EN

G1

CM-CAN1

User Manual

Communication Module
CM-CAN1

Project design, installation and commissioning of CDA3000 on the CANLUST field bus

LUST

LUST

Overview of documentation

Before purchase

CDA3000 Catalogue

Selecting and ordering a drive system

With shipment (depending on supply package)

Operation Manual CDA3000

Quick and safe initial commissioning

Operating Instructions KEYPAD KP200

Operation via KEYPAD KP200

Application Manual

Adaptation of drive system to application

Manual, CAN_{Lust} Communication Module

CDA3000 project design, installation and commissioning on the field bus

Manual, CAN_{open} Communication Module

CDA3000 project design, installation and commissioning on the field bus

Manual, PROFIBUS-DP Communication Module

CDA3000 project design, installation and commissioning on the field bus

CM-CAN1 User Manual

ID no.: 0916.21B.0-00

Version: May 2000

Applicable as from software version V1.40

LUST

Dear User,

This manual is intended for you in your role as a **project engineer, commissioning engineer or programmer** of drive and automation solutions on the CAN field bus. It is assumed that you are already familiar with this field bus based on appropriate training courses and/or study of the relevant literature.

We assume that your drive is already in operation – otherwise you should first refer to the operation manual.

Good luck, and have a nice day!

How to use this manual

DE
EN

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.

Table of contents

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 CDA3000 inverter drives 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 can destroy components).

1.2 System requirements

Any system with a CAN interface is suitable. No requirements are made in terms of processor speed, since the timeout monitors on the machines can be adapted to the respective processor performance.

1.3 User level in operation over CAN bus

The CAN BUS INTERFACE always operates on a high user level on the relevant drive unit. The user level corresponds to parameter 1-MODE in subject area _36KP, but cannot be influenced by way of it. Some of the parameters at those user levels are service parameters, and are not documented in the Operation Manuals of the individual devices.

Note: Unintentional write access to such parameters may severely impair the functioning of the device!

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 (http://www.lust-tec.de). Follow the Service link.
- Engineering Guide CDA3000
- ISO 11898, Road Vehicles, Interchange of digital information - Controller Area Network (CAN) for high-speed communication
- CiA/DS20x : CAN Application Layer for Industrial Applications
- CiA/DS 102-1 : CAN Physical Layer for Industrial Applications - Part 1: Two Wire Differential Transmission

1.5 General information on the structure of a CAN network

Multimaster capability

A CAN network has multimaster capability - that is, any station can independently send messages on the bus which can be received by any other station on the bus.

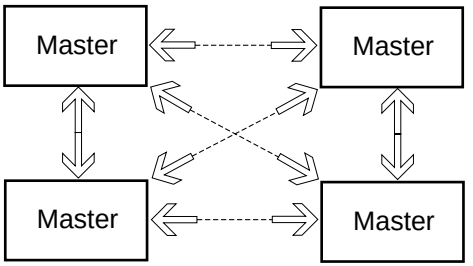


Figure 1.1 Any station can independently send messages.

Typically, however, transmissions are exchanged between two stations on the bus.

The basic rule is: Anyone can evaluate the information from an identifier, but only one station per identifier can have transmission rights .

Each transmission is assigned a priority by the selection of the identifier for that transmission. The priority is antiproportional to the identifier number - that is, a rise in the significance of the identifier results in fall in the priority of the transmission. Monitoring of the priorities and the issue of access rights to the bus is controlled on the hardware side by the CAN controller.

Note: To operate drive controllers in a network there must be no overlaps between the identifiers used.

1.5.1 Access rights

Access rights to the bus where a number of stations are accessing it simultaneously are assigned by checking the priorities of the identifiers. The identifier with the lowest significance has the highest priority, and is able to continue its transmission in the event of a conflict.

1.5.2 Size of identifiers

The size of the identifiers corresponds to the standard format, i.e. 11 bit identifiers. The 'Extended' format is not supported.

1.5.3 Time response

Series	Control channel	Parameter channel
CDA3000	1 - 2 ms	< 10 ms

Table 1.1 Time response

Note: Transmission of the control protocols by the master in a time division < 1 ms is not permitted. It may occur that messages are not processed by the drive unit!

For status messages the sampling time can be freely set by way of a parameter.

Exceptions:

1. If a 1 is entered in device parameter 04-PROG, the drive unit overwrites all parameter settings with their default values. In this case the reply telegram is only sent when the complete parameter list has been reinitialized. This action can take up to 10 seconds.
2. During read-in of the SMARTCARD no communication with the drive unit is possible over the CAN bus. This condition lasts up to 10 seconds.
3. If an error state is acknowledged over the CAN bus, a device restart may result. For more detailed information on this topic refer to section 6 “Fault rectification”.

1.5.4 Transmission speeds

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

Transmission speed	Maximum line length over the entire network	
500 KBaud	100 m	Factory setting
250 KBaud	200 m	
125 KBaud	450 m	
75 KBaud	770 m	
50 KBaud	1000 m	
25 KBaud	1000 m	

Table 1.2 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.

The following factors influence calculation of the permissible line length:

- Propagation time of the signal on the line
- Signal propagation time of the optocouplers
- Signal propagation time of the gates

The values specified for the line length already include the signal propagation times in the drive unit. For the control, a signal propagation time from the bus connector to the control's CAN controller of max. 80 ns is assumed. If these control values are exceeded, the transfer rate must be reduced by at least one increment!

1.6 CAN protocol for LUST drives

The CAN protocol for LUST drives permits integration of the device in a CAL network. The identifiers are defined in the devices by setting of the device address.

After power-on, the drive unit responds cyclically with its **logon identifier**. From this identifier the higher-order control can identify which devices are present on the bus and which addresses have been assigned for the devices.

Note: It is not permitted to operate two devices with the same address on one bus.

After the **system start** the drive unit switches to transmission of the status message. The control thereby detects that the slave is connected to the network and is now ready for controlling. For control of the devices, a protocol for selective control of each drive is available.

A broadcast telegram (System Start/Stop) is provided for synchronized starting and stopping of all drives.

1.6.1 Device states

In contrast to the CAN system state, which describes the status of the entire bus system, the device states in the various devices of a bus system may vary.

The device state is determined, firstly, by the selective control commands over the bus and, secondly, by means of information from the respective process.

For example, an error in an application results in a change of device state.

In the devices a so-called device state machine is operated which assigns to each state defined responses to events.

1.6.2 Device control

There are two modes for controlling the devices over CAN.

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.

In the second control mode the drive unit is controlled by way of the **DRIVECOM state machine**.

EasyDrive

In direct 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 unused control terminals of the drive unit to the control for other process tasks.

DRIVECOM

To control a drive unit in the second control mode over CAN, the state machine defined in the DRIVECOM PROFILE no. 20 of January 1994 for INTERBUS-S must be followed.

2 Mounting and connection

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

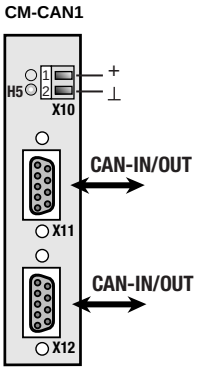
2.1 Setting the address

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	See below
	Address setting finished; for further procedure see Installation.	

Two possible methods of address assignment

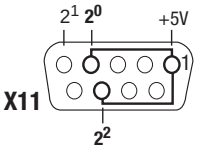
1. By bus address parameter 571-CLADR:
   By way of parameter 571-CLADR in subject area _57OP, Option modules, an address from 0 to 99 can be set. If the setting 0 is selected in parameter CLADR, hardware coding is enabled.

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 7 can be selected.



X10	Assignment
1	+24 V
2	CAN_GND

Example for address 5 Dec:



X11/X12	Assignment
1	+5 V
2	CAN_LOW
3	CAN_GND
4	ADR0
5	ADR1
6	CAN_GND (as X10/2)
7	CAN_HIGH
8	ADR2
9	+24 V (as X10/1)

Table 3.1 Pin assignment with a connector coding example

Attention: The device address coded on the connector is only used if parameter 571-CLADR is set to 0.

2.2 Mounting

2.2.1 Size BG1...5 (0.37 ... 15 kW)

Step	Action	Comment
1	Make sure the power supply to the drive unit is cut.	
2	Connect the CMxxxx to the drive unit as shown in Figure 2.1 (A). Use only the slot at the top.	The module lock must engage audibly. The bottom slot is reserved for the UM-xxxx module.
3	Mounting clearance min. 35 mm for additional/other devices Figure 2.1 (B)	
	Mounting is finished; for the further procedure see section 2.3 “Electrical installation”.	

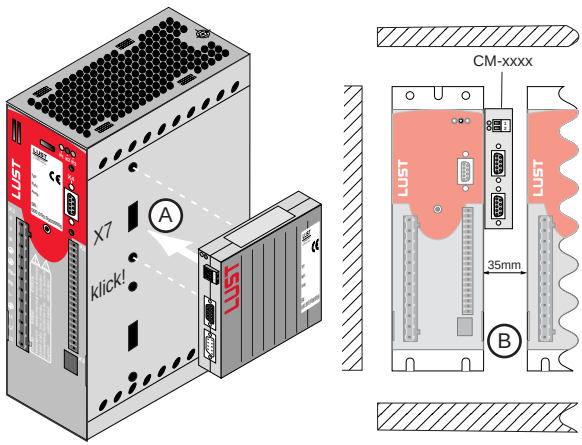


Figure 2.1 Mounting for BG1...5

2.2.2 Size BG6...8 (22 ... 90 kW)

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 2.3 (A)	The bracket is part of the MP-UMCM mounting package (see Figure 2.2).
4	Bolt the bracket onto the bottom slot position - see Figure 2.3 (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 2.3 (C).	The ribbon cable is part of the MP-UMCM mounting package (see Figure 2.2).
	Mounting is finished; for the further procedure see section 2.3 “Electrical installation”.	

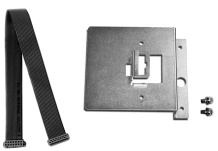


Figure 2.2 Mounting package MP-UMCM

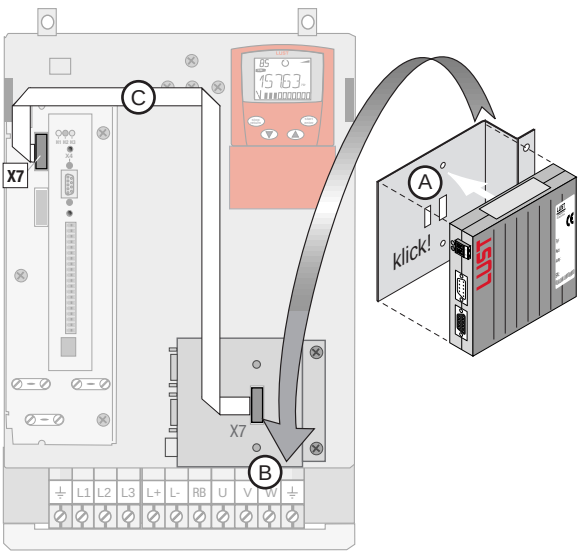


Figure 2.3 Mounting of size BG6...8

2.3 Electrical 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 2.4
2	Wire the controller enable on the CDA3000.	see section 2.3.1
3	Wire up the supply voltage for the module.	19 ...29 VDC see Table 3.2
4	Switch on the drive unit.	
	Electrical installation is finished; for the further procedure see section 3 “Commissioning and configuration”.	

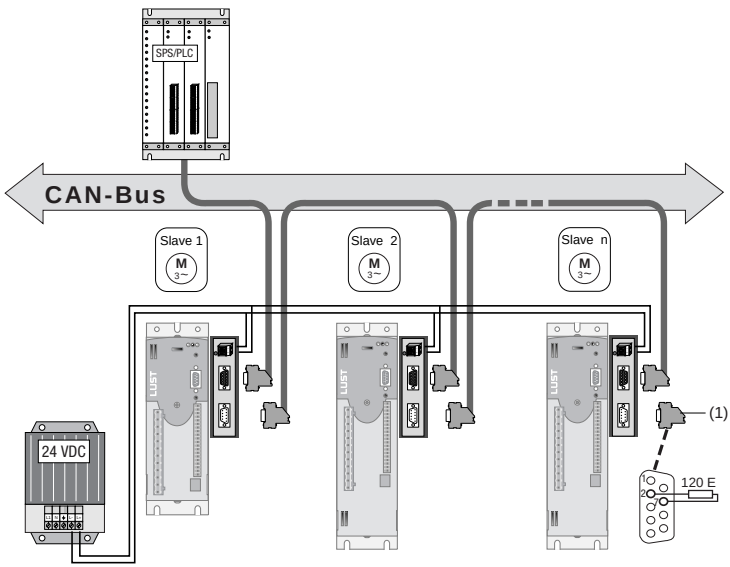


Figure 2.4 System connection. (1) Bus termination plug

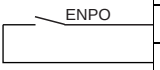
Characteristics	CM-CAN1
Voltage supply	19 ... 29 V, supply **optionally** via X10, X11 or X12
Voltage ripple	max. 3 Vss
Current consumption	max. 80 mA per station
Cable type	9-wire, surge impedance 120 Ω

Table 3.2 Specification, CAN bus connection

2.3.1 Controller enable (ENPO)

The drive units have an additional hardware-based controller enable from the power stage (ENPO) via control terminal X2/8. 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).



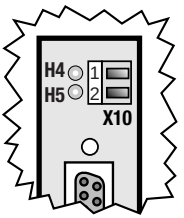
X2	Des.	Function
9	ISD00	Digital input 1
8	ENPO	Power stage hardware enable
7	UV	Auxiliary voltage 24 V
6	UV	

Figure 2.5 Configuration of controller enable ENPO on the CDA3000

2.3.2 LED status display

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

LED H5 indicates a correct voltage supply.



Red LED (H4)	Green LED (H5)	Bus state
Off	Off	24V supply to module missing
Off	On	Voltage supply OK

Table 3.3 LED status display

3 Commissioning and configuration

3.1 Commissioning sequence

Step	Action	Comment
1	Wire the drive unit as specified in the Operation Manual.	To test CAN communication, it is sufficient to connect the mains voltage and activate the ENPO signal (hardware enable) at terminal X2/8.
2	Mount the communication module at option slot 2 (X7).	See section 2
3	Check the wiring. Make sure hardware enable ENPO is not connected.	
4	Switch on the supply voltage.	The green LED H5 on the communication module CM-CAN1 is lit steadily.
5	If the initialization was completed correctly, parameter 578 -OPTN2 in subject area _570P, Option modules, displays the value LCAN. Please check the parameter (See Figure 3.1).	If it does not show the value, refer to section 3.3.

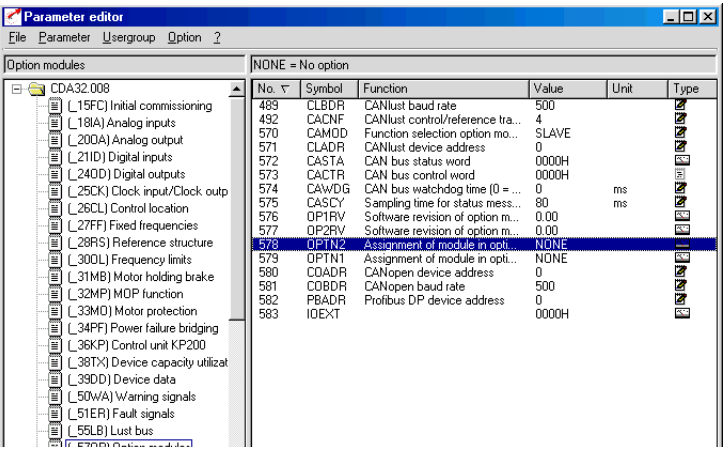


Figure 3.1 If the initialization is correct parameter 578-OPTN2 shows LCAN.

Step	Action	Comment
6	Start initial commissioning as specified in the Operation Manual.	Acquisition of motor-specific data and automatic calculation of the parameters of the various control circuits
7	Configure the drive unit using the Application Manual.	(Inputs/outputs, software functions, ...)
8	Test the control quality and optimize the controller settings as necessary using the Operation Manual.	
9	Set the CAN-specific parameters (refer to section 4.2).	For an initial test of CAN communication the following settings are required as a minimum: See Table 3.1.
10	Test the drive on the higher-order controller	See section 3.4
11	Finally, save the setting with parameter 150 -SAVE = START (1); See section 3.5.1.	

Parameter	Value	Comments
489-CLBDR	Baud rate	Baud rate setting, factory setting = 500kB
571-CLADR	Address	Device address, factory setting = 0
260-CLSEL	OPTN2 (5)	Assign control location to CAN_{LUST}
280-RSSL1	FOPT2	Apply reference value from CAN_{LUST}
150-SAVE	START (1)	Finally, save settings in device

Table 3.1 Minimum parameters to be set

152-ASTER: Proposal: BUS 1-3 preselects the setting for CLSEL and RSSL1

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 valid reply if several devices with the same device address are connected to the bus.

3.3 Errors in initialization

If 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 = LCAN 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 the device must transmit the **logon identifier** (base ID 1543 with data length 0) at a sampling time of 100 ms. When the master has once transmitted the **System Start** command (ID 221, with data length 1 and value 1), the drive unit must cyclically transmit its **status identifier** (base ID 881, with data length 7) instead of the logon identifier. 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 with the KEYPAD on a SMART-CARD 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

Function	Effect
• Parameter 04-PROG = 1 (subject area _86SY System)	➢ All parameters **of the current** user data sets up to user level **MODE = 4** are reset to their factory defaults.
• Press and hold down both cursor keys during power-on.	➢ All parameters in **all** user data sets up to user level **MODE = 5** are reset to their factory defaults.
• Parameter 4-PROG = 850 (...)	➢ All parameters in **all** user data sets up to user level **MODE = 6** 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 backed-up in the device, however. Data backup is initiated by way of the DRIVEMANAGER user interface or by writing to parameter 150-SAVE = (1)START 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)STOP 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 Representation of parameter data

The parameters are set by way of the parameter channel described in section 4.6 “Parameter channel”.

The parameter data are transmitted in binary format within a CAN data block. The parameter data begin at data byte 3 and have a maximum length of 4 bytes (Intel format).

Priority based on CAL	Base ID	Data byte 0	Data byte 1	Data byte 2	Data byte 3+4+5+6	Data byte 7
5	1101	PARA_LO	PARA_HI	Mode of transfer: See Table 4.1	DATA	Counter or index for field parameters

Interpretation of the data transferred in the data block differs depending on parameter data type.

Note: For most device parameters the settings are displayed in the KEYPAD and the DRIVEMANAGER user interface in the form of value substitution texts (abbreviations). In response to queries and for transfers over the bus system the settings are transferred in the form of numerical values. The following descriptions of the settings give both: (numerical value) value substitution text.

4.1.1 Data types

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	Whole number, signed
INT16	-32768 ... 32767	
INT32	-2147483648 ... 2147483647	
INT32Q16	-32767.99 ... 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

Table 4.1 Data types

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

4.1.2 Mapping data types

All data types are represented appropriate to their preceding sign as 32-bit variables in Intel format.

Bytes	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 L	Post-point H	Pre-point L	Pre-point H
FIXPOINT16 *	See examples, Table 4.3			
FLOAT32	IEEE format			
ERR_STRUC	Error no.	Error location	TOP L	TOP H
STRING	See examples, Table 4.3			
* 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

L Low Byte

H High Byte

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 section 4.6.1 and 4.6.2.

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 Application Manual.

Parameter 152-ASTER can be used to select from three preset solutions for operation in 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.

The following parameters are changed automatically in the device with the setting e.g. 152-ASTER = BUS_1:

Parameter	Factory setting (FS)	Changed value	Function
151-ASTPR	DRV_1	BUS_1	Original application data set
152-ASTER	DRV_1	BUS_1	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 BUS_1

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

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

4.3 CDA3000 parameters for bus operation

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

Over the following pages you will find a more detailed description of the individual parameters.

Overview

Subject area	Parameter	Function	Value range	FS	Your set.	Unit
1. General bus settings						
_57OP	492-CACNF	CAN configuration: Type of control/ reference transfer	0 ... 4	4		
	571-CLADR	CAN bus Device address	0 ... 99	0		
	489-CLBDR	CAN bus baud rate	25 ... 500	500		
	574-CAWDG	CAN bus watchdog time	0 ... 255	0		ms
	575-CASCY	Sampling time for status message	1 ... 32000	80		ms
	570-CAMOD	Function selection option module CAN_{LUST}	Slave/Master	Slave		
2. Definition of control location and reference channel						
_26CL	260-CLSEL	Control location selector	TERM ... **OPTN2**	TERM	OPTN2	
_28RS	280-RSSL1	Reference selector 1	OFF ... **FOPT2**	FMAX	FOPT2	
_57OP	573-CACTR	CAN bus control word	0000H ... FFFFH	0000H		Hex
	572-CASTA	CAN bus status word	0000H ... FFFFH	0000H		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**	STOP		
FS = Factory setting						

Table 4.5 Overview of CDA3000 bus parameters

4.3.1 General bus settings

492-CACNF - CAN configuration

The parameter can be used to select the mode of activation via CAN. With the DRIVECOM state machine the resolution of the reference input and of the actual value can additionally be varied.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	0 ... 4	4	–	USIGN8	FLASH

CACNF	Reference	Actual	Activation
0	No reference adopted	No actual value transfer	No activation
1	16-bit reference frequency (Q0)	16-bit actual frequency (Q0)	DRIVECOM state machine
2	32-bit reference frequency (Q16)	32-bit actual frequency (Q16)	DRIVECOM state machine
3	32-bit reference frequency (Q16)	16-bit actual frequency (Q0) 16-bit actual torque (Q0) *	DRIVECOM state machine
4	32-bit reference frequency (Q16)	32-bit actual frequency (Q16)	EasyDrive control mode (CDA3000-specific), **factory setting**
* - Only in loop controlled operation			

Table 4.6 CAN configuration

571-CLADR - CAN address

As described in section 2.1, the device address can be assigned in two ways. The decisive factor is the setting of parameter 571-CLADR. If the parameter is set to the value 0, the device address is ascertained after system start from the connector configuration.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	0 ... 99	0	–	USIGN8	FLASH

If the parameter is set to values between 1 and 99, the connector configuration is ignored and the inverter starts after the reset with the device address set in CLADR (save the setting prior to the reset with parameter 150-SAVE).

489-CLBDR - CAN bus baud rate

By way of this parameter the baud rate of the CAN controller is set.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	25 ... 500	500	kBaud	USIGN8	FLASH

CLBDR *	Transmission speed	Comments
0	500 kBaud	Factory setting
1	250 kBaud	
2	125 kBaud	
3	75 kBaud	
4	50 kBaud	
5	25 kBaud	
* - Transfer value for parameter setting		

Table 4.7 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!

574-CAWDG - Bus watchdog time in ms

Value for watchdog to monitor the CAN bus. The watchdog time is adjustable in millisecond increments. The value 0 deactivates the watchdog.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	0 ... 255	0	ms	USIGN8	FLASH

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.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	1 ... 32000	80	ms	USIGN16	FLASH

570-CAMOD - Function selection option module CAN_{Lust}

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

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_570P	0 (SLAVE) ... 1 (MASTR)	0 (SLAVE)	–	USIGN8	FLASH

4.3.2 Definition of control location and reference channel

260-CLSEL - Control location

The control location is selected by way of parameter 260-CLSEL. With CLSEL = OPTN2 the control word of the device is formed from bytes 0 and 1 of the data content of the control identifier (base ID 661).

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_26CL	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 “SYSTEM START” state. The control mode and the structure of the control and status word is set by way of parameter 492-CACNF (EasyDrive, DRIVECOM).

280-RSSL1 - Reference selector

Set RSSL1 = FOPT2 so the reference is formed from bytes 2-5 of the data content of the control identifier (base ID 661).

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_28RS	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 CAN system state “SYSTEM START”.

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 4.8 Settings for reference selector 280-RSSL1

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

573-CACTR - Control word

The control word received via the control identifier is entered in parameter 573-CACTR. During commissioning the parameter can be used to check the reception of data. The parameter is for display purposes only.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_57OP	0000H ... FFFFH	0000H	–	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 the status identifier. The parameter is for display purposes only.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_57OP	0000H ... FFFFH	0000H	–	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 data bytes 2-5 of the control identifier. The interpretation of the value is dependent on the selected operation mode. The parameter is for display purposes only.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_28RS	-32764 ... 32764	0	Hz	INT32Q16	RAM actual value

4.3.3 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 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 drive

unit 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.

Subject area	Value range	Factory set.	Unit	Data type	Memory type
_15FC	0 (STOP) ... 1 (START)	0 (STOP)	–	USIGN8	RAM control value

4.4 Representation of parameter number

The parameter number (PARA_HI PARA_LO) is represented as a four-digit hexadecimal number.

Drive units have parameter numbers from 0 - 999. These parameters must be converted to four-digit hexadecimal numbers and inserted into the protocol frame under PARA_HI and PARA_LO, with PARA_LO representing the Low Byte and PARA_HI the High Byte of the parameter number (see section 4.1 and 4.6). Leading zeroes must be entered.

4.5 Telegram execution and verification

Data transfers are acknowledged by reply telegrams containing the same data content and the parameter number. Only data byte 2 of the reply differs, no longer containing the transfer mode but the STATUS instead.

The STATUS byte indicates whether the transfer was successful or what problems occurred (see also section 4.5, Parameter channel).

Generally a reply is sent only after successful entry of the new parameter value in the drive unit.

Mode-related access restrictions

If bit 6 (hexadecimal value 40 H) in the STATUS byte is set in a reply telegram, write access to the parameter concerned was refused irrespective of the transmitted value.

This in turn does not necessarily mean the parameter is generally write protected. It may be that write access was refused merely based on the current operating state of the device.

Note: For details of which parameters are writable when, refer to the Application Manual.

4.6 Parameter channel

Function: Parameter setting
Data direction: Master -> Drive unit
Drive unit -> Master
Type: Selective

By way of the parameter channel all parameters of the drive unit can be addressed. These transfers are processed at a lower priority level in the drive unit.

Access to parameters is possible irrespective of the system status (see Control and reference input) and definition of the control location (260-CLSEL) and the reference channel (280-RSSL1). If the device baud rate and address match, after initialization of the device parameters can be queried and written.

Parameter enquiry/transfer 130

The data in this transfer are scaled according to the stipulations in the inverter parameter list.

Data direction: Master -> Drive unit

At ID 1101 parameters are transferred or enquiries entered. Each transmission of this ID results in a reply with ID 1321.

Priority based on CAL	Base ID	Data byte 0	Data byte 1	Data byte 2	Data byte 3+4+5+6	Data byte 7
5	1101	PARA_LO	PARA_HI	Mode of transfer: See Table 4.9	DATA	Counter or index for field parameters

Transfer mode	Value (Dec)	Description
Enq	(05)	Request standard parameter
Sel	(02)	Write standard parameter
ENQUIRY_List	(04)	Request parameter data description
SELECT_String	(08)	Writing string parameters
ENQUIRY_String	(11)	Reading string parameters
List_End	(16)	Universal List-End identifier

Table 4.9 Transfer modes

PARA_LO: Parameter number Low byte
PARA_HI: Parameter number High byte
DATA: 32-bit data (at “List-End” : Checksum)
COUNTER: Block counter for data lengths > 4 bytes, such as string parameters (incremented on every transfer).

Data bytes 3 - 6 are transmitted in Intel format:

Byte 3 = Low Word Low Byte

Byte 4 = Low Word High Byte

Byte 5 = High Word Low Byte

Byte 6 = High Word High Byte

Data direction: Drive unit -> Master

Priority based on CAL	Base ID	Data byte 0	Data byte 1	Data byte 2	Data byte 3+4+5+6	Data byte 7
6	1321	PARA_LO	PARA_HI	STATUS 0 = Transfer OK	DATA	Counter or Index for field parameters
				Function of bits: 0 = Vacant 1 = SIO watchdog 2 = Transfer mode unknown 3 = Read not permitted 4 = Repeat action 5 = Parameter unknown 6 = Change not permitted 7 = Impermissible value		

PARA_LO: Parameter number Low byte
PARA_HI: Parameter number High byte
DATA: 32-bit data (at “List-End” : Checksum)
COUNTER: Block counter for data lengths > 4 bytes, such as string parameters (incremented on every transfer).

4.6.1 Reading string parameters

The master registers in data byte 2 (transfer mode = 11) that it wants to read a string parameter. The contents of data bytes 3-6 are not relevant.

The block counter (data byte 7) contains the value 0. The reply telegram from the drive unit contains the status byte and gives information on the readability of the parameter. If the parameter is readable, the first reply telegram contains the first four characters.

For synchronization purposes the master requests each substring by means of a request telegram. The drive unit copies the received telegram to its transmit area, overwrites the telegram's data area with the string data and sends it back to the master. Data byte 7 (block counter) is incremented by the master and by the slave on every partial transfer. The last-but-one reply telegram from the drive unit contains the 0 terminator of the string in its data area.

In the last reply telegram the drive unit enters the *LIST_ End identifier* in the status byte. The data area of the telegram now contains the checksum covering all individual data areas (0 to number of blocks -1) of the drive unit reply telegrams which have contained part of the data string.

If the string length is $\leq$ 3, the second block is the last block and then already contains the checksum.

Telegram sequence

Action	Base ID	Data byte 2 (selector)	Data bytes 3 - 6 (see below)	Data byte 7 (counter)
Master enquiry	1101	ENQ_String (11)	xxxx	0
Drive unit reply	1321	Status (0)	4 characters for status = 0	0
If status = 0 and string longer than 3 characters, 2nd block follows				
Master enquiry 2	1101	ENQ_String (11)	xxxx	1
Drive unit reply	1321	Status (0)	4 characters	1
Last but one block				
Master enquiry	1101	ENQ_String (11)	xxxx	Number of blocks - 1
Drive unit reply	1321	Status (0)	0-3 characters, 0 terminator	Number of blocks - 1
Last block				
Master enquiry n	1101	ENQ_String (11)	xxxx	Number of blocks
Drive unit reply	1321	LIST_End (16)	32-bit checksum	Number of blocks

Table 4.10 Telegram sequence, reading a string

Data bytes 3 - 6 are transmitted in Intel format:

Byte 3 = Low Word Low Byte

Byte 4 = Low Word High Byte

Byte 5 = High Word Low Byte

Byte 6 = High Word High Byte

Plausibility checks:

After the first block the existence and access rights of the parameter are checked. If the drive unit inserts an error in the status of the reply telegram of block 1, communication for the parameter in question is terminated.

The last telegram contains the checksum of the overall string. If it is wrong, or if the counter is incorrect, the transmitted string is not valid.

The telegram sequence within the drive unit is run according to a state machine. This state machine is automatically reset if the master transmits a telegram with an incorrect value for the block counter.

4.6.2 Writing string parameters

The master enters in data byte 2 the code for “Write string parameter”. Data bytes 3-6 are of no significance in block 0. In the reply telegram from the drive unit a status message is entered in block 0 in data byte 2. If the status is 0, write access is permitted and the master begins transmitting the first strings.

The master transmits 4 characters per data block. The last-but-one data block must contain a 0 terminator. For the purposes of synchronization, the drive unit sends each data block back to the master.

Explanatory note on checksum: Blocks 1 to n - 1 by logical XOR linking of data bytes 3 - 6.

Telegram sequence

Action	Base ID	Data byte 2 (selector)	Data bytes 3 - 6 For data format see below	Data byte 7 (counter)
Master job	1101	SEL_String (8)	xxxx	0
Drive unit reply	1321	Status (0)	xxxx	0
If status = 0 and string longer than 3 characters, 2nd block follows				
Master job 2	1101	SEL_String (8)	4 characters	1
Drive unit reply	1321	Status (0)	4 characters	1
Last but one block				
Master job n-1	1101	SEL_String (8)	0-3 characters, 0 terminator	Number of blocks - 1
Drive unit reply	1321	Status (0)	0-3 characters, 0 terminator	Number of blocks - 1
Last block				
Master job n	1101	LIST_End (16)	32-bit checksum	Number of blocks
Drive unit reply	1321	Status (0)	32-bit checksum	Number of blocks

Table 4.11 Telegram sequence, writing a string

Data bytes 3 - 6 are transmitted in Intel format:

Byte 3 = Low Word Low Byte

Byte 4 = Low Word High Byte

Byte 5 = High Word Low Byte

Byte 6 = High Word High Byte

Plausibility checks:

After data block 1 the drive unit verifies the access rights to the parameter. If the status is unequal to 0, communication is terminated for the parameter.

If the master transmits more than 100 characters for a string, the string is not saved and the error is entered at the end of the block sequence in the status (bit 7 = 1).

If the checksum in the last telegram is not identical to its own, a telegram repetition is requested by setting of bit 4 in the status.

4.7 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 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 signal 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 “Card-Writeable” 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.
5. If the parameter data set has been accepted in full, the data set can be permanently stored in the device by way of parameter 150-SAVE.

Note: If the connection is interrupted during transfer, or if the timeout expires, the transfer must be repeated or the drive controller restarted.

5 Control and reference input

5.1 Controller enable (ENPO)

The drive units require an additional hardware enable via control terminal X2/8 ENPO for control over the CAN bus. This control signal is high-active. When this control signal is removed the motor runs out freely. Refer also to the description relating to the drive unit in the Operation Manual.

5.2 CAN system states

The CAN system state refers to the state of the overall bus system. The following system states are currently supported:

- **System logon**
  After power-on each drive unit is in the System Stop state.
  In this state the drive controller transmits the logon identifier 1543 (607 h) + CAN address every 100 ms.
- **System Stop**
  In this state parameters can be set over the bus or control commands and reference values can be transmitted to the individual devices. The control commands and reference values are only stored, however (1 reference / 1 control command) and are not executed until the System Start system state.
- **System Start**
  System Start is the normal operating state. The devices can be controlled by way of their selective control commands. If control commands were transmitted to the devices during System Stop, they are not executed in the drive unit until the switch is made to System Start. This method permits presetting of the individual devices before the complete system is up and running. On System Start all the devices then receive their start command synchronously (1 ms jitter).

State transitions are triggered as specified in section 5.5.4 “System Start/Stop”.

5.3 Device states

In contrast to the CAN system state, which describes the status of the entire bus system, the device states in the various devices of a bus system may vary.

The device state is determined, firstly, by the selective control commands over the bus and, secondly, by means of information from the respective process. For example, an error in an application results in a change of device state.

The devices run a so-called state machine, which assigns defined responses to events for each state.

5.4 Device control

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

In the first control mode the key functions of the device can be activated directly by way of a LUST-specific control word. In the following this mode is termed the **“EasyDrive control mode”**. 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.

In the second control mode the drive unit is controlled by way of 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.

By way of parameter 492-CACNF the control mode and the mode of reference input are defined.

CACNF	Reference	Actual	Activation
0	No reference adopted	No actual value transfer	No activation
1	16-bit reference frequency (Q0)	16-bit actual frequency (Q0)	DRIVECOM state machine
2	32-bit reference frequency (Q16)	32-bit actual frequency (Q16)	DRIVECOM state machine
3	32-bit reference frequency (Q16)	16-bit actual frequency (Q0) 16-bit actual torque (Q0)	DRIVECOM state machine
4	32-bit reference frequency (Q16)	32-bit actual frequency (Q16)	EasyDrive control mode (factory setting)

Table 5.1 Reference and actual value transfer, CAN_{LUST}

5.4.1 EasyDrive control mode

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

Control word		
Bit	**Function**	**Signal**
0	START, enable control	1 = Controller enable 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]
5	FFTB1, select table reference (significance 2^1) *	
6	FFTB2, select table reference (significance 2^2) *	
7	ERES, reset error	0->1 = Reset latest device error [4]
8	CUSEL, data selection **	0 = Characteristic data set 1, 1 = Characteristic data set 2 [2]
9	UM0, select user mode (significance 2^0) ***	Binary selection of active user mode [3]
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

Status word		
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 is limited via 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 to start, initialization OK
8	ENPO, status 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, irrespective of 213-FIS03	Status of input ISD03
13	Actual status ISD02, irrespective of 212-FIS02	Status of input ISD02
14	Actual status ISD01, irrespective of 211-FIS01	Status of input ISD01
15	Actual status ISD00, irrespective of 210-FIS00	Status of input ISD00

Table 5.2 EasyDrive control word and status word

* - Only if 280-RSSL1=(7) TBSEL

** - Only if 651-CDSSL=(6) OPTN2

*** - Only if 166-UDSSL=(3) OPTN2

Additional explanatory notes to Table 5.2

1) 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.
2) 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 possibility of storing four complete parameter 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.

5.4.2 Control via DRIVECOM STATE MACHINE

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

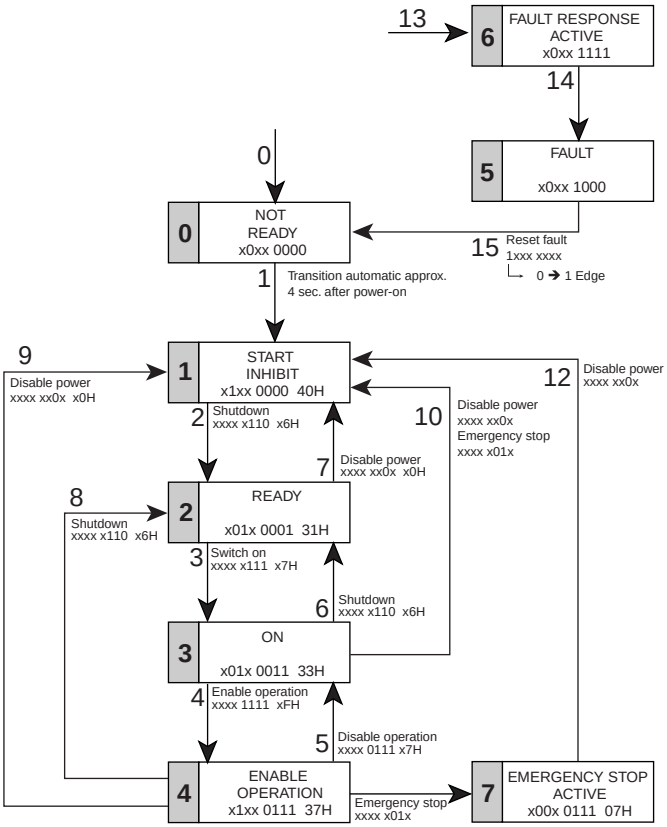


Figure 3.1 DRIVECOM state machine

Control word		
Bit	**Function**	**Signal**
0	Activate	
1	Disable power	
2	Emergency stop	1 = Emergency stop
3	Enable operation	
4	FFTB0, select table reference (significance 2^0) *	Binary selection of a table reference [1]
5	FFTB1, select table reference (significance 2^1) *	
6	FFTB2, select table reference (significance 2^2) *	
7	Reset fault	0->1 = Reset latest device error [4]
8	CUSEL, data selection **	0 = Characteristic data set 1, 1 = Characteristic data set 2 [2]
9	UM0, select user mode (significance 2^0) ***	Binary selection of active user mode [3]
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

Status word		
Bit	**Function**	**Signal**
0	Ready for start	
1	On	
2	Enable operation	
3	Fault	
4	Power disabled	1 = Voltage disabled, function not implemented
5	Emergency stop	
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 = Fmin Fmax limitation active
12	Status of input ISD03	Status of input ISD03
13	Status of input ISD02	Status of input ISD02
14	Status of input ISD01	Status of input ISD01
15	Status of input ISD00	Status of input ISD00

Table 5.3 DRIVECOM control word and status word

* - Only if 280-RSSL1=(7) TBSEL

** - Only if 651-CDSSL=(6) OPTN2

*** - Only if 166-UDSSL=(3) OPTN2

Additional explanatory notes to Table 5.3

1) 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 = (7) TBSEL. Direct reference input is then not possible.
2) 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 possibility of storing four complete parameter 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).

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 5.4 Bit combinations of the DRIVECOM state machine

5.5 Identifiers

5.5.1 Selective transmissions

For communication between the various CAN bus stations a “base” CAN identifier is defined for each data transfer.

Each station on the bus is assigned an address (0 - 99) which can be set on the devices by way of two different options:

1. By way of parameter 571-CLADR
2. By way of the coding pins on CAN connectors X11 and X12

Setting by way of parameter has priority. Only if the address set in the parameter is 0 is the hardware preset applied (see also section 2.1 “Setting the address”).

Station 0 operates with the “base” CAN identifier. All other stations operate with identifiers calculated according to the following formula:

ID = “base” CAN identifier + number of station

Base identifier ID	DLC*	Function
441 (1B9 $_{hex}$)	3	Error messages from device
1543 (607 $_{hex}$)	0	Logon identifier
661 (295 $_{hex}$)	*6	Control identifier
881 (371 $_{hex}$)	*6	Status identifier
1101 (44D $_{hex}$)	8	Parameter channel, data direction Master -> Slave
1321 (529 $_{hex}$)	8	Parameter channel, data direction Slave -> Master
* CACNF dependent See section 5.5.5		

Table 5.5 Base identifier

Broadcast identifier	DLC*	Function
221 (DD $_{hex}$)	1	Switch system state START/STOP, no base ID, broadcast

Table 5.6 Broadcast identifier

* - DLC = Data Length Code (number of data bytes)

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

5.5.2 Broadcast transmissions

Broadcast transmissions are received and evaluated by all devices. The 'Remote Transmission Request' flag must not be set for these transfers. No reply is given to such transmissions.

Any one broadcast transmission can be sent only by **one** bus station.

5.5.3 Station logon

Function: System logon after power ON
Data direction: Drive unit -> Master
Type: Selective

This message is delivered only after power-on in the **System Logon** system state cyclically every 100 ms.

Priority based on CAL	Base ID	Data byte
7	1543	No data

After power-on each bus station attempts to log on to the master.

The drive unit transmits this identifier with a sampling time of 100 ms. The master identifies from the identifiers which devices are connected to the bus and which address is assigned to the devices concerned.

The identifier is transmitted until the drive unit has been addressed once by the master over the bus (function: **System Start**).

If the master addressed the drive unit with identifier 221 System Start, the drive unit detects that the master has received the logon, terminates the transmission with the “logon identifier” and immediately begins cyclically sending status messages from the device onto the bus.

The sampling time of 100 ms cannot be changed!

5.5.4 System Start/Stop

Function: System Start/ Stop
Data direction: Master -> All
Type: Broadcast

Priority based on CAL	ID	Data byte 0
1	221	00 = STOP 01 = START

STOP

- The drive unit switches to System Stop
- The drive unit stops the drive
- Reference values are then only received and stored (1 reference)
- Status messages are transmitted
- Parameter access possible

START

- Time monitoring enabled (watchdog functions)
- Control functions are processed
- Status messages are transmitted
- Error messages can be sent over the bus
- Parameter access possible

5.5.5 Control functions

Function: Control functions/reference
Data direction: Master -> Drive unit
Type: Selective

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 state machine of the drive units has a sampling time of 1 ms. All control commands and reference values are processed during this sampling time by the drive unit.

The state control and the reference input are selected by way of parameter 492-CACNF.

CACNF	Base ID	Control word	Reference	
		Bytes 0-1	Bytes 2-3	Bytes 4-5
1	661	**DRIVECOM control word**	16-bit reference frequency (Q0)	
2.3	661	**DRIVECOM control word**	32-bit reference frequency (Q16)	
4	661	**EasyDrive control word**	32-bit reference frequency (Q16)	
Priority based on CAL = 3				

Table 5.7 Control functions

Control word: See description of control word

Reference: Reference frequency for control

Where CACNF=1: -> Value range: -32767 to +32768
The data format is Byte 2 = Reference Low Byte
Int16Q0 Byte 3 = Reference High Byte

Where CACNF=2 -4: -> Value range: -32767,999 to +32768,999
The data format is Byte 2 = Reference Low Word Low Byte
Int32Q16 Byte 3 = Reference Low Word High Byte
Intel format 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
Content	0	80	14	0

$0.5 = 2^{-1}$ 20 = 14 H

5.5.6 Status messages

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

Status messages are transmitted in the START and STOP system states.

CACNF	Base ID	Status word	Actual	
		Bytes 0-1	Bytes 2-3	Bytes 4-5
1	881	**DRIVECOM status word**	16-bit actual frequency (Q0)	
2.3	881	**DRIVECOM status word**	32-bit actual frequency (Q16)	
4	881	**EasyDrive status word**	32-bit actual frequency (Q16)	
Priority based on CAL = 3				

Table 5.8 Status messages

Status word: See description of status word

Reference: Actual frequency for control

Where CACNF=1 + 3: -> Value range: -32767 to +32768
The data format is Byte 2 = Actual value Low Byte
Int16Q0 Byte 3 = Actual value High Byte

Where CACNF=2 -4: -> Value range: -32767,999 to +32768,999
The data format is Byte 2 = Actual value Low Word Low Byte
Int32Q16 Byte 3 = Actual value Low Word High Byte
Byte 4 = Actual value High Word Low Byte
Byte 5 = Actual value High Word High Byte

Example: Actual value = 20.5 Hz

Actual value data in Hex:

Byte	2	3	4	5
Content	0	80	14	0

$0.5 = 2^{-1}$ 20 = 14 H

6 Fault rectification

6.1 Programmable error responses

In case of error, this state is indicated by the LEDs on the drive unit, by the red backlighting of the KEYPAD and by the device status word.

In all error cases the drive unit disables the power stage, if the default error response is set. The error response is programmable for each error in four stages.

In the error state the devices can still be operated by way of the KEYPAD and all connected bus systems (except the control function).

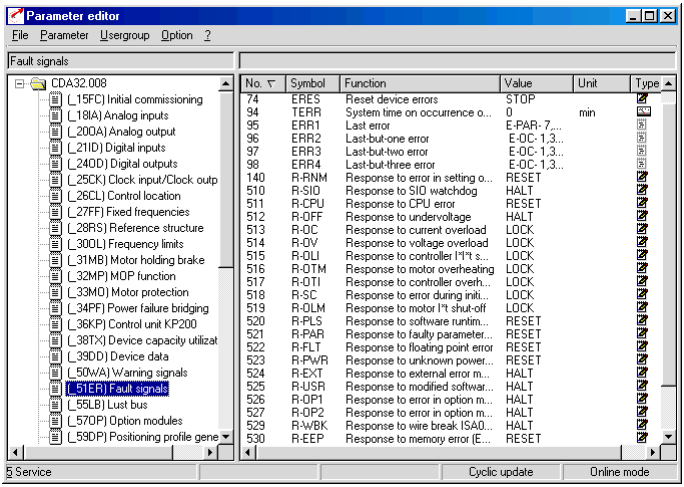


Figure 6.1 The error responses can be programmed with the parameter editor. The screenshot shows the factory setting.

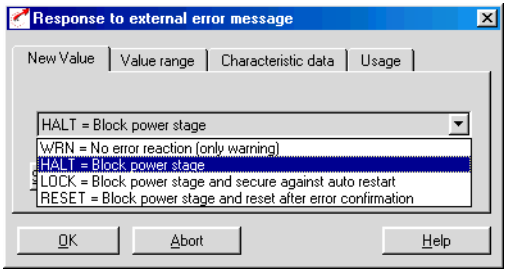
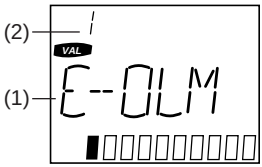


Figure 6.2 Possible error responses

Notes on error handling in the drive unit

Error location: On the KEYPAD the error (1) and, for more precise error definition, the error location (2) are shown at the top left of the display. On the DRIVEMANAGER a window indicating possible error causes and remedies appears in case of error.



Error memory: The last four error messages are stored in the device in parameters 95-ERR1 to 98-ERR4.

The error message **E-OFF** (power failure) is only entered in the error memory in the event of brief power failures (the device does not shut down completely before the power is restored).

Warning message: If the parameter setting for response to an error is a warning message (WRN), the device indicates the warning by way of an appropriately parameterized digital output (e.g.: 242 -FOS02 = WARN). No other device response occurs. Safety-related errors cannot be set as warnings in the parameters.

6.2 Error messages

Function: Error messages
Data direction: Drive unit > Master
Type: Selective

Messages are only transmitted in the SYSTEM START device state.

- Each error message is indicated by one-time transmission of error identifier 441.
- When the error state has been eliminated an error identifier 441 with data content 0 is transmitted.

Priority based on CAL	Display	Base ID	Data byte 0/1	Data byte 2	Data byte 3
2	Error active	441	Error no.	Error location	Reserved Always 0
	Error reset	441	0	0	0
Error number: The number corresponds to the error number of the drive unit (for definition see Operation Manual >> Error message) Error location: This number permits more precise definition of the cause of the error on the devices.					

Table 5.9 Error messages

Error connected with CAN bus

Bus	DM/ KP	Error location no.	Error cause	Possible remedy	Response no.
16	E-0P2	170	Error in module at option slot 2	1. Check module and identifier; 2. (1)	STOP
		171	Error on option 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. The error may also be caused by another station on the bus.	
		172	Error on option 2: Transmit protocol could not be sent.	Check contacting of module. If the error still occurs after switching off and back on again, the device or the module is faulty.	
		173	Error on option 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.	
		174	Error on option 2: Module has signaled error.	Check contacting of module. If the error still occurs after switching off and back on again, the device or the module is faulty.	

Table 5.10 CAN bus error

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	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	E-WRN	Warnings
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	PowerFail
23	E-RM	InitRunMode
24	E-FDG	Transmission error in reference coupling
25	E-LSW	Limit switches reversed

Table 5.11 Error messages

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

6.3 Parameterizable warnings on the CAN

Priority based on CAL	Display	Base ID	Data byte 0	Data byte 1-2
2	Warning active	441*	Error no. Always FF	Warning bit coded 1 Word
* Signaled if the status of the bit coded warning word changes.				

Table 5.12 Warnings

Bit coded warning messages

Bit in data byte 1-2	Hex value	Function
0	0001H	Warning message when DC-link voltage has fallen below value in parameter 503-WLUV
1	0002H	Warning message when DC-link voltage has exceeded value in parameter 504-WLOV
2	0004H	Warning message when I^2*t integrator of device is active
3	0008H	Warning message when motor temperature has exceeded value in parameter 502-WLTM
4	0010H	Warning message when heat sink temperature has exceeded value in parameter 500-WLTI
5	0020H	Warning message when interior temperature has exceeded value in parameter 501-WLTD
6	0040H	Warning message when apparent current has exceeded value in parameter 506-WLIS
7	0080H	Warning message when output frequency has exceeded value in parameter 505-WLF
8	0100H	Warning message from slave when reference value from master is faulty in Master/Slave operation
9	0200H	Warning message when Ixt integrator of motor is active
10 - 15		Reserved

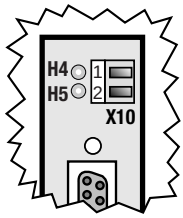
Table 5.13 Warning messages (corresponds to Warnings status word, parameter 120-WRN in subject area _50WA)

Note: Several warning messages may be present at any one time.

6.4 LED status display on the module

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

LED H5 indicates a correct voltage supply.



Red LED (H4)	Green LED (H5)	Bus state
Off	Off	24V supply to module missing
Off	On	Voltage supply OK

6.5 Acknowledgment of error messages

- By means of a rising signal edge at input ENPO
- Rising edge at a programmable digital input with function selector set to ERES (e.g.: 231-FIS03 = (8) ERES)
- Writing of value 1 to parameter 74-ERES via control unit or bus system. The entry is automatically deleted again.
- By way of the error reset bit in the control word
- Transition from **SYSTEM START** to **SYSTEM STOP**

After an error reset the state machine of the device (EasyDrive or DRIVECOM) assumes the same state as after power-on. That is to say, the control must be restarted.

7 Examples

7.1 Activation of a CDA3000

7.1.1 EasyDrive control mode

Requirements:

1. Communication module CM-CAN2 (CANopen) is plugged in
2. Activate the application data set you want to use 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 presetting of device parameters:

- Parameter 260-CLSEL = (5) OPTN2
- Parameter 280-RSSL1 = (7) FOPT2
- Parameter 489-CLBDR = (2) 500 Set baud rate
- Parameter 571-CLADR = 1 Device address
- Parameter 492-CACNF = 4 Control mode, direct control

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

Action	ID	Data	Comments
System logon	1545	None	The CDA transmits this identifier in a 100 ms cycle until the master has addressed an identifier of the CDA.
Start system	For all CDAs: 221	01	The master sends “System Start”. With this command the control commands stored in the control word of the CDA are activated. **From this point on the preset timeout 574-CAWDG is monitored.** If the relevant control identifier is not transmitted in this time division, an error is generated.

Table 5.14 Example, EasyDrive

Action	ID	Data	Comments
Send control identifier	For CDA 0: 661 For CDA 1: 663 etc.	00 00 00 00 00 00 00 00	The master transmits the control identifier to the CDA. Cyclical transmission of the control identifiers with watchdog monitoring.
Send control identifier	For CDA 0: 661 For CDA 1: 663 etc.	05 00 00 00 0A 00	Example: CDA 1 is to rotate clockwise at 10 rpm.
Status message	For CDA 0: 881 For CDA 1: 883 etc.	16 01 00 00 0A 00	Example: CDA 1 rotates clockwise at 10 rpm.

Table 5.14 Example, EasyDrive

7.1.2 Control mode: DRIVECOM state machine

Requirements:

1. Communication module CANopen (CM-CAN2) plugged in
2. Activate the application data set you want to use 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 presetting of device parameters:

- Parameter 260-CLSEL = (5) OPTN2
- Parameter 280-RSSL1 = (7) FOPT2
- Parameter 489-CLBDR = (2) 500 Set baud rate
- Parameter 571-CLADR = 1 Device address
- Parameter 492-CACNF = 2 Control mode, direct control

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

Action	ID	Data	Comments
System logon	1545	None	The CDA transmits this identifier in a 100 ms cycle until the master has addressed an identifier of the CDA.
Start system	For all CDAs: 221	01	The master sends “System Start”. With this command the control commands stored in the control word of the CDA are activated. **From this point on the preset timeout 574-CAWDG is monitored.** If this time is exceeded an error is generated.
Send control identifier	For CDA 0: 661 For CDA 1: 663 etc.	00 00 00 00 00 00 00	The master transmits the control identifier to the CDA. Cyclical transmission of the control identifiers with watchdog monitoring.
Send control identifier	For CDA 0: 661 For CDA 1: 663 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 CDA 0: 881 For CDA 1: 883 etc.	40 02 00 00 00 00 00	Example: CDA 1 signals “ready for start” state.
Send control identifier	For CDA 0: 661 For CDA 1: 663 etc.	06 00 00 00 0A 00 00	Example: CDA 1 is to switch from “ready for start” to “on” state. Reference value 10 rpm clockwise applied.
Status message	For CDA 0: 881 For CDA 1: 883 etc.	31 02 00 00 00 00 00	Example: CDA 1 signals “on” state.
Send control identifier	For CDA 0: 661 For CDA 1: 663 etc.	0F 00 00 00 0A 00 00	Example: CDA 1 is to switch from “on” to “operation enabled” state. Reference value 10 rpm clockwise applied.
Status message	For CDA 0: 881 For CDA 1: 883 etc.	37 02 00 00 0A 00 00	Example: CDA 1 rotates clockwise at 10 rpm and signals "Operation enabled".

Table 5.15 DRIVECOM state machine, example

7.1.3 Parameter setting

Action	ID	Data	Comments
Enquire for parameter	1103	68 01 05 XX XX XX XX 00	Poll parameter to be displayed as continuous actual value (parameter 360-DISP)
Reply from CDA	1323	68 01 00 96 01 00 00 00	Message: Parameter 360-DISP = 406 (406-REFF Current reference frequency)
Send parameter	1103	68 01 02 0E 00 00 00 00	Set parameter 360-DISP to 14-MIST (actual torque)
Reply from CDA	1323	68 01 00 0E 00 00 00 00	Checkback from CDA after successful data transfer

Table 5.16 Example of parameter setting

Appendix Glossary

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

CAL: (CAN Application Layer). CiA protocol primarily describing the way in which variables are transferred, 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 controller are always slaves and have no "control function".

LMT: (Layer Management). See NMT

DBT: (Identifier Distributor). See NMT

CANopen: 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 engineering and I/O for input/output segment) (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.

Appendix Index

Q

R

S

T

U

W

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