

LMT: (Layer Management). See NMT

DBT:(Identifier Distributor). See NMT

CAN_{open}: Based on CAL definition

Corresponds to CiA Draft Standard 301

Expands the CAL definition to include function and unit assignment of the predefined variables

This definition is being drafted by CiA and various user groups (MOTION for drive technology and I/O for inputs/outputs) (e.g. variable for torque in Nm).

Motion: User group under CiA tasked to draft a profile of the CANopen protocol for drive technology.

I/O: User group under CiA tasked to draft a profile of the CANopen protocol for sensors and actuators.

General points on the various protocol definitions

CAL: Mainly in use in Europe.

LUST has currently implemented a protocol which can be activated by a CAL master.

The initialization is simpler than CAL (CCDA), for example addressing by way of jumper, which has no influence on operation.

DeviceNet: Mainly in the USA (corresponds to CAL definition).

SDS: Has not established itself.

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