DE
EN

CDF30.002 light

Operation Manual

Betriebsanleitung

Positioning controller

Rated current 2 A
Mains voltage 24 V

LUST

LUST

Operation Manual CDF30.002
Betriebsanleitung CDF30.002

Ser.-No.: 1041.20B.0-0 • **05/2007**

Gültig ab Softwareversion V0.2
Valid from software version V0.2

Technische Änderungen vorbehalten.
We reserve the right to make technical changes.

Documentation overview

Document	Ordering designation	Purpose
Operating manual CDF30.002	1041.00B.x-xx	Installation and commissioning
Application Manual CDE/CDB/CDF3000	1001.02B.x-xx	Project planning and description of function
Communication manual CANopen	1001.06B.x-xx	Project planning and description of function

DE
EN

Pictograms

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

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

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

➔ **Note:** Useful information

Table of contents

1 Safety

1.1 Measures for your safety

In order to avoid physical injury and/or material damage the following information must be read before first start-up. The safety regulations must be strictly observed at any time.

Read the Operation Manual first!

- Follow the safety instructions!

Electric drives are generally potential danger sources:

- Rotating parts
- hot surfaces
- electric voltages

Protection against magnetic and/or electromagnetic fields during installation and operation.

- For persons with pacemakers, metal containing implants and hearing aids etc. access to the following areas is prohibited:
  - Areas in which drive systems are installed, repaired and operated.
  - Areas in which motors are assembled, repaired and operated. Motors with permanent magnets are sources of special dangers.

Note: If there is a necessity to access such areas a decision from a physician is required.

Your qualification:

- In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device.
- The qualified person must become familiar with the Operation Manual (refer to IEC364, DIN VDE0100).
- Knowledge of the national accident prevention regulations (e. g. VBG 4 in Germany)

During installation follow these instructions:

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

Pictograms used

The notes on safety describe the following danger classes.
The danger class describes the risk which may arise when not complying with the note on safety.

Warning symbols	General explanation	Danger class acc. to ANSI Z 535
	**Attention!** Operating errors may cause damage to or malfunction of the drive.	This may result in physical injury or damage to material.
	**Danger, high voltage!** Improper behaviour may cause fatal accident.	Danger to life or severe physical injury.
	**Danger from rotating parts!**The drive may automatically start.	Danger to life or severe physical injury.

1.2 Intended use

Drive controllers are components for installation into electric systems or machines.

When installed in machines the commissioning of the drive controller (i. e. start-up of intended operation) is prohibited, unless it has been ascertained that the machine fully complies with the regulations of the EC-directive 98/37/EC (Machine Directive); compliance with EN 60204 is mandatory.

Commissioning (i. e. starting intended operation) is only permitted when strictly complying with EMC-directive (89/336/EEC).

CE The series CDF30.002 complies with the EMC directive 89/336/EEC

The harmonized standards EN 61800-3 und EN 61800-5-1 are applied for the drive controllers.

Note: This is a restricted availability product in accordance with IEC 61800-3. This product may cause radio interference in domestic environments; in such cases the operator may need to take appropriate countermeasures.

If the drive controller is used in special applications, e. g. in areas subject to explosion hazards, the applicable regulations and standards (e. g. in Ex-environments EN 50014 “General provisions” and EN 50018 “Flameproof housing”) must be strictly observed.

Repairs must only be carried out by authorized repair workshops. Unauthorised opening and incorrect intervention could lead to physical injury or material damage. The warranty granted by LUST will become void.

1.3 Responsibility

Electronic devices are never fail-safe. The company setting up and/or operating the machine or plant is itself responsible for ensuring that the drive is rendered safe if the device fails.

EN 60204-1/DIN VDE 0113 "Safety of machines", in the section on "Electrical equipment of machines", stipulates safety requirements for electrical controls. They are intended to protect personnel and machinery, and to maintain the function capability of the machine or plant concerned, and must be observed.

The function of an emergency stop system must not necessarily lead to the interruption of the power supply to the drive. To protect against danger, it may be more beneficial to keep individual drives running or to initiate specific safety sequences. Execution of the emergency stop measure is assessed by means of a risk analysis of the machine or plant, including the electrical equipment in accordance with DIN EN 1050, and is determined by selecting the circuit category in accordance with DIN EN 954-1 "Safety of machines - Safety-related parts of controls".

Before using the Autostart function the user must make sure that automatic restarting of the machine will not impose any danger on operator and machine (3.10.2 "Autostart function").

2 Mechanical installation

2.1 Notes for operation

Please strictly avoid that ...

- any moisture enters into the device,
- aggressive or conductive substances in the immediate vicinity,
- drill chippings, screws or foreign bodies dropping into the device,
- covering the ventilation openings.

The unit may otherwise be damaged.

2.2 Installation, device butt mounted

Attention: According to EN 61800-5-1 the device is **only** suitable for installation in control cabinets.

Step	Action	Comment
1	Mark the position of the tapped holes on the backing plate. Cut a tap for each fixing screw in the backing plate.	Dimensional drawings/hole spacing see Table 2.1. The tapping area will provide you with good, full-area contact.
2	Mount the positioning controller **vertically** on the backing plate.	Do not forget the mounting clearances! The metal of the contact surface must not be insulated.
3	Mount the additional components, such as the braking resistor etc., on the backing plate.	
4	Continue with the electrical installation in section 3.	

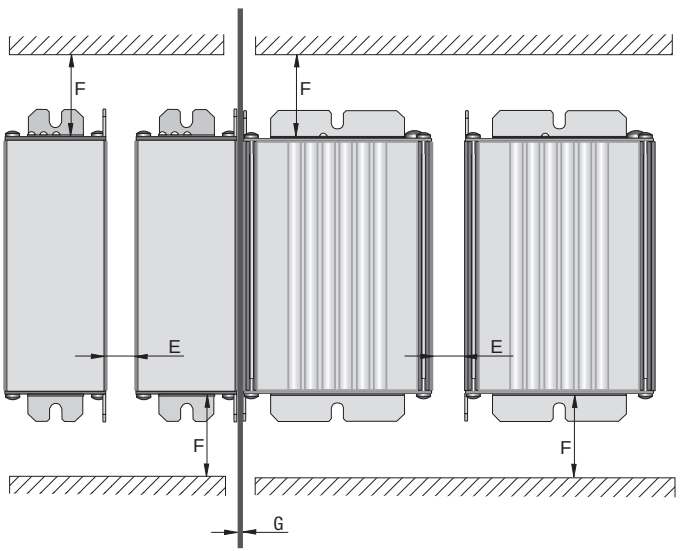


Fig. 2.1 Mounting clearances (see Table 2.1)

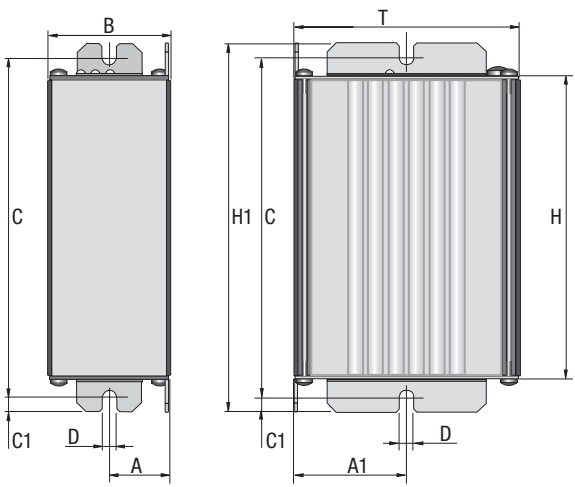
	CDF30.002
Weight [kg]	0,4
B (Width)	42
H (Height)	104
T (Depth)	78
A	21
A1	38,9
C	117
C1	5
D	4,8
E	15
F	100
G (wall thickness of backing plate)	≥ 3
H1	127
	

Table 2.1 Dimensional drawings for wall mounting (dimensions in mm)

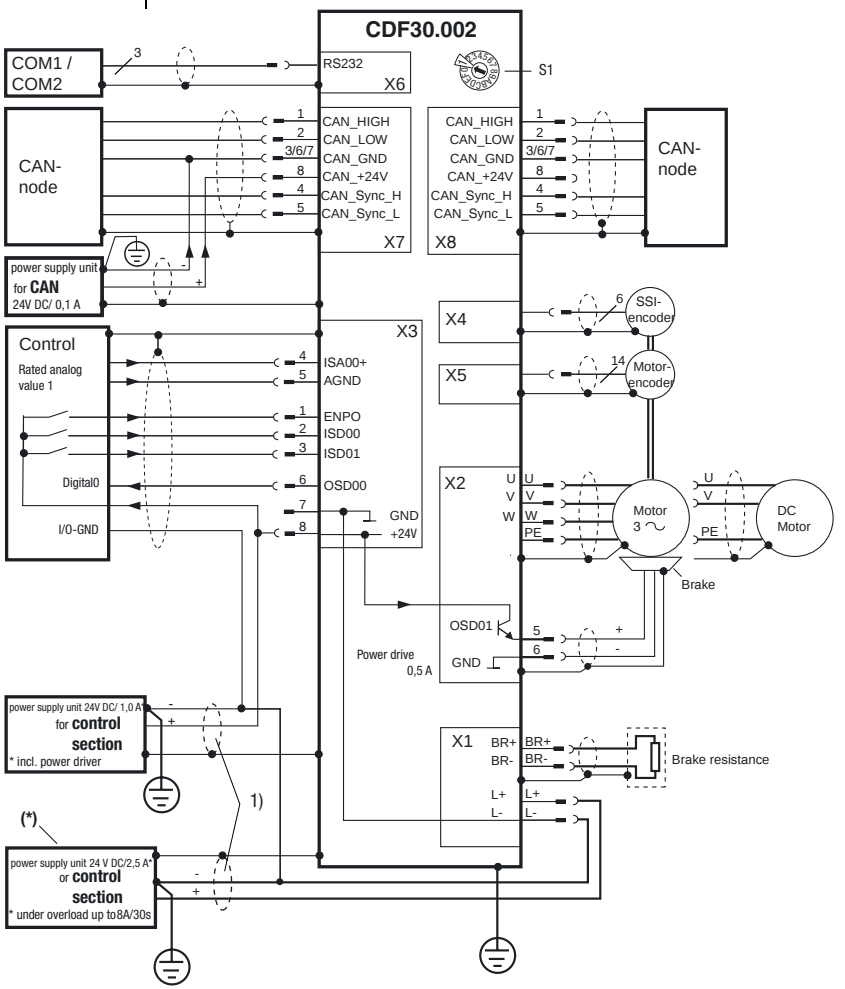
Please note:

- Air must be able to flow through the device without restriction.
- For mounting in switch cabinets with convection (= heat loss is discharged to the outside via the cabinet walls), always fit an internal air circulation fan.
- The backing plate must be well earthed.

3 Installation

Attention: The installation must only be made by expert personnel, who is fully trained in electrics and has been instructed in accident prevention measures.

3.1 Connection overview



1) Screening of the line is only required to maintain interference level "B"

Fig. 2.2 Connection plan CDF30.002 (overview

* The power supply unit must be protected against overvoltage in regenerative operation (e. g. by a protecting diode)

Legend	Explanation	continue
X1	Power terminal (4-pin plug connector)	Page 3-5
X2	Motor connection (6-pin plug connector)	Page 3-8
X3	Control connection (8-pin plug connector)	Page 3-21
X4	SSI Encoder connection (6-pin plug connector)	Page 3-14
X5	Motor transducer connection (14-pin plug connector)	Page 3-10
X6	RS232 connection, for operation with NOTEBOOK/DRIVEMANAGER CHAPTER 4.5 (4-pin RJ10 plug connector)	Page 3-16
X7/8	CANopen interface with DS402 profile (two 1:1 connected 8-pin RJ45 plug connectors)	Page 3-18
S1	Encoder switch CAN-address	
⏚	PE-connection	
	Attention: Strictly pay attention to chapter 3.3 "Connection of power supply units".	Page 3-5

Table 3.1 Legend to connection plan CDF30.002

Note: All connecting leads for terminals X1 to X5 must be provided with crimp contacts and plug housings from Co. Molex (or compatible products).
Further information see chapter 3.3.1 "Cable cross-section for X1 and X2".

3.2 Position plan

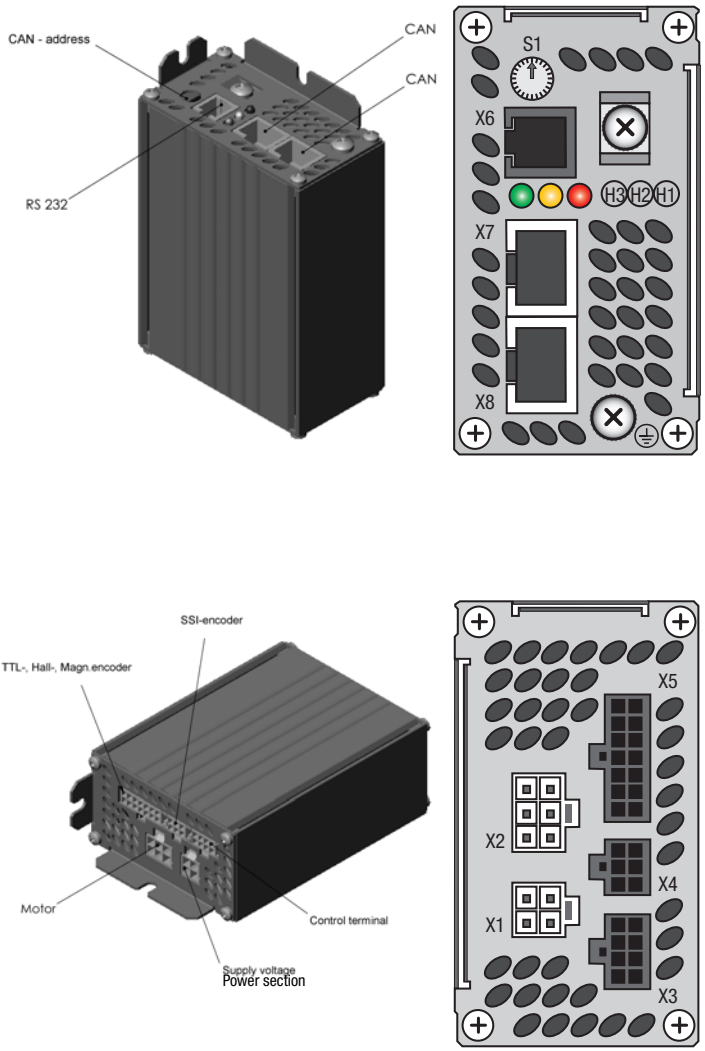
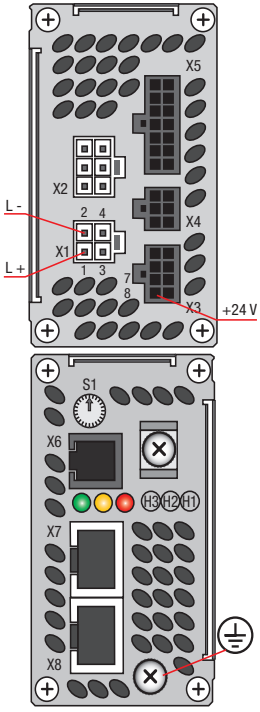


Fig. 2.3 Position plan CDF30.002

3.3 Connection of power supply units



The drive controller must only be connected to power supply units (stabilized and smoothed), which fulfil the requirements of a functional extra-low voltage with protective separation acc. to EN 50178.

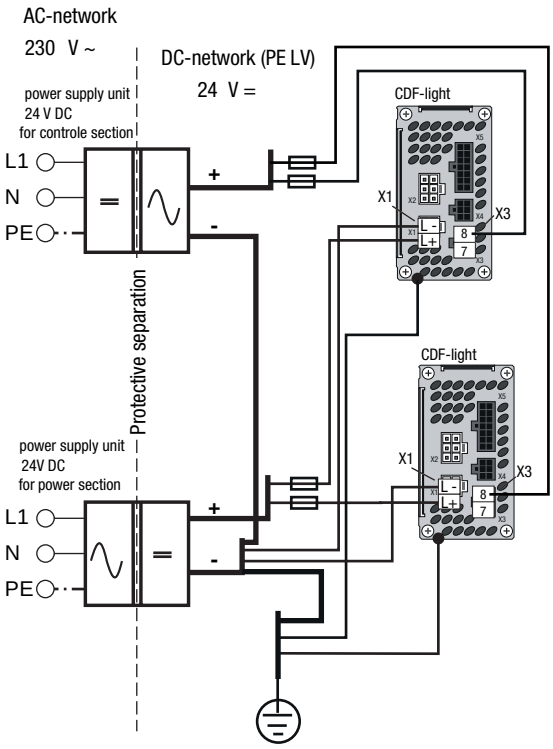


Fig. 2.4 Connection overview of DC-network

Note: Power side 24 V DC: Each device is to be individually protected with a fuse of max. 6 A utilization category gG (acc. to EN60269-1, EN0636-301) or a fuse element with comparable characteristic!
Control side 24 V DC: Each device is to be individually protected with a fuse of max. 2 A utilization category gG (acc. to EN60269-1, EN0636-301) or a fuse element with comparable characteristic!
Supply the control and power sections with an own power supply unit!

Attention: (*)Terminals X1/L- and X3/7 (GND) are connected with each other inside the device. The L-line conduct the total of power and control current supply. Terminal X3/7 (GND) serves the sole purpose of diagnostics and must not be used in normal operation.

Please note:

- The power supply units must be suitable for energy recovery (e. g. regenerative operation). The brake chopper threshold voltage is max. 35 V DC. It can be changed with the parameter "DCIN".
- Due to the high dynamics on the d.c. link, the power supply unit of the power section (supply for X1) is solely to be used for operation of the CDF30.002 (no further consumers permitted).
- Appropriate line protection must be provided in the DC mains supply. The lines must be protected with appropriate fuses.
- The earthing lead must be laid out in star configuration to conform to the EMC standards.
- The motor cable, mains lead and control cable must be laid out separately from each other.
- Avoid loops, and lay cable over short distances.
- At the supply terminal the (-) pole of the power supply units must be earthed as shown in Fig. 3.3.

3.3.1 Cable cross-section for X1 and X2

Controller	Device connected load [kVA]	Cable cross-section [mm²]
CDF30.002	60 VA at U_{mains} = 24 V	Minimum cross-section of connections X1/X2 = 0,75 mm² (see also Table 3.3)

Table 3.2 Cable cross-sections (observe VDE0298)

The CDF30.002 has no precharging connection. It does therefore not limit the charging current when switching on the supply voltage. In order to be able to utilize the current limitation of the power supply unit, power should be connected before the power supply unit (see Fig. 2.5).

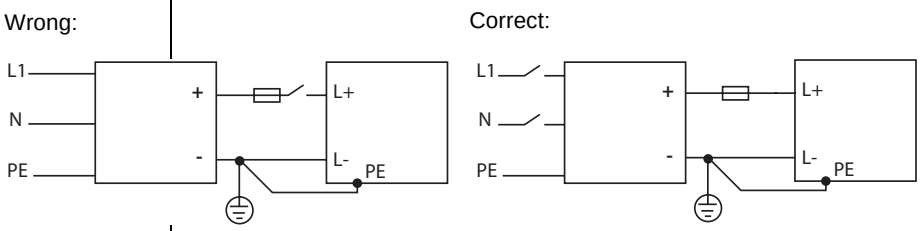


Fig. 2.5 Connection of supply voltage

3.3.2 Connection accessories X1-X5

In order to connect the CDF30.002, the connecting leads must be furnished with crimp contacts and housings from Co. Molex or compatible products.

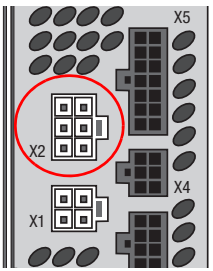
Plug connector	Molex model range	Crimp contact (Female Terminal)	Housing (Receptacle)
X1	Mini-Fit Jr.™ 4.20 mm	AWG18, 39-00-0039 AWG 16, 39-00-0078	39-01-3042 4-pin
X2	Mini-Fit Jr.™ 4.20 mm	AWG18, 39-00-0039 AWG 16, 39-00-0078	39-01-2060 6-pin
X3	Micro-Fit 3.0™ 3.00 mm	AWG 20-24, 43030-0007 AWG 26-30, 43030-0010	43025-0800
X4	Micro-Fit 3.0™ 3.00 mm	AWG 20-24, 43030-0007 AWG 26-30, 43030-0010	43025-0600
X5	Micro-Fit 3.0™ 3.00 mm	AWG 20-24, 43030-0007 AWG 26-30, 43030-0010	43025-1400

Table 3.3 Connection accessories

3.4 Motor connectio

Note: The CDF30.002 positioning controllers are short-circuit proof at the terminals during operation. In the event of a short-circuit or earth fault in the motor cable, the output stage is disabled and an error message is submitted.

Step	Action	Comment
1	Choose the desired synchronous motor.	
2	Wire the **motor phases** U, V, W via a shielded cable and earth the motor to X2/PE.	
3	If present, connect the motor brake using connection OSD01 and GND.	Brake driver specifications see table



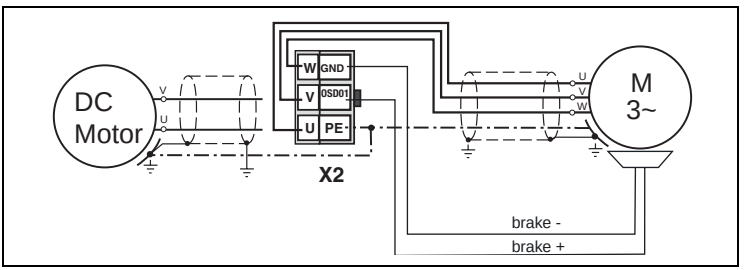


Fig. 2.6 Connection of motor and brake

Attention: The motor phases U,V and W must under no circumstances be mixed up by mistake! With motor phases reversed the positioning controller has no control over the motor. The motor may buck or accelerate in an uncontrolled manner ("race").

Attention: At the motor terminals the device is **not** earth-fault proof!

Des.	X2/	Specification	potential-free
Brake driver			
OSD01	5	I_{max} = 0.5 A short-circuit proof High-side driver Terminal scan cycle = 1ms Cable breakage monitoring	no
GND	6		

Table 3.4 Brake driver specification

3.5 Encoder connections

The CDF30.002 is able to control and position the following motor and encoder combinations:

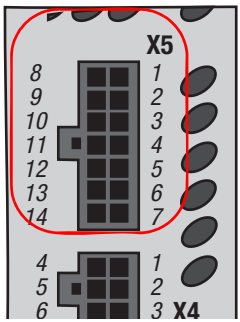
Motor type	Application	Hall-effect transducer	Incremental sensor	Magnetic sine-wave transducer	Optional SSI-encoder as additional load sensor (1)
D.C.-motor DC	Motor controlled (2)				
	Motor for speed controller and positioning operation		X		X
Brushless D.C.-motor BLDC	Motor for speed controller and positioning operation, low performance	X			X
	Motor for speed controller and positioning operation, high performance	X	X		X
Synchronous servo motor	-			under preparation	X

1) The SSI-encoder is typically located on the load, so that inaccuracies in the drive mechanics can be compensated.

2) If the D.C.-motor is operated without incremental sensor, this corresponds with the U/f-control of an A.C.-motor. This does not enable positioning operation.

Table 3.5 Motor-sensor combinations

3.5.1 Connector pin assignment encoder connections X5



Various motor encoder signals can be evaluated through this interface. Specification and terminal assignment can be taken from Table 3.6.

X5 Pin	Function	Description
1	GND Hall/magn./increment.	GND of the motor encoder voltage supply[1)]
2	V_{CC} Hall/magn./increment.	+5 V power supply for motor encoder (±5 %, 120 mA max.)
3	Hall A	Hall signal A
4	Hall B	Hall signal B
5	Hall C	Hall signal C
6	V_{CC} Hall/magn./increment.	+5 V power supply for motor encoder [1)] (±5 %, 120 mA max.)
7	Magn. B-	Not available at present!
8	Magn. B+	
9	Magn. A-	
10	Magn. A+	
11	Incr. B-	Incremental sensor, track B- (RS422 level)
12	Incr. B+	Incremental sensor, track B+ (RS422 level)
13	Incr. A-	Incremental sensor, track A- (RS422 level)
14	Incr. A+	Incremental sensor, track A+ (RS422 level)

1) not isolated from power section

Table 3.6 Assignment of motor encoder interface X5

Note: The max. cable length is 10 m.

Assignment motor/encoder cable

Compare the type plates on the components. Make absolutely sure that you use the correct components! Plug design for motor-/encoder cables, see chapter 3.3.2.

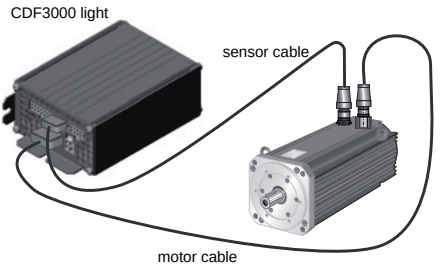


Fig. 2.7 Motor with pre-fabricated cable end

3.5.2 Specification of incremental sensor connection

The pin assignment for the incremental sensor on plug X5 can be found in Table 3.6. The specification of the input is as follows:

	min	max	Type
Interface		RS 422	
Input frequency	0 Hz	150 kHz	
Input voltage: High-Level Low-Level	 + 0.2 V - 6 V	 + 6 V - 0.2 V	
Wave terminating resistor	-	-	120 Ω
Encoder voltage supply	4.75 V	5.25 V	5 V/120 mA*
* distributed to all connected encoders			

Table 3.7 Input specification

3.5.3 Specification of Hall-effect transducer connection

The pin assignment for the Hall-effect transducer on plug X5 can be found in Table 3.6. The specification of the input is as follows:

	min	max	Type
Design	Three open collector signals		
	Hall A	Hall B	Hall C [1)]
Input frequency	0	660 Hz	
Input voltage: High-Level Low-Level	 3.5 V 0 V	 5 V 0.4 V	Leave input open
Pull-up resistor	10 kΩ on VCC are integrated in CDF-light		
Voltage supply for Hall-effect transducer	4.75 V	5.25 V	5 V / 120 mA*

* distributed to all connected encoders.

1) The Hall-effect transducer specific phase displacement between the three Hall signals (e. g. 60° or 120°) must be parameterized in CDF-light.

Table 3.8 Input specification

Motor phase assignment

See application manual.

3.5.4 Connection of a SSI-encoder to X4

A SSI-encoder can be evaluated on X4, in addition to the motor control circuit. During simultaneous use, the SSI-encoder must solely be used for the positioning, as described in Fig. 2.8. Motor commutation and lower level speed regulation in this case takes place via the motor encoder.

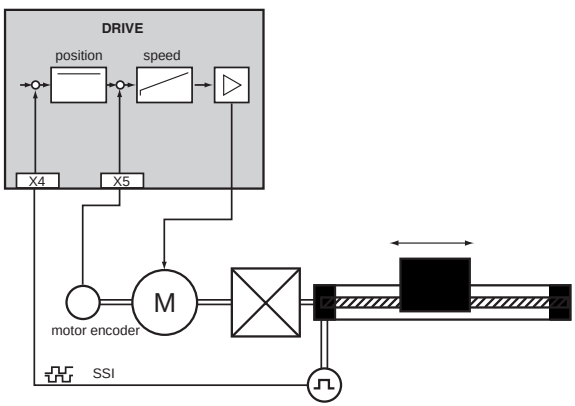


Fig. 2.8 Drive with two measuring systems

3.5.5 Specification X4 for SSI-encoder

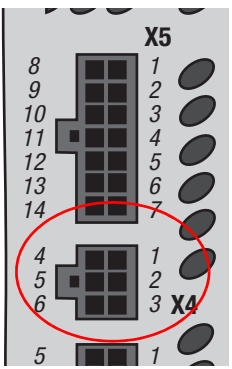
The electrical specification of the interface for SSI-encoders can be taken from Table 3.9, the terminal assignment from Table 3.10.

	SSI encoder
Connection	Molex Micro-Fit, 6-pin
Interface	RS422 (differential)
Wave terminating resistor	DATA: 120 Ω (internal) CLK: no termination required
Max. signal frequency f_{limit}	500 kHz
Voltage supply	+ 24 V +20 % -25 %, max. 150 mA not isolated towards the power potential
Scanning frequency	4 kHz
Interface log	SSI (Graycode)
Lines per revolution / resolution	13 bit (single turn) 25 bit (multi turn)
Max. cable length	10 m

Table 3.9 Specification of encoder interface X4

The cable type for SS-encoders must be chosen acc. to the specification of the encoder manufacturer. Thereby please observe the following boundary conditions:

- Always used shielded cables. The shielding must be placed on both sides of the cable.
- Connect the differential track signals A, B or CLK, DATA to each other via twisted strands.
- Do not separate the encoder cable, for example to route the signals via terminals in the switch cabinet.



X4 Pin	Function SSI	Description
1	CLK+	Timing circuit (+)
2	CLK-	Timing circuit (-)
3	DATA-	Data line (-)
4	DATA+	Data line (+)
5	+ 24 V	24 V power supply, max. 150 mA
6	GND	GND SSI-encoder

Table 3.10 Assignment of encoder interface X4

3.5.6 Motor temperature monitoring

In the performance range supported by the CDF30.002, the temperature sensors installed in the motor are too slow to assure effective protection for the motor winding. For this reason the
$i^2 \times t$ Software monitoring is used.

3.5.7 Project planning notes on the encoder connection

The max. lines per revolution of the encoder can be calculated with the following formula:

$$SZ_{max} = \frac{60 \cdot f_{Grenz}}{n_{max}}$$

SZ_{max} =	Maximum number of encoder lines in pulses per rev.
n_{max} =	maximum speed of motor in rpm
f_{limit} =	maximum input signal frequency of interface

Example for n_{max} = 6000 rpm, f_{limit} = 150 kHz:

calculated: $SZ_{max} = \frac{60 \cdot 150.000}{6000} = 1500$ Pulses/rev.

selected: An encoder with 1024 pulses/rev.

Minimum motor speed

Formula to calculate the minimum displayable motor speed n_{min}, depending on the lines per revolution of the encoder:

$$n_{min} = \frac{3000}{SZ} \cdot \frac{1}{min}$$

SZ =	Number of lines of encoder in pulses per rev.
n_{min} =	minimum speed of motor in rpm

Note: A speed < n_{min} cannot be measured. In this range the actual speed of 0 min^{-1} is set. In the range $0 < n < n_{min}$ the amplification of the encoder is reduced.

3.6 Serial interface (SIO)

The serial interface (SIO, X6) serves the purpose of connecting a Notebook, on which the PC-Tool DRIVEMANAGER is installed. This can be used to parameterize the CDF30.002.

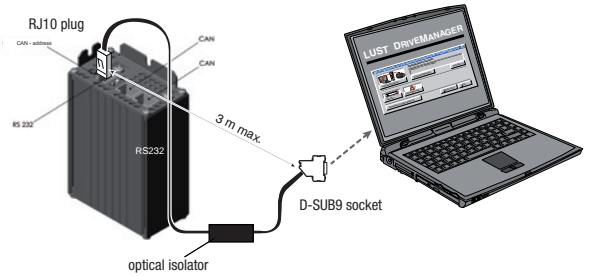
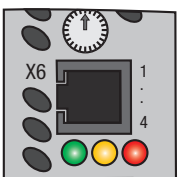


Fig. 2.9 Connection X6

Attention: The RS232 interface must only be used for service and commissioning. Using the interface for control purposes is not permitted.

Pin assignment X6



X6 Pin-No.	Function
1	+12 V DC for operation panel KP200XL
2	TxD, data transmission
3	RxD, data reception
4	GND 1)
1) not isolated from power section	

Table 3.11 Pin assignment of the serial interface X4

Please use a RS232 cable with RJ10 plug and D-SUB9 socket acc. to Fig. 2.9 (maximum length 3 m), e. g. prefabricated cable, type: KRS232-RJ10 article: 1041.300.0 to connect the positioning control.

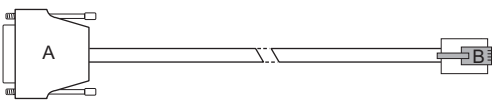


Fig. 2.10 Cable RS232

RS232	Specification	PIN	Function
Plug A	D-SUB9 socket	1 2 3 4 5	+ 12 V T x D R x D not used Ground
Plug B	4-pin plug	1 2 3 4	+ 12 V T x D R x D Ground

Table 3.12 Connector pin assignment

Attention: The RS232 interface is connected to the potential of the control electronics (-)pole. Due to possible differences in potential of the earthing of (-)pole and Notebook, the shield and the signal lines of the interface cable and the shield earthing on the Notebook can cause a PE-loop. This may cause damage to the RS232, the Notebook and the CDF30.002! We therefore recommend the use of an optical isolator in the interface line.

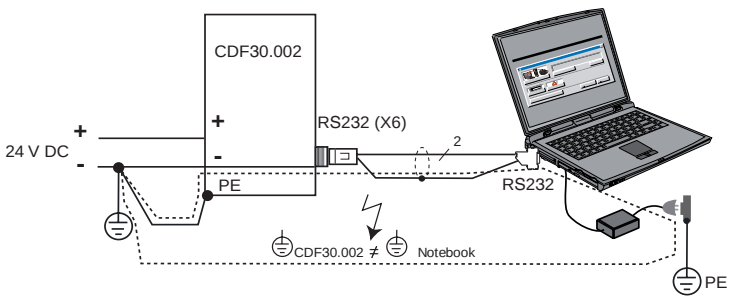


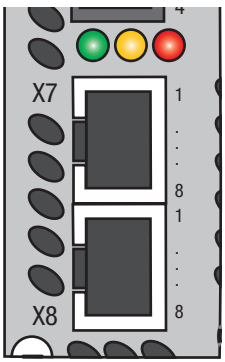
Fig. 2.11 Connection of serial interface

3.7 CAN$_{open}$ - interface

The CAN$_{open}$-interface is integrated in the drive controller. The connection is accomplished with two RJ45 plug connectors (X7 or X8: internally connected 1:1 with each other). This enables looping through of the CAN-signal to a further CAN-node. The CAN-interface is isolated towards the control electronics. Supply to the interface is provided by the customer.

Connection X7 / X8	RJ45-plug connector, 8-pin
Wave terminating resistor - bus termination	external
Max. incoming frequency	1 MHz
Max. transmission rate	1 MBaud
Ext. voltage supply	24 V DC ±20 %, 50 mA max. (potential-free to drive controller)

Table 3.13 Connection of CAN$_{open}$ - interface



Assignment of connection X7 / X8:

Pin	Function
1	CAN_HIGH
2	CAN_LOW
3	CAN_GND
4	CAN-SYNC_HIGH This PIN can be switched by the Microcontroller optionally as input or output (no function).
5	CAN-SYNC_LOW This PIN can be switched by the Microcontroller optionally as input or output. (no function)
6	CAN_GND
7	CAN_GND
8	CAN_V+ (24 V DC ±20 %, 50 mA max.)

Table 3.14 Pin assignment connection X7 / X8

The CAN-bus node address is set via coding switch S1.

Note: The bus termination requires an external 120 Ω wave terminating resistor.

3.8 Multi-axis operation

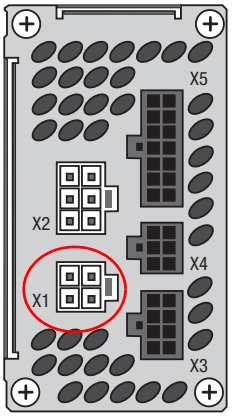
The positioning controllers operated in multi-axis interconnection in a regenerative mode (braking operation), feed energy into the network, which is then consumed by the motor operated positioning controllers.

Interconnected operation of several positioning controllers minimises the power consumption from the mains and external braking resistors can be eliminated where appropriate.

Picture not yet available at printing deadline!

Fig. 2.12 Network plan CDF30.002

3.9 Braking resistor (RB)



The connection is not short-circuit and overload proof.

Attention: Braking of the drive is of importance for the safety of machine or plant!
The safe function of the braking facility must be tested during commissioning! In case of incorrect dimensioning (overloading) the braking resistor or the brake electronics may be destroyed and machine or plant may be damaged. Such overload (failure of the braking facility) may even cause fatal accidents or severe injury, e.g. in case of lifting applications!

In regenerative operation, e. g. when braking the drive, the motor feeds energy back to the positioning controller. This increases the voltage in the DC-link. If the voltage exceeds a threshold value, the internal braking transistor is activated and the regenerated power is converted into heat by means of a braking resistor.

The switching transistor is installed as standard. The design of the external braking resistor depends on various factors of the drive: e. g. the load to be moved, the required dynamics of the drive or the duration of braking and duty cycles.

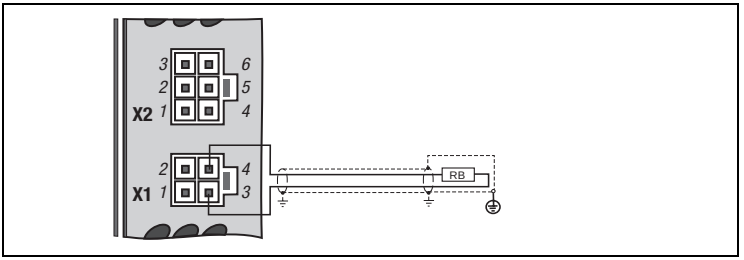


Fig. 2.13 Connection X1 braking resistor

Please note:

- The design of the braking resistor must be clarified at the project planning stage.
- The minimum permissible ohmic resistance of an externally installed braking resistor for the various positioning controllers can be found in appendix A2.

For further information please consult your project engineer.

Attention: The braking resistor must be installed in such a way, that in case of a chopper transistor failure (e. g. in case of "Break Clown" of chopper transistor) the braking resistor will not be the source of a fire hazard, or appropriate measures to deenergize the resistor must be applied.

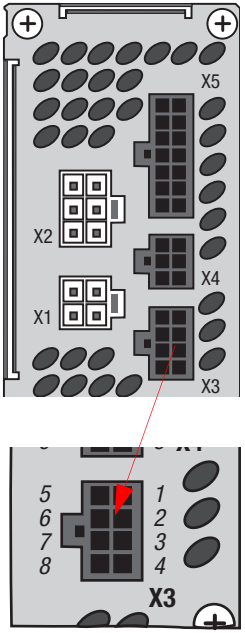
3.10 Control connections

Step	Action	Comment
1	Please check whether you already have a **SmartCard** or a **DriveManager dataset** with a complete device setup available, i.e. the drive has already been planned as required.	
2	If this is the case, a special control terminal assignment applies. Please contact your project engineer to obtain the terminal assignment.	**Bulk customers** For details of how to load the data set into the positioning controller refer to chapter 4.2.
3	Choose a terminal assignment.	**First commissioning** There are various pre-set solutions available to make it easier to commission the device.
4	Wire the control terminals with shielded cables. Only the signals ENPO and a start signal (control via terminal) are strictly required.	Earth the cable shields over a wide area at both ends.
5	Keep all contacts open (inputs inactive).	
6	Check all connections once again!	Continue with commissioning in section 4.

Please note:

- Always wire the control terminals with shielded cables.
- Lay the control cables separately from the mains lead and motor cable.
- The CDE/CDB/CDF3000 Application Manual contains more preset drive solutions.
- A cable type with double copper braiding with 60 - 70% coverage must be used for all screened connections.

3.10.1 Specification of control connections



Control terminal X3 is located on the bottom side of the device.

Des.	Terminal X3	Specification	potential-free
Analog inputs, differentially			
ISA00+	4	U_{IN} = 0 ... 5 V DC or ±10 V DC R_{IN} = 110 kΩ Resolution 10 Bit Terminal scan cycle = 1ms Tolerance: U = ±1% of end value	no
ISA00-	5		no
Digital inputs Note: In the range > 4,8 V / < 18 V the performance of the inputs is undefined.			
ISD00 ISD01	2 3	• Limit frequency 500 Hz • Switching level low/high: <4.8 V / >18 V DC • I_{max} at 24 V = typically 3 mA • Terminal scan cycle = 1ms	no
ENPO	1		no
Digital outputs			
OSD00	6	• short-circuit proof • I_{max} = 50 mA • Terminal scan cycle = 1ms • Protection against inductive load • High-side driver	no
Voltage supply			
+24 V	8	• ext. +24 V, ± 20 % Feed for control electronics • strictly required for operation of the CDF30.002 • I_{max_in} = 1,0 A incl. current of output OSD01	–
DGND	7	• Reference point for control electronics[1)]	-

Table 3.15 Specification of control connections

Attention: **1)** Connections X1/L- and X3/7 (GND) are connected inside the device. Line L - conducts the sum of power and control current. Connection X3/7 (GND) solely serves diagnostic purposes and must not be used in normal operation.

3.10.2 Autostart function

Evaluation of start signal

Prerequisites for starting the controller:

- The hardware release ENPO is set at least 2 ms before the start signal (High-Level).

The start signal is evaluated in dependence on the signal level.

Start "flank triggered" (factory setting)

Starting takes place after a Low-High transition of the signal. If the start signal is at High-Level immediately after switching on, the control is not started. A Low-High transition is required first.

Start "Level triggered" (Auto-Start)

Starting takes place when the start signal has High-Level. If the start signal is at High-Level immediately after switching on the mains supply, the control is started.

The function is also used for automatic starting after switching on the main supply. It is switched on by parameter 7-AUTO = ON.

Attention: With Auto-Start the drive starts automatically after Mains On or after resetting an error, depending on the error reaction.

Function	Meaning	Value range	WE	Parameter
Auto-Start	OFF: Start Low-High-flank triggered ON: Start "Level triggered"	OFF/ON	OFF	7-AUTO (_CONF)

Table 3.16 Parameter Auto-Start

Note: For further information on parameterization please refer to the application manual CDE/CDB/CDF article-no. 1001.02B.X.

4 Commissioning

Attention: Commissioning must only be carried out by qualified electricians who have undergone instruction in the necessary accident prevention measures.

4.1 Choice of commissioning

Mode of commissioning	Commissioning steps	Continued on
• Project planning and commissioning have already been completed. • Loading an existing data set.	Serial commissioning	Page 4-2
• First project planning and commissioning of the drive system.	First commissioning	Page 4-4
• Project planning and basic setting of the drive system have already been carried out.	Test run	Page 4-13

4.2 Serial commissioning

Apply this mode of commissioning when you want to commission several identical drives (i.e. serial commissioning). The same positioning controller and motor must be set for each drive in an identical application.

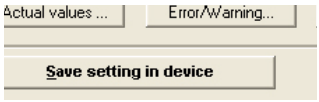
If you already have a complete dataset available, please skip the paragraph *"Save dataset from unit to file"* (with DRIVEMANAGER).

4.2.1 Serial commissioning with DRIVEMANAGER

Prerequisite:

- All positioning controllers are completely connected.
- The **first** drive has already been fully taken into operation.
- A Notebook with the user software DRIVEMANAGER installed is connected.

Save dataset from unit to file

Step	Action	Comment
1	Connect your Notebook with the positioning controller of the **first** drive and switch on the mains supply for the positioning controller (X4).	Use a standard serial cable (9pole D-SUB, socket/pin) and an optical isolator.
2	START DRIVEMANAGER.	Automatically links the connected positioning controller.
	If the connection setup fails you should check the settings in the menu **Extras** > **Options** and retry it again with the icon.  .	
3	Save the current dataset by clicking on the icon , either to the parameter database (directory: c:/../userdata) of the DRIVEMANAGER or to a floppy disk (a:/). 	The icon always saves the most current dataset of the connected unit. Name the file as desired.
4a	Use this icon to disconnect from all devices 	
4b	Connect your Notebook with the positioning controller of the **next** drive and switch on the mains supply for the positioning controller.	
5	Click on icon to establish a link between the DRIVEMANAGER and the newly connected device. 	
6	Click on icon to load the dataset saved in step 4 into the device. 	
7	Use the icon to select the main window. Save the settings with the button ->  	
	Repeat steps 4 ... 7 on every other drive.	

Load dataset from file into device

Please remember to save the setting.

For further information concerning the DRIVEMANAGER please refer to the DRIVEMANAGER manual.

4.3 First commissioning

Prerequisites:

- The positioning controller is completely connected, see chapter 3.
- Installed DRIVEMANAGER version V3.4 and higher.
- The database for motors is installed on the Notebook.
- The device is connected to the Notebook via the RS232 interface (X6).

Attention: Never wire or disconnect electrical connections while they are live.

Input ENPO = apply Low-Level to terminal X3/1 to avoid unintended starting of the motor (output stage locked, mains voltage for positioning controller switched on).

Preparations:

- Switching on the positioning controller CDF30.002.
  A self-test is performed.
- Start the DRIVEMANAGER.

DRIVEMANAGER Connect
or:
Communication > Connect...

Set up a connection to the device.

DRIVEMANAGER *or:*
Active device >
Change settings

Opening the main window "Set CDF30.002":

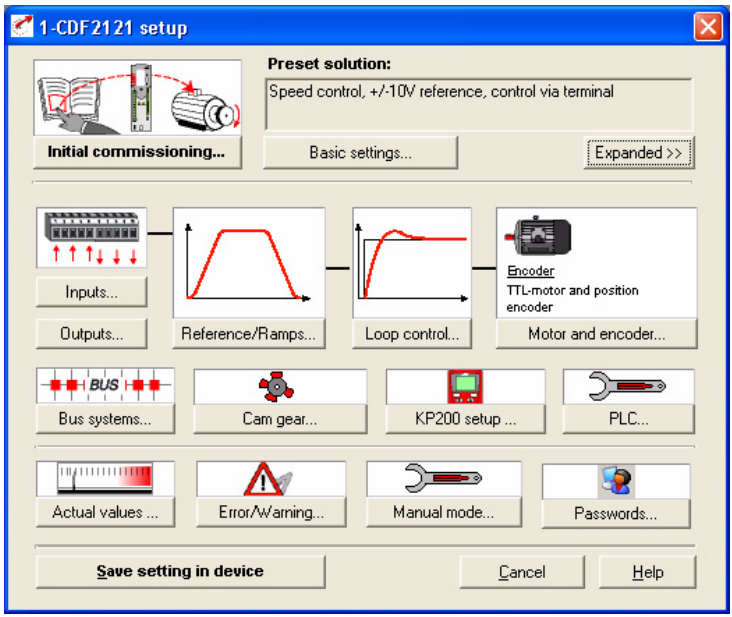
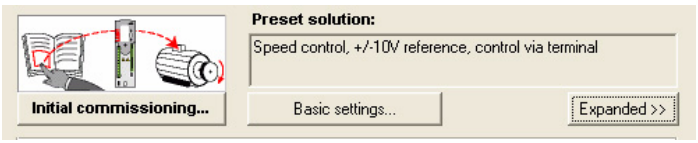


Fig. 4.1 Main window for the different settings in the DRIVEMANAGER

Continue with:



4.3.1 Presetsolutions

Pre-set solutions are complete parameter data sets which are provided to handle a wide variety of typical application movement tasks.

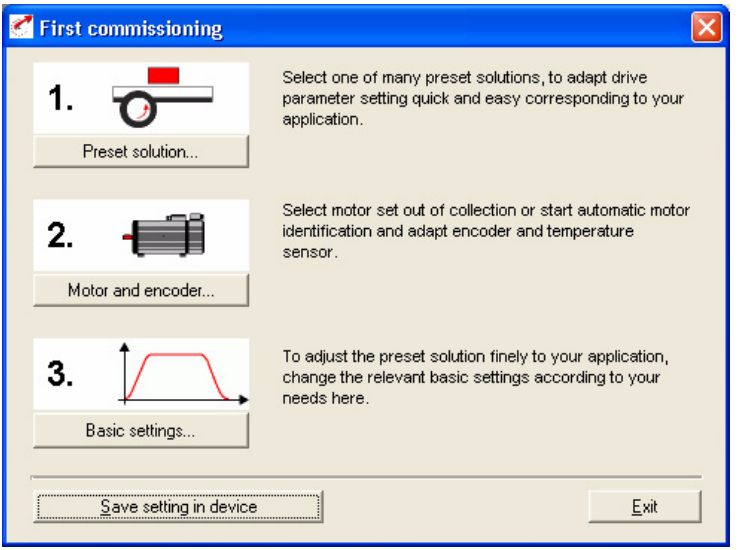


Fig. 4.2 First commissioning

The positioning control is automatically configured by loading a pre-set solution into the random access memory (RAM). The parameters for

the control location of the drive controller,

- the reference source,
- the assignment of signal processing input and outputs and
- the type of control

are the focal points of the setting.

The use of a pre-set solution considerably simplifies and shortens the commissioning of the positioning control. By changing individual parameters, the preset solutions can be adapted to the needs of the specific task. Pre-set solutions modified this way are stored in the unit as user datasets. In this way, you can arrive more rapidly at your desired movement solution.

A total of 20 preset solutions cover the typical areas of application for the CDF30.002 controller.

Abbreviation	Setpoint source	Start of controller via/ Bus control profile
TCT_1	+/-10V-analog - torque	I/O-terminals
SCT_1	+/-10V-analog	I/O-terminals
SCT_2	Fixed speed table	I/O-terminals
SCC_2	Fixed speed table	CANopen-fieldbus interface - EasyDrive-Profile "Basic"
SCB_2	Fixed speed table	Field bus options module (Profibus) - EasyDrive-Profile "Basic"
SCC_3	CANopen-fieldbus interface	CANopen-fieldbus interface - EasyDrive-Profile "Basic"
SCB_3	Field bus options module (Profibus)	Field bus options module (Profibus) - EasyDrive-Profile "Basic"
SCP_3	PLC	PLC
SCT_4	PLC	I/O-terminals
SCC_4	PLC	CANopen-fieldbus interface - EasyDrive-Profile "Basic"
SCB_4	PLC	Field bus options module (Profibus) - EasyDrive-Profile "Basic"
PCT_2	Drive set tables	I/O-terminals
PCC_2	Drive set tables	CANopen-fieldbus interface - EasyDrive-Profile "TabPos"
PCB_2	Drive set tables	Field bus options module (Profibus) - EasyDrive-Profile "TabPos"
PCC_1	CANopen-fieldbus interface	CANopen-fieldbus interface - DSP402-Profiles position mode - DSP402-Profiles velocity mode
PCB_1	Field bus options module (Profibus)	Field bus options module (Profibus) - EasyDrive-Profile "DirectPos"
PCP_1	PLC	PLC
PCT_3	PLC	I/O-terminals
PCC_3	PLC	CANopen-fieldbus interface - EasyDrive-Profile "PlcPos"
PCB_3	PLC	Field bus options module (Profibus) - EasyDrive-Profile "PlcPos"

Table 4.1 Preset solutions for speed control with CDF30.002

All pre-set solutions have an individual window for basic settings in DRIVEMANAGER.

Select the pre-set solution matching your application.

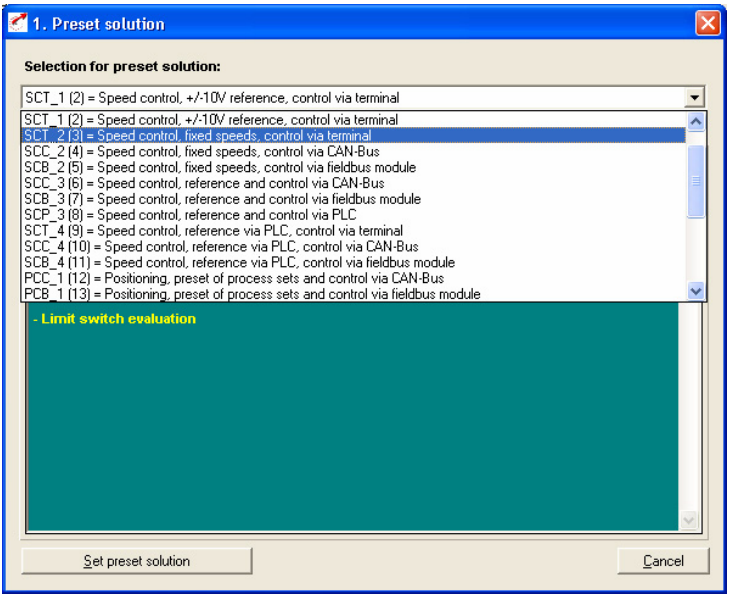
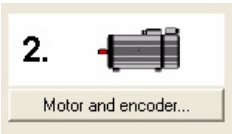


Fig. 4.3 Selecting the pre-set solution

Note: For more detailed information on pre-set solutions and terminal assignment please refer to the application manual CDF30.002.

4.3.2 Setting motor and encoder



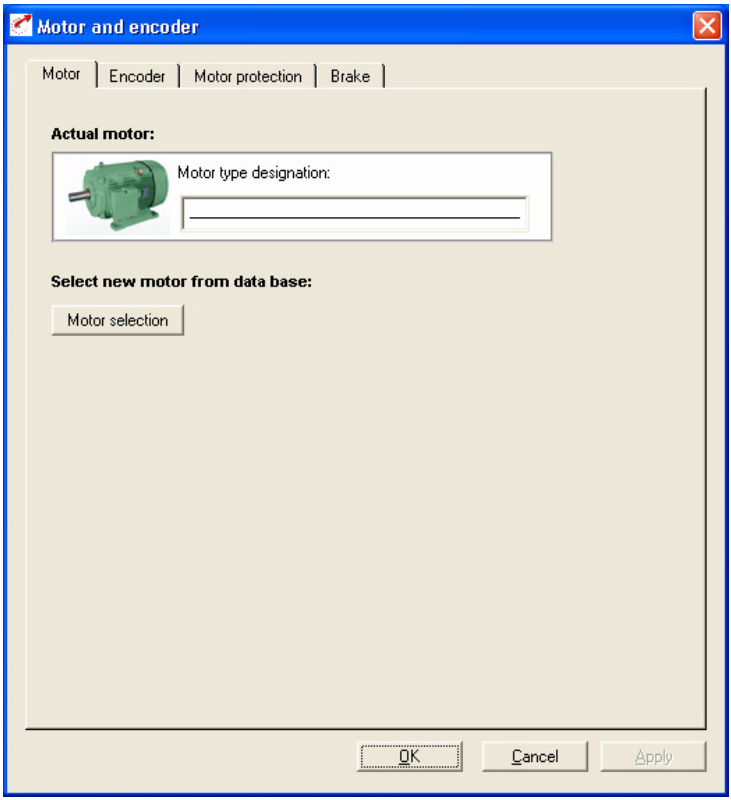


Fig. 4.4 Setting the motor and encoder

Setting up the motor data via the motor database

This setting must be made if a suitable motor dataset or a complete motor database is available. Using the correct motor dataset ensures:

- that the electrical data of the motor are correctly parameterized,
- that the motor protection ("Motor protection" tab) is correctly set and
- the control circuits for the drive are pre-set.

Note: The torque control is optimally adjusted, so that no further adaptations are required.
The setting of the speed control is based on the assumption that the moment of inertia of the machine reduced to the motor shaft is identical with the moment of inertia of the motor.
The speed and positioning controllers have a high level of attenuation and therefore also suitable for the control of elastic mechanical components.

For special settings for optimizing the speed and position circuitry you should use the application manual for the CDF30.002.

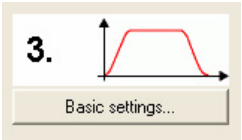
Checking the encoder

To check the encoder, rotate the motor shaft by hand.

The viewing is from the front onto the end of the shaft (flange). The "CDF30.002 reference and actual values" status display, under "n_{ist}, Actual speed", must indicate a positive speed in clockwise rotation and a negative speed in counter-clockwise rotation. If the speed is incorrect, check the following points:

- Is the encoder cable correctly connected to the motor and the positioning controller?
- Is the encoder cable in use the correct one for the type of encoder?

4.3.3 Making basic settings



Custom setup screens are provided for fine adjustment of each preset solution. You can use them to adapt the drive to your application. For a detailed description of the individual functions, refer to the CDF30.002 Application Manual.

Fig. 4.5 Speed control

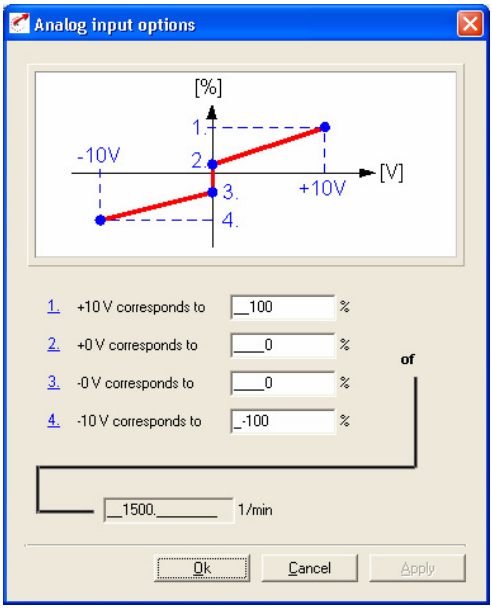


Fig. 4.6 Analog input, options

4.3.4 Saving the settings

DRIVEMANAGER
CDF30.002 Settings

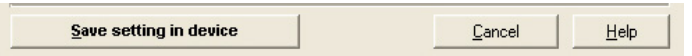
or:
Active device > Change settings

DRIVEMANAGER
CDF30.002 Settings

or:
Active device > Save device settings in a > file

Saving the settings in the device

All changes that are to be permanently stored in the device, must be saved via the mask *CDF30.002 Settings*.



These changes can also be saved in a file.

Saving the settings in a file

Choose the file name (e. g. mydata). All parameters are saved under the chosen file names (e. g. mydata) with the appropriate extension (*.00D). It is possible to assign a description to the device data prior to saving it.

Continue with "Test run", see chapter 4.4.

4.4 Test run

Attention: Test run with motor installed:
In this case it must be assured that the test will not cause any damage to the system! Pay particular attention to the limitations of the positioning range.
Please note that you yourself are responsible for safe operation. Lust Antriebstechnik GmbH will not assume liability for any occurring damage.

Danger to life from uncontrolled rotation!
Before starting motors with feather keys in the shaft end these must be reliably secured against being ejected, as far as this is not already prevented by drive elements such as belt pulleys, couplings or similar.

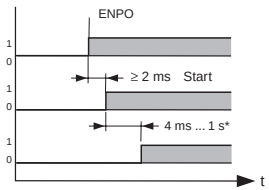
Pre-set solution for torque control:
In this pre-set solution the drive must not be operated without load torque, because otherwise the motor shaft would accelerate uncontrolled up to the adjusted speed limit.

Attention: Destruction of motor:
The motors are intended for operation on the positioning controller. Direct connection to the mains supply can destroy the motor.
The surface temperatures on the motors may increase to a very high level. No temperature sensitive parts may touch or be mounted to these areas, appropriate measures to prevent contact must be applied wherever necessary.
Before starting the motor the motor brake (if present) must be checked for correct function.
The optionally installed holding brake is only designed for a limited number of emergency brake operations. Use as working brake is strictly prohibited.

The drive is tested without the coupled mechanics. The test run is conducted in the speed controlled mode, independently from the selected pre-set solution.

A test run is still possible, even if the motor has already been coupled to the system:

1. **Set power stage enable ENPO**
   High-level at terminal X3/1



Input ENPO

Start

Device status: "Technology ready"

   Observe the temporal behaviour of the inputs.
   * after regulator initialization after a parameter change

2. **Control with** DRIVEMANAGER**:**
   Select "Speed control" and start the drive, e.g. with nominal value 100 min^{-1}.

DRIVEMANAGER
Open-loop control
or:
Active device > Open-loop control> Basic operating modes

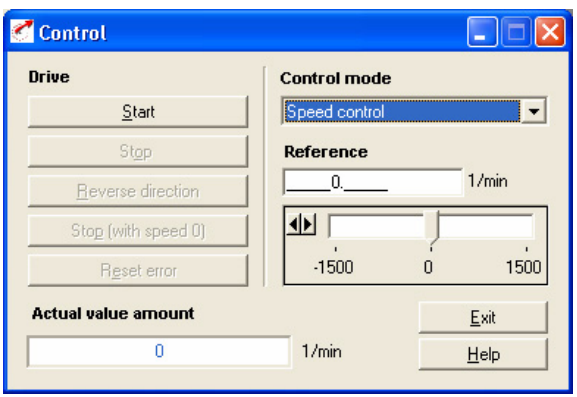


Fig. 4.7 Open-loop control

DRIVEMANAGER
Digital Scope
or:
Active device > Monitor > Quickly changing digital scope values

Check the drive response

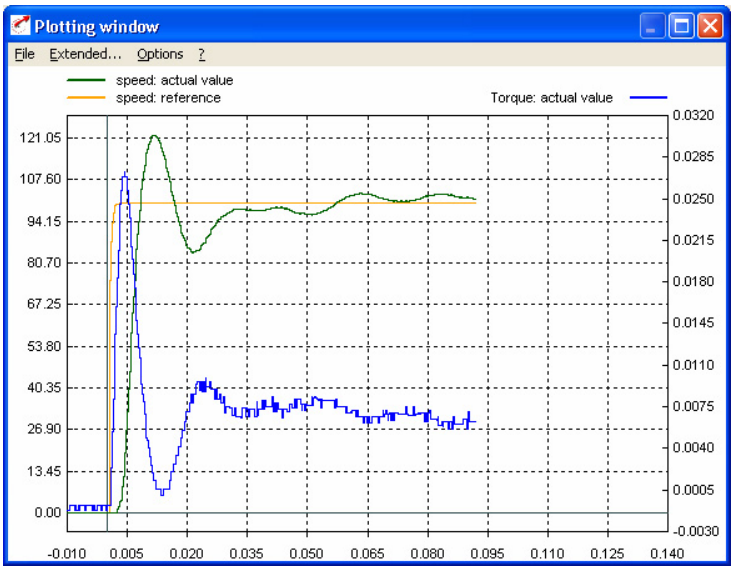
Now you can assess the drive performance with the aid of step responses, which can be recorded using the digital scope function of the DRIVEMANAGER.

Select the following four recording variables:

- 0: Speed: Reference
- 1: Speed: Actual value
- 2: Torque: Reference
- 3: Torque: Actual value

Triggering condition:

Channel 0; rising flank, pre-trigger 10 %; level: 30 min $^{-1}$



Start the drive with a reference value of e. g. 100 min^{-1}.
Compare the step response of your drive with the illustration. With resolvers the overshoot of the actual speed value should be around 20 %; with sin/cos incremental encoders approx. 30 % (with reference to the nominal value). Make sure that the drive system shows small-signal response (the nominal value of the torque must be less than the maximum value).

If the torque reference reaches its maximum, reduce the speed step.

The time response (rise time, correction time) of the speed control loop is independent of the speed step.

Result:

If the step response of your drive does approximately correspond with the illustration, it is assured that the motor phases are correctly wired, the encoder is correctly connected and the CDF30.002 is parameterized to the correct motor.

If the step response deviates considerably from the illustration, it is to be assumed that

- the motor dataset was incorrectly selected or
- that the wiring is incorrect

Check the individual steps from Chapter 3 "Installation" and Chapter 4.3 "First commissioning" and repeat the test run.

The step response may also deviate if the ratio of the machine moment of inertia reduced onto the motor shaft relative to the motor moment of inertia is very high. Here the loop control settings must be optimized. For special settings to optimize the speed and position control loops, please use the CDF30.002 Application Manual.

4.5 Operation with DRIVEMANAGER

Prerequisite:

- DRIVEMANAGER version V3.4 or higher is installed on the Notebook.
- The CDF30.002 has been installed as instructed in chapter 3.

Attention: Make sure that both the CDF30.002 housing as well as the GND-connection (control voltage 0 V) are connected to the protective conductor potential. Otherwise the serial interface of the CDF30.002 may be destroyed by potential displacement (see chapter 3.3).

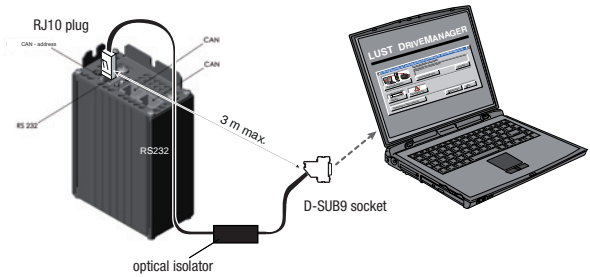


Fig. 4.8 Connection of positioning controller to Notebook/DRIVEMANAGER

Attention: The RS232 interface must only be used for service and commissioning. Using the interface for control purposes is not permitted.

Attention: The RS232 interface is connected to the potential of the control electronics (-)pole. Due to possible differences in potential of the earthing of (-)pole and Notebook, the shield and the signal lines of the interface cable and the shield earthing on the Notebook can cause a PE-loop. This may cause damage to the RS232, the Notebook and the CDF30.002! We therefore recommend the use of an optical isolator in the interface line.

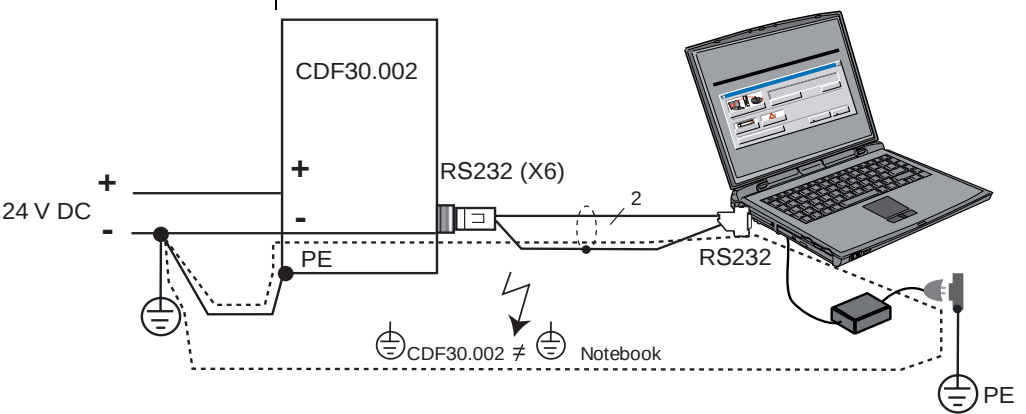


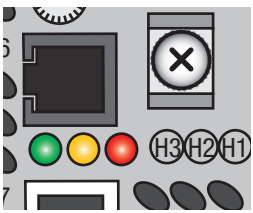
Fig. 4.9 Connection of serial interface

The most important functions

Icon	Function	Menu
	Change setting of active device	Active device > Change settings
	Print parameter dataset	Active device > Print settings
	Digital Scope	Active device > Monitor > Quickly changing digital scope values
	Control drive	Active device > Open-loop control > Basic operation modes
	Connect to device	Communication > Connect > Single device
	Bus initialisation, change setting	Communication> Bus-configuration
	Disconnect all device connections	Communication > Disconnect
	Save dataset of active device in file	Active device > Save settings of device to
	Dataset transfer from file to active device	Active device > Load settings into device from

5 Troubleshooting

5.1 Light emitting diodes



The positioning controller is fitted with three status LED's in green (H3), yellow (H2) and red (H1) at the top right.

Device status	Green LED (H3)	yellow LED (H2)	red LED (H1)
Supply voltage* applied	●	-	-
Standby [1)]	●	●	❍
In service/auto-tuning active	●	✳	❍
Warning	●	● / ✳	●
Fault	●	❍	✳ (flash code)

❍ LED off, ● LED on, ✳ LED flashing

+ 24 V on control terminal X3

[1)] Prerequisite: "Safe Stop" and ENPO set after each other.

5.2 Error messages

If an error occurs during operation it is indicated by a flash code from LED H1 (red) on the positioning controller. The code indicates the type of error.

Flash code of red LED H1	Explanation	Cause/Remedy
1x	Collective error	The exact error code can be read out via the KEYPAD or the DRIVEMANAGER.
2x	Undervoltage shut-off	Check power supply, also occurs briefly in response to normal power-off.
3x	Current overload shut-off	**Short-circuit, earth fault**: Check wiring of power terminals, check motor coil, (see also section 3, Installation). **Device setup not correct**: Check parameters of control circuits, check ramp setting.
4x	Overvoltage shut-off	**Voltage overload from mains**: Check mains voltage, restart device. **Voltage overload resulting from feedback from motor** (regenerative operation): Decelerate brake ramps - if not possible use braking resistor.
5x	Motor protection shut-off	**Motor overloaded** (after I x t-monitoring): If possible slow down process cycle, check dimensioning of motor.
6x	Device safety shut-off	**Device overloaded**: Check dimensioning
7x	Motor temperature too high	**Motor-PTC correctly connected**? **Parameter MOPTC correctly set** (type of motor-PTC evaluation)? **Motor overloaded**: Allow motor to cool down, check dimensioning.
8x	Excessive temperature of positioning controller	**Ambient temperature too high**: Improve ventilation in control cabinet. Excessive load during driving/braking: Check dimensioning
1) For further information please refer also to the **CDE/CDB/CDF application manual**		

Table 5.1 Error messages

Helpline

If you have any technical questions concerning project planning or commissioning of the drive unit, please feel free to contact our helpline.

Contact us at the following address:

Mo.-Thu.:8.00 - 16.30 hrs
Fr.: 8.00 - 16.00 o'clock

Phone++49 (0) 6441 966-180
Fax: +49 (0) 6441/966-177

E-Mail: helpline@lust-tec.de

Service/Repair

If you need further assistance for service work, our specialists at the Lust helpline will be happy to help.

Contact us at the following address:

Mo.-Thu.:8.00 - 16.30 hrs
Fr.: 8.00 - 16.00 o'clock

Phone++49 (0) 6441 966-171
Fax: +49 (0) 6441/966-211

E-Mail: service@lust-tec.de

A Appendix

A.1 Technical data

CDF30.002

Technical data	CDF30.002
Output motor side	
Voltage	0 ... 33 V DC
Continuous current effective (I_N) (S1-operation)	2.0 A_{eff}
Peak current for 30 s (in case of 300 s S3-operation - 10 %)	6 A_{eff} *
Maximum current for 3 s (in case of 300 s S3-operation - 1 %)	8 A **
Rotating field frequency	0 ... 400 Hz
Power stage switching frequency	8, **16** kHz
Input mains supply side	
Mains voltage	absolute 12 ... 33 V
Device connected load	60 VA at U_{mains} = 24 V
Power loss	10 W
Brake chopper power electronics	
Minimum ohmic resistance of an externally installed braking resistor	2,7 Ω -10 % at 12 V DC*** 3,9 Ω -10 % at 18 V DC*** 4,7 Ω -10 % at 24 V DC*** 5,6 Ω -10 % at 33 V DC***
* for operation with three-phase motors or D.C. motors ** for operation with D.C. motors *** see note on switch-on threshold	

Table A.1 Technical data

Factory setting: Mains voltage 24 V DC
Threshold voltage 26 V DC (brake chopper)
Breaking threshold 31 V DC (overvoltage)

Note: The threshold voltage of the brake chopper may need to be readjusted in dependence on the applied mains voltage. This is accomplished with parameter DCIN. Further details can be found in the application manual CDE/CDB/CDF3000.

A.2 Ambient conditions

Characteristic		Positioning controller
Temperature range	during operation	-10 ...45 °C (EN60721-3-3)
	during storage	-25 ... +55 °C (EN60721-3-1)
	during transport	-25 ... +70 °C (EN60721-3-2)
Relative humidity		15 ... 85 %, dewing not permitted
Protection	Device	IP20 (NEMA 1)
Protection against direct contact		VBG 4
Mounting height		up to 1000 m above zero level, at altitudes higher than 1000 m above zero level with power reduction of 1 % per 100 m, max. 2000 m above zero level
Voltage load of motor winding		Typical rate of voltage rise 2 kV/µs at controller output
Max. contamination level		2 (acc. to EN61800-5-1)

Table A.2 Ambient conditions

Attention: Do not install the drive controllers in places where they are permanently exposed to vibrations.

A.3 UL-Approbation

Additional measures to keep up the UL-approbation:

The CDF30.002 is still in the testing state. Information concerning the UL-approbation can only be made after UL-testing.

AppendixB Glossary

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P

R

S

T

U

V

W

Hinweis zur EN 61000-3-2 DE	Notes on EN 61000-3-2 EN
(rückwirkende Netzbelastung durch Oberwellen) Unsere Positionierregler und Servoregler sind im Sinne der EN61000 "professionelle Geräte", so dass sie bei einer Nennanschlussleistung ≤1kW in den Geltungsbereich der Norm fallen. Beim direkten Anschluss von Antriebsgeräten ≤1kW an das öffentliche Niederspannungsnetz sind entweder Maßnahmen zur Einhaltung der Norm zu treffen oder das zuständige Energieversorgungsunternehmen muss eine Anschlussgenehmigung erteilen. Sollten Sie unsere Antriebsgeräte als eine Komponente in Ihrer Maschine/ Anlage einsetzen, dann ist der Geltungsbereich der Norm für die komplette Maschine/ Anlage zu prüfen.	(limits for harmonic current emissions) Our frequency inverters and servocontrollers are "professional devices" in the sense of the European Standard EN 61000, and with a rated power of ≤1kW obtained in the scope of this standard. Direct connection of drive units ≤1kW to the public low-voltage grid only either by means of measurements for keeping the standard or via an authorization of connection from the responsible public utility. In case our drive units are used as a component of a machinery/ plant, so the appropriate scope of the standard of the machinery/plant must be checked.

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Id.-Nr. / ID no.: 1041.20B.0-0 • 05/2007