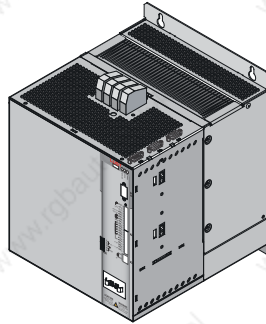
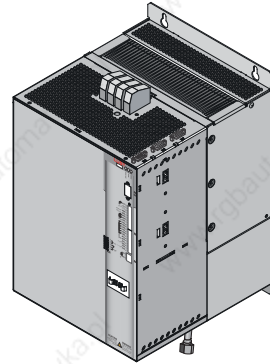


CDS4000

Operation Manual



Drive controller for high-frequency drives
17 A - 72 A

Size 44.017 and 032**Size 44.072**

Operation Manual CDS4000



ID no.: 1000.20B.1-03

Date: 12/2011

Applicable as from software version V500.00 and 420.30

We reserve the right to make technical changes.

The content of our documentation was compiled with the greatest care and attention, and based on the latest information available to us.

We should nevertheless point out that this document cannot always be updated in line with ongoing technical developments in our products.

Information and specifications may be subject to change at any time.
Please visit www.lti-i.com for details of the latest versions.

Documentation overview

Document	Order designation	Purpose
Catalogue – CDA/CDD3000-HF, CDS4000	1000.04B.x-xx	Selecting and ordering a drive system
Application Manual CDD3000	0931.02B.x-xx	Adapting the drive system to the application
CAN _{open} Communications Manual	1001.06B.x-xx	Project planning and function description
CAN _{open} Communications Manual	1005.06B.x-xx	Project planning and function description
PROFIBUS-DP Communications Manual	0916.00B.x-xx	Project planning and function description

How to use this Manual

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3	Electrical installation 3
4	Commissioning 4
5	Diagnosis/Troubleshooting 5
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Pictograms



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

Serious injury or damage to property may occur.



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

Death or serious injury will occur.



⇒ **Danger from rotating parts!**
Drive may start up automatically.

Death or serious injury will occur.



⇒ **Note:** Useful information.



Note: The transport packaging is designed and tested to EN61800-2.

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1 Safety

1.1 For your safety

The CDS4000 high-frequency drive controllers 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



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

- Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas:
 - Areas where drive systems are installed, repaired and operated.
 - Areas where motors are installed, repaired and operated. Motors with permanent magnets pose a particular hazard.



Danger:

If it is necessary to access such areas, suitability to do so must be determined beforehand by a doctor

**Your qualification:**

- In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device.
- The said qualified personnel must be familiar with the contents of the Operation Manual (cf. IEC364, DIN VDE0100).
- Awareness of national accident prevention regulations (e.g. BGV A3 in Germany).

**During installation observe the following instructions:**

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

1.2 Intended use

Drive controllers are components that are intended for installation in stationary electrical systems or machines.

The drive controllers may not be commissioned (i.e. it may not be put to their intended use) until it has been established that the machine complies with the provisions of EC Directive 98/37/EC (Machinery Directive); EN 60204 is to be observed.

Commissioning (i.e. putting the device to its intended use) is only permitted in compliance with the EMC Directive (2004/108/EC).



The CDS4000 conforms to the Low Voltage Directive 2006/95/EC.

The harmonized product norm of the EN61800-5-1:2003 series is applied to the drive controllers.

If the drive controller is used for special applications (e.g. in areas subject to explosion hazard), the required standards and regulations (e.g. EN50014, "General provisions" and EN 50018, "Pressurized enclosure") must always be observed.

Repairs may only be carried out by authorized repair workshops. Unauthorized opening and incorrect intervention could lead to death, physical injury or material damage. The warranty provided by LTI DRIVES would thereby be rendered void.



Note: Deployment of the drive controllers in non-stationary equipment is classed as non-standard ambient conditions, and is permissible only by special agreement.

1.3 Responsibility

Electronic devices are fundamentally not 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.

An emergency off system does not necessarily have to cut the power supply to the drive. To protect against danger, it may be more beneficial to maintain individual drives in operation or to initiate specific safety sequences. Execution of the emergency off measure is assessed by means of a risk analysis of the machine or plant, including the electrical equipment to EN ISO 14 12 1 (formerly DIN EN 1050), and is determined with selection of the circuit category in accordance with EN ISO 13849-1 (formerly DIN EN 954-1) “Safety of machines - Safety-related parts of controls”.

2 Mechanical installation

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2.1 Notes for operation



Please ensure that ...

- no damp enters the device
- no aggressive or conductive substances are in the immediate vicinity
- no drill chippings, screws or other foreign bodies penetrate into the device
- the vent openings are not covered over.

The device may otherwise be damaged.

2.2 Mounting

Step	Action	Comment
1	Mark out 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 high-frequency drive controller vertically on the backing plate.	Pay attention to the mounting clearances! The contact surface must be metallically bright.
3	Mount the other components, such as the motor choke, sine filter etc., on the backing plate.	
4	Continue with electrical installation in section 3.	

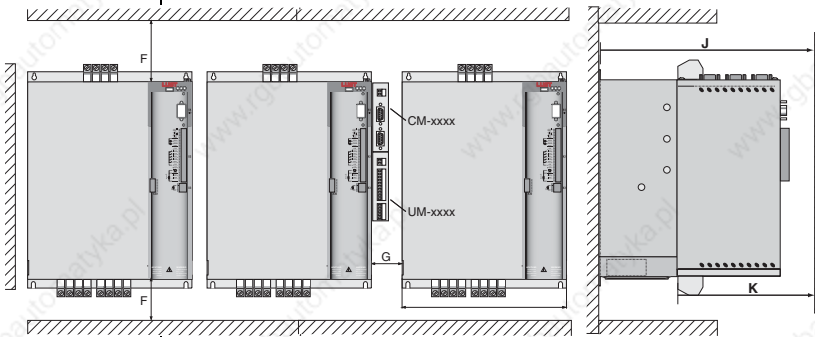
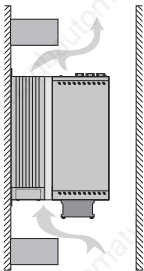


Figure 2.1 Mounting clearances (See Table 2.1), air/fluid cooling

L = Required clearance with fluid connection
(see dimensional drawings)

Note the following points:

- With air cooling, the air must be able to flow unhindered through the unit.
- The backing plate must be grounded in order to discharge high-frequency interference signals.
- The best result for effective EMC installation is attained with a chromated or galvanized backing plate. If backing plates are varnished, the coating must be removed in the area of the contact surface!
- The device is designed only for vertical installation in a switch cabinet.



	CDS44.017,W/ CDS44.032,W	CDS44.017,W NF/ CDS44.032,W, NF
Cooling method	Air cooling	Air cooling
Mounting type	Vertical mounting with unhindered air flow	
Protection	IP20	
Cooling air temperature	40 °C (at 64 kHz switching frequency of power stage)	
Weight	10,5/12,0	23,5/25,0
Dimensions	Standard device [mm]	with built-on mains filter [mm]
W (width)	245	346,5
H (height)	327	327
D (depth)	269	269
A	180	180
C	293	293
D	7	7
E	310	310
F	100	100
G	45	45
J	≥ 400	≥ 400
K	125	125

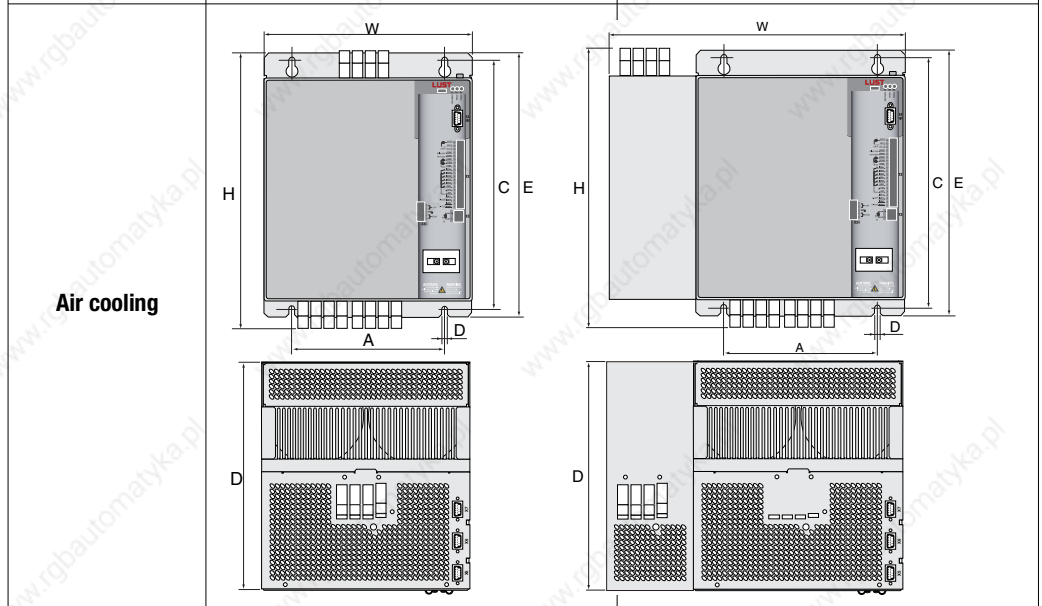


Table 2.1 Dimensional drawings for wall mounting (dimensions in mm), air cooling

	CDS44.017,LC/ CDS44.032,LC	CDS44.017,LC NF/ CDS44.032,LC, NF	CDS44.072, W
Cooling method	Fluid cooling	Fluid cooling	Fluid cooling
Mounting type	Vertical mounting with unhindered air flow		
Protection	IP20		
Cooling air temperature	40 °C (at 64 kHz switching frequency of power stage)		
Weight	13/14,5	21,0/22,5	20,0
Dimensions	Standard device [mm]	with built-on mains filter [mm]	Standard device [mm]
W (width)	245	346,5	260
H (height)	327	327	-
D (depth)	269	269	265
A	180	180	190
C	293	293	436,5
D	7	7	7
E	310	310	457,5
F	100	100	100
G	45	45	45
J	≥ 400	≥ 400	≥ 400
K	125	125	125
L	12 cm		
H _w (height)	410	410	538
Water cooling			
<ul style="list-style-type: none"> • Dimensional data excluding screws, mating connectors and shield connections, and with fluid cooling also excluding pipes! • Allow additional space for the bend radii of the connecting cables and the fluid connections. 			

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

3 Electrical installation

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

3.1 Overview – CDS4000

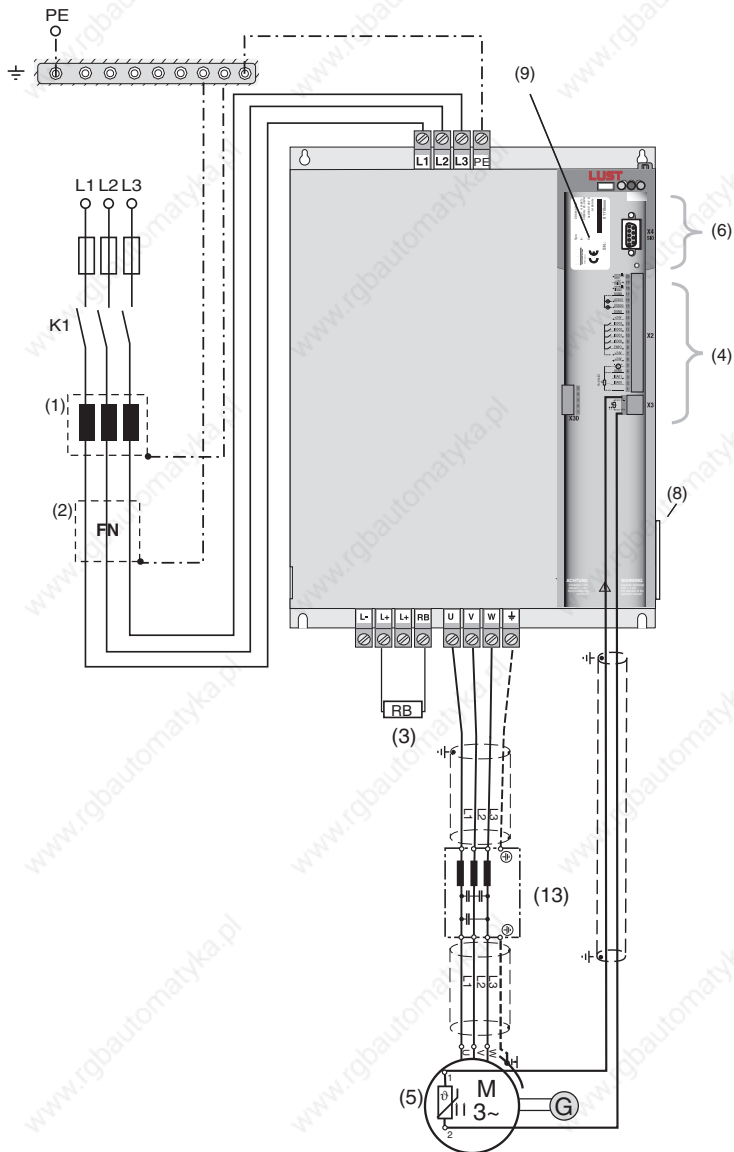


Figure 3.1 Overview of terminals – CDS4000

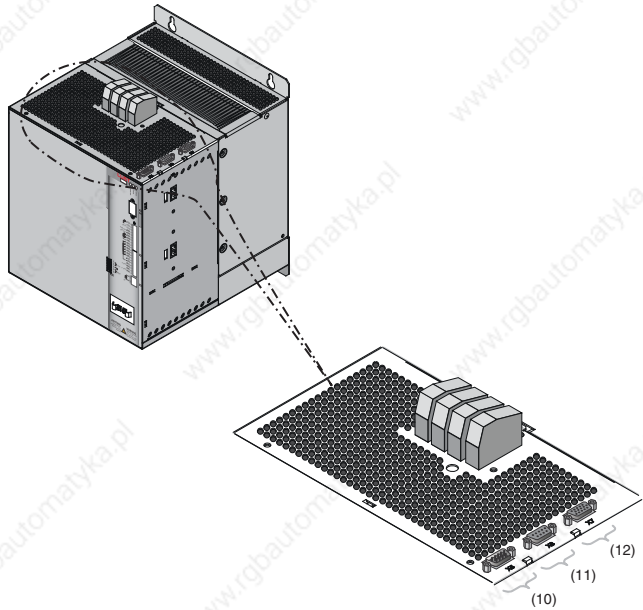


Figure 3.2 Overview of terminals CDS4000

Key	Explanation	See section
(1) Line reactor ¹⁾	Reduces the voltage distortions in the system	
(2) Mains filter ¹⁾	Suppresses line-borne interference emission	
(3) Braking resistor ¹⁾	Required for fast braking	3.6 Page 3-19
(4) Control connections X2	Connection	3.7 Page 3-21
(5) Motor PTC connection X3	For thermal monitoring of the motor	3.3.2 Page 3-8
(6) RS232 connection X4	For operation with KEYPAD/DRIVEMANAGER	4.6 Page 3-23/ 4.5 Page 3-21
(8) Software rating plate	Indicates the shipped software status	
(9) Rating plate	Contains the hardware data and the serial number	
(10) Encoder simulation/master encoder X5, TTL encoder	Connection and specification	3.9 Page 3-27
(11) Resolver connection X6	Connection and specification	Page 3-11
(12) Opt. encoder or Hall-IC connection X7	Connection and specification	Page 3-15
(13) Motor filter ¹⁾	reduces current harmonics	

1) For supplementary components see Order Catalogue of drive solutions for high-frequency applications.

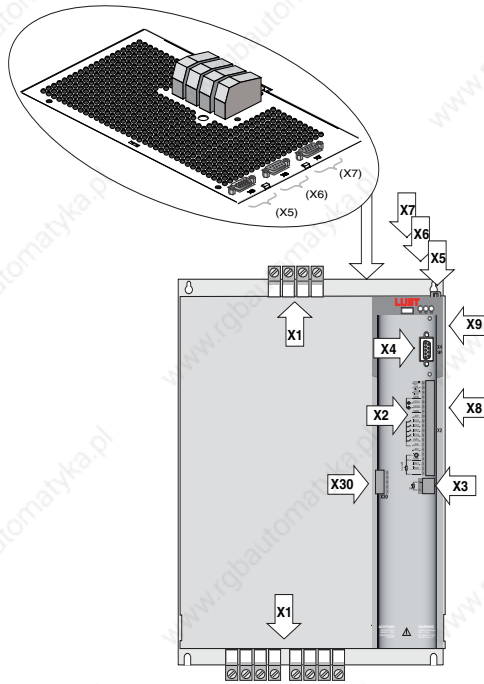


Figure 3.3 Terminal layout

Terminal	Explanation
X1	Power connections
X2	Control connections
X3	Motor PTC connection
X4	PC/KeyPad connection (RS232 interface)
X5	Encoder simulation / Master encoder
X6	Resolver connection
X7	Optical encoder connection
X8	UM-xxx module connection
X9	CM-xxx module connection
X30	Voltage source 24 V, 500 mA



Note: For all shielded connections a cable type with double copper braiding with at least 70 % coverage must be used.

3.2 PE conductor connection

Step	Action	Note: PE mains connection EN61800-5-1
1	Ground each HF drive controller! Connect terminal X1 / ⊕ (next to the power connection) in star configuration to the PE rail (main ground) in the switch cabinet.	Use PE conductor cross-section according to cross-section of mains cables, and at least once 10 mm ² Cu.
2	Also connect the PE conductor connections of all other components, such as the line reactor, filter, heat sink, etc., in star configuration to the PE rail (main ground) in the switch cabinet.	

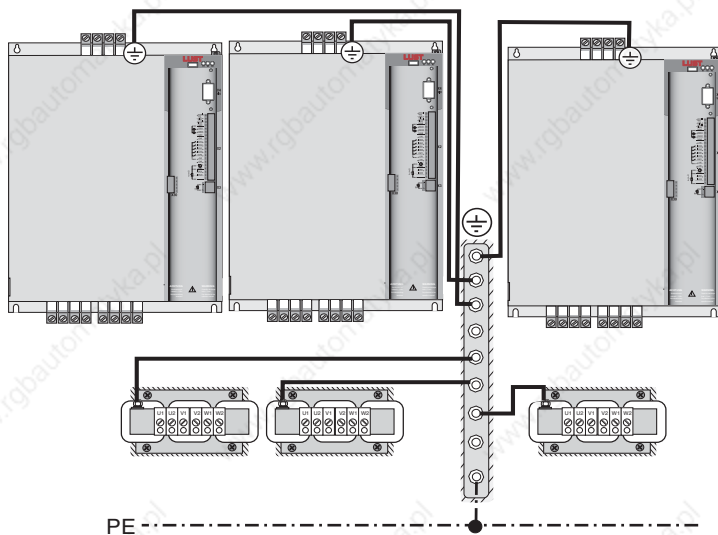


Figure 3.4 Star configuration layout of the PE conductor



Note the following points:

- The PE conductor must be laid out in star configuration to conform to the EMC standards.
- The backing plate must be grounded in order to discharge high-frequency interference signals.
- The motor cable, mains cable and control cable must be laid separately from each other.
- Avoid loops, and lay cable over short distances.
- The operational leakage current is > 3.5 mA.

3.3 Motor connection (X1)

Step	Action	Comment	Section
1	Define the cable cross-section depending on the maximum current and ambient temperature. Wire the motor phases U, V, W by way of a shielded cable and ground the motor to X1 directly next to the motor connection terminals.	Cable cross-section to VDE0100, part 523, see section 3.5 "Mains connection (X1)" Mount shielding at both ends to reduce interference emission.	3.3.1
2	Wire the temperature sensor (if fitted) with separately shielded wires or with wires routed in the motor cable.	Mount shielding at both ends to reduce interference emission.	3.3.2
3	Wire the holding brake (if fitted) with separately shielded wires or with wires routed in the motor cable.	Mount shielding at both ends to reduce interference emission.	3.3.3
4	Connect the encoder by a ready made-up cable to the high-frequency drive controller.	Various ready made-up cables are available for connection of the encoder.	3.4
5	Wire the external ventilator unit (if fitted) with separate wires.	An adequate flow of cooling air is required.	



Note the following points:

- Always use shielded cables to connect the motor.
- Shield contact on the high-frequency drive controller:
 - A shield plate (ST10) permitting simple mounting with all-round contact is available for the CDS4000 high-frequency drive controller.
- The motor at the HF drive controller output may be shut off by means of a contactor or motor circuit-breaker. The high-frequency drive controller cannot be damaged in the process. A error message may occur however, see section 5 "Diagnosis/Troubleshooting".

If you have any further queries refer to the "Helpline" (see page 5-3).

3.3.1 Motor phase connection



Note: The CDS4000 high-frequency drive controllers are protected against short-circuit and ground faults at the terminals when in operation. In the event of a short-circuit or ground fault in the motor cable, the power stage is disabled and an error message is delivered.



Attention: Do not confuse the motor filter and unit ends of the motor phases U, V and W! If the motor phases are incorrectly connected, the high-frequency drive controller will lose control over the motor and the motor may buck or accelerate uncontrollably (“run away”). The entire system may be damaged as a result! There may consequently also be danger to human life!



Attention - Danger to life: Do not touch the motor terminals! There may also be dangerously high voltages present at motor terminals U, V and W in the “power stage off” condition!

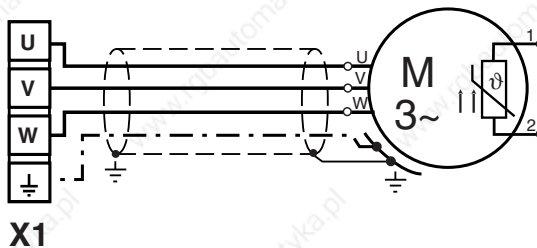


Figure 3.5 Connection of motor phases

3.3.2 Motor temperature monitor (X3)

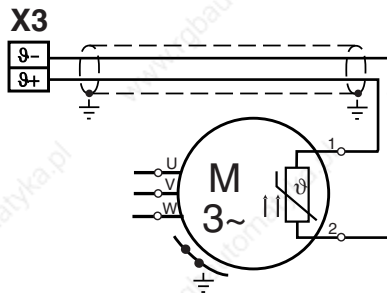


Figure 3.6 Connection of the temperature sensor

For thermal monitoring of the motor winding, the temperature sensors specified in Table 3.1 can be connected to terminals X3 / θ^- and θ^+ .

Sensor	No PTC used	Standard PTC	Linear voltage evaluation	TSS, Thermostatic circuit-breaker
Tech. data				
Usable type	-	PTC based on DIN 44082	KTY84-130 KTY 11-6	Klixon
Parameters 330-MOPTC =	OFF	DIN	KTY	TSS
Measurement voltage U_{MAX}	-	12 V		-

Table 3.1 Motor temperature monitor specification



Attention: Contrary to the DIN VDE0660 standard, part 303 (Short-circuit detection < 20 Ω) the CDS4000 detects a short-circuit at < 50 Ω .

The appropriate temperature sensor must be configured during commissioning if no suitable motor data set is available.

3.3.3 Holding brake (if installed)

A holding brake can be actuated via the digital output OSD03 at terminal X2. In the factory setting the wire-break and short-circuit shut-off is active by default. You can disable it by way of parameter 468-03CFC or from the DRIVEMANAGER menu by choosing > Digital outputs > Wire-break monitor.

Function		Symbol	Value		
			Min.	type	Max.
Input: X2: 18 (VCC03) X2: 19 (GND03)	Voltage supply	V_{IN}	21.6 V	24 V	26.4 V
	Current consumption	I_{IN}	-	-	2.1 A
Output: X2: 20 (OSD03)	Output voltage	V_{OUT}	-	V_{IN}	-
	Output current	I_L	-	-	2.0 A
Monitoring function (shutdown)	Cable break shut-off	$I_{L(OL)}$	-	-	150 mA
	Short-circuit shut-off	$I_{L(SCr)}$	-	4 A	-
Ambient temperature maximum 45 °C, above that the maximum output current is reduced.					

Table 3.2 Technical data, output OSD03



Note: At a holding brake current consumption > 2 A a relay should be inserted between OSD03 and the holding brake.

3.4 Encoders

3.4.1 Encoder types

The CDS4000 evaluates different encoders:

Type	Designation	cable	See
User	Encoder type not corresponding to Rx and Gx		
R1	Resolver 1 pole pair	KRY2	
R2	Resolver 2 pole pairs		
R8	Resolver 3 pole pairs		
G1	Sin/Cos 2048 lines zero pulse		
G2	Sin/Cos 2048 lines single-turn SSI 25/13 bits		
G3	Sin/Cos 2048 lines multi-turn SSI 25/25 bits	KGS2	
G4	Sin/Cos 2048 lines single-turn SSI 11/11 bits		
G5	Sin/Cos 2048 lines single-turn SSI 13/13 bits		
G6	Sin/Cos 1024 lines single- or multi-turn HIPERFACE	KGH2	
G7	Sin/Cos 512 lines single- or multi-turn HIPERFACE		
H1	Hall switch		

Table 3.3 Encoder type classification (LTi)

3.4.2 Encoder connection specification

Which resolver?

Resolver

With the CDS4000 high-frequency drive controller, resolvers to the following specification can be evaluated:

Function	Value
Number of poles	2 - 8 (permissible number of poles: 2, or equal to number of motor poles)
Input voltage	$7 V_{eff}$; 4 - 20 kHz
Input current	max. 65 mA
Transformer ratio	$0,5 \pm 10 \%$
Recommended resolver	Siemens V23401-D1001-B101 or derivatives

Table 3.4 Resolver specification

Connection

The resolver is connected via plug connection X6 to the CDS4000.



Figure 3.7 Resolver cable

Connector

Connector A : D-Sub 9-pin plug, metal housing (HF drive controller)

Connector B : Customer-specific, as specified by motor manufacturer (motor)

Cable type

Cable festoon compatible, e.g. Intercond 3MYI 17Z 10P (4x2x0.25 mm² + 2x1 mm²) or Lapp Unitronic FD CP TP (3x2x0.25 mm²) with UL approval.

Pin assignment

You can enter your custom assignment in the columns for connector B.

Connector A	Function	Connector B	Wire colour
CDS4000-X6			Custom
1	SIN+ (S2)		
2	SIN- (S4)		
3	COS+ (S1)		
4	GND		
5			
6	REF+ (R1) (8 kHz, approx. 7 V AC)		
7	REF- (R2) (GND)		
8	COS- (S3)		
9			
Outer shield on housing			

Table 3.5 Resolver cable pin assignment

Sin/Cos encoder

With the high-frequency drive controller the following rotary encoders can be evaluated:

Which encoders?

- **G1:**
Sin/Cos encoders from various manufacturers with zero pulse, $U_V = 5\text{ V} \pm 5\%$, $I_{MAX} = 150\text{ mA}$ (e.g. Heidenhain ERN1381, ROD486)
Gear wheel encoders, e.g. Lenord & Bauer GEL 244-KN
- **G2-G5:**
Heidenhain Sin/Cos encoder with SSI interface (single-turn 13 or 25-bit and multi-turn 25-bit), $U_V = 5\text{ V} \pm 5\%$, $I_{MAX} = 150\text{ mA}$ (e.g. ECN1313))
- **G6-G7:**
Stegmann Sin/Cos encoder with HIPERFACE® interface (single- and multi-turn), $U_V = 8\text{ V}$, $I_{MAX} = 100\text{ mA}$ (e.g. SRS50, SRM50)

Connection

The encoder is connected via plug connection X7 to the CDS4000.

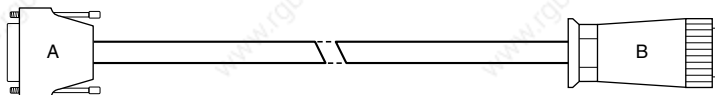


Figure 3.8 Encoder cable

Connector

Connector A: (HF drive controller)	D-Sub 15-pin High-Density plug (as VGA plug), metal housing
Connector B: (motor):	Customer-specific, as specified by motor manufacturer

Cable types

Sin/Cos encoder with zero pulse:	Various manufacturers (3x2x0.14 mm ² + 2x1 mm ²) Heidenhain encoder: Cable festoon-compatible Heidenhain 244 957 01
Sin/Cos encoder with SSI interface (Heidenhain):	Cable festoon-compatible, (4x2x0.14 mm ² + 4x0.5 mm ² + (4x0.14 mm ²)) Heidenhain 266 306 01
Sin/Cos encoder with HIPERFACE® interface (Stegmann):	e.g. Intercond special flex type 3MYI 17Z 10P ((4x2x0.25 mm ² + 2x1 mm ²) (UL approval))

Pin assignment

You can enter your custom assignment in the columns for connector B.

Connector A	Function Sine/Cosine	SSI function	HIPERFACE® function	Connector B	Wire colour
CDS4000 X7				Custom	
1	A-	A-	REFCOS		
2	A+	A+	+COS		
3	+5 V / 150 mA	+5 V / 150 mA			
4		DATA+	Data+ RS485		
5		DATA-	Data- RS485		
6	B -	B -	REFSIN		
7			Us 7-12V / 100mA*		
8	GND	GND	GND		
9	R-				
10	R+				
11	B+	B+	+SIN		
12	+5 V / (sensor)	+5 V / (sensor)			
13	GND (sensor)	GND (sensor)			
14		CLK+			
15		CLK-			

Outer and inner shield (if fitted) on both sides of housing
 * To 250 mA with external +24 V (-5 %/+20 %) supply via terminal X2 permitted.

Table 3.6 Encoder cable pin assignment

Hall IC encoder

With the CDS4000, Hall IC switches built-in to the motor can also be evaluated. They can be 90° or 120° electrically aligned.

Cable type

To evaluate the Hall ICs, you will need a cable with integrated adaptation of the Hall IC signals to the CDS4000 high-frequency drive.

Connection

The two Hall ICs are connected via the plug-in connection X7 on the CDS4000.



Figure 3.9 Hall IC cable KHI-xxx

Single wires	Function
Red	+U _B (+12 V)
Yellow	Hall IC, track A
Green	Hall IC, track B
Black	Ground
Orange	
Brown	

Table 3.7 Cable assignment KHI-xxx

Festoon-compatible:	No
Permissible bend radius:	15 x outer diameter
Permissible temperature range:	Resting: -30 °C to +80 °C Moving: -20 °C to +80 °C
Cable:	UL-LiYCY 6 x AWG24
UL approval:	Yes
Material of outer sheath:	Special PVC
Resistance:	Largely oil-repellant, petrol-tight, weather-proof, UV-resistant

3.4.3 LTi encoder cables

For connection of motors from the LTi standard range, ready made-up encoder cables are available in various lengths:

Cable <> motor matching according to encoder type

Cable type	Designation	Motors	
		ASM, DSM4	LSH, LST
KRY	Resolver cable	R1, R2, RS	-
KRY2	Resolver cable	-	R, 3R
KGS	SSI encoder cable	G3, G5	-
KGS2	SSI encoder cable	-	G3, G5
KGH	HIPERFACE encoder cable	G6, G6M	-
KGH2	HIPERFACE encoder cable	-	G6, G6M

Table 3.8 Cable <> motor matching

Technical data of the LTi encoder cables

Cable		KRY-KSxx ¹⁾	KRY2-KSxx ¹⁾	KGS-KSxx ¹⁾	KGS2-KSxx ¹⁾	KGH-KSxx ¹⁾	KGH2-KSxx ¹⁾
Motor with encoder system		R1, R2, R8	R, 3R	G3, G5		G6, G6M	
Festoon-compatible		Yes					
Minimum bend radius:	in fixed installation	-	40 mm	-		-	
	in flexible use	90 mm	100 mm	-		90 mm	
Temp. range:	in fixed installation	-	-35 ... +80 °C	-		-40 ... +85 °C	
	in flexible use	-40 ... +85 °C	-35 ... +80 °C	-		-	
Cable diameter approx.		8.8 mm		8.8 mm		8.8 mm	
Material of outer sheath		PUR		PUR		PUR	
Resistance		Resistant to oil, hydrolysis and microbic attack (VDE0472),					
Approvals		UL style 20233, 80 °C - 300 V, CSA-C22.2N.210-M90, 75 °C-300V FT1					
1) xx = Length of cable in metres, standard lengths: 2, 3, 5, 8, 10, 15, 20 and max. 50 m							

Table 3.9 Technical data of the LTi encoder cables

3.5 Mains connection (X1)

Step	Action	Comment
1	Define the cable cross-section depending on the maximum current and ambient temperature.	Cable cross-section to VDE0100, part 523
2	Install a circuit-breaker K1 (power switch, contactor, etc.).	Do not connect the power!
3	Use mains fuses (type gG) or miniature circuit-breakers (trip characteristic C) to cut the mains power to all poles of the high-frequency drive controller.	To protect the cable in accordance with VDE guidelines

¹⁾ see appendix A.4



Connection of the servocontroller via a line reactor with a short-circuit voltage of 4 % of the rated voltage ($u_k = 4\%$) is obligatory:

- Where the drive controller is used in applications with disturbance variables
1. corresponding to environment class 3, as per EN 61000-2-4 and above (hostile industrial environment).
 2. To comply with the limit values for variable-speed electric drives (see standard EN 61800-3/ IEC 1800-3)



Please note that the mains power cable and fuses used must conform to the specified listings (such as cUL, CSA).

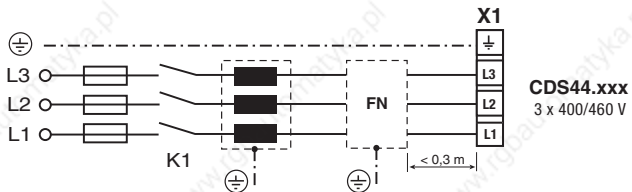


Figure 3.10 Mains connection



Attention: Danger to life! Never wire or disconnect electrical connections while they are live! Before working on the device disconnect the power. Wait until the DC-link voltage at terminals X1/L+ and L- has fallen to $\leq 60\text{ V}$ before working on the device.



Note the following points:

- Only all-current sensitive residual current protective devices (RCDs) suitable for high-frequency operation may be used.

- Switching the mains power: Cyclic power switching is permitted every 120 seconds; jog mode is not permitted.
 - If switching is too frequent, the device protects itself by means of high-resistance isolation from the system.
 - After a rest phase of a few minutes the device is ready to start once again.

- TN network and TT network: Permitted without restriction.
- IT network: Not permitted!
 - In the event of a ground fault the voltage stress is around twice as high, and creepages and clearances to EN50178 are no longer maintained.

Mains filters



Note: Compliance with the limit curves to attenuate the line-borne interference voltage and the interference emitted from the HF drive controller depends on

- use of a line reactor (recommended),
- the motor cable length and
- the preset clock frequency (16, 32, 64 kHz) of the HF drive controller power stage.

For further information please consult your project engineer.

Cable cross-section

HF drive controller	Connected load [kVA]	Max. possible cable cross-section of terminals [mm ²]	Min. tightening torque [Nm]	Recommended mains fuse rating (gL) [A]
CDS44.017	12,4	10	2,3	3 x 25
CDS44.032	23,3	10	2,3	3 x 50
CDS44.072	50	35	2,5	3 x 100

Table 3.10 Cable cross-sections and mains fuses (conformance to VDE 0298 is required)¹⁾

¹⁾ The minimum cross-section of the mains power cable is based on the local provisions (VDE 0100 Part 523, VDE 0298 Part 4), the ambient temperature and the specified rated current of the inverter.

3.6 Braking resistor (RB)

In regenerative operation, e.g. braking the drive, the motor feeds energy back into the high-frequency drive 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 way of a braking resistor.

The braking transistor is installed as standard. The design of the external braking resistor depends on a number of drive factors: for example the load to be moved, the required dynamics of the drive or the braking and cycle duration.

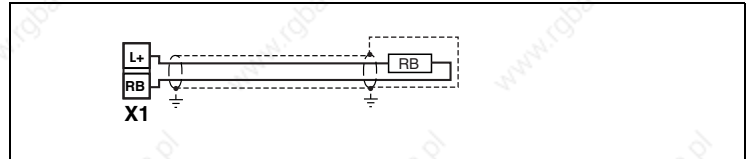


Figure 3.11 Braking resistor connection



Attention: Danger to life! Never wire or disconnect electrical connections while they are live! Before working on the device disconnect the power. Wait until the DC-link voltage at terminals X1/L+ and L- has fallen to ≤ 60 V before working on the device.



Note: The design of the braking resistor must be clarified at the project planning stage. Please talk to us!



Attention: In device version **CDS 44.xxx, BR** the braking resistor is built-in. No additional braking resistor may be connected to terminals X1/L+ and RB; this would damage the high-frequency drive controller.



Attention: Braking the drive is important to the safety of the machine or system!

Commissioning should include a test for safe functioning of the braking system! Incorrect dimensioning (overload) could lead to destruction of the braking resistor or the braking electronics, and damage to the machine or system. Overload (failure of the braking device) can also lead to serious or fatal physical injury to human beings, for example in lifting applications!




Attention: If the error message E-OTI (device heat sink overheating) appears, the connected device must be isolated from the mains, as the cause may be overloading of the braking resistor due to mains overvoltage. Please integrate one of the digital outputs into your control concept accordingly, e.g. set OSDxx to ERRW (warning or device fault).

The braking resistor should be monitored by a temperature-sensitive sensor. The sensor is not evaluated with the drive controller, but is integrated into a higher-level safety sequence. When overheating of the braking resistor is signalled, all poles of the drive controller must be isolated from the mains. If the braking resistor overheats it may pose a fire hazard.

Please observe the installation instructions for external braking resistors!

3.7 Control connections

Step	Action	Comment
1	Check whether your high-frequency drive controller is fitted with a modified software package (Sxx) or/and a ready-to-run data set (Dxx) . If it is, the control terminal assignment is different. Please contact your project engineer with regard to wiring and commissioning!!	 <p>Position of software rating plate see section 3.1 page 3-2</p>
2	Check whether you already have a SMARTCARD or a DRIVEMANAGER data set with a complete device setup. If this is the case, the control terminal assignment is different. Please contact your project engineer to obtain the terminal assignment!	<p>Bulk customers</p> <p>For details of how to load the data set into the high-frequency drive controller refer to section 4.2.</p>
3	Choose one of the preset solutions.	see section 4
4	Wire the control terminals with shielded cables. Only the ENPO signal is essential.	Ground the shields over a wide area at both ends. Cable cross-section maximum 1.5 mm ² or two strands per terminal at 0.5 mm ²
5	Keep all contacts open (inputs inactive).	
6	Check all connections again!	Continue with commissioning in section 4.



Note the following points:

- Always wire the control terminals with shielded cables.
- Lay the control cables separately from the mains and motor cables.

3.7.1 Specification of control connections

Control terminal X2:

	No.	Des.	Specification	Isolation
Analog Inputs	1	ISA00+	<ul style="list-style-type: none"> ISA00: $U_{IN} = \pm 10$ V DC, resolution 12-bit, sampling time 1 ms (special function 125 μs) ISA01: $U_{IN} = + 10$ V DC, resolution 10-bit, sampling time 1 ms Tolerance: ± 1 % of meas. 24 V digital input, PLC-compatible Switching level Low/High: <4.8 V / > 8 V DC Sampling time 1 ms $R_{IN} = 110$ kΩ 	
	2	ISA00-		
	3			
	4	ISA01+ ISA01-		
Digital Inputs	8	ISD00	<ul style="list-style-type: none"> ISD00-ISD02: Frequency range < 500 Hz, sampling time 1 ms ISD03-ISD04: Frequency range < 500 kHz, sampling time 1 ms (special functions < 2 μs) PLC-compatible Switching level Low/High: <5 V / > 18 V DC I_{max} (at 24 V) = 10 mA $R_{IN} = 3$ kΩ 	✓
	9	ISD01		
	10	ISD02		
	11	ISD03		
	12	ISD04		
	7	ENPO	<ul style="list-style-type: none"> Hardware enable of power stage = High level Specification as ISD00 	✓
Digital Outputs	14	OSD00	<ul style="list-style-type: none"> Short-circuit-proof PLC-compatible, sampling time 1 ms $I_{max} = 50$ mA, high-side driver Protection against inductive load 	✓
	15	OSD01		
Relay output	16	OSD02	<ul style="list-style-type: none"> Relay, 1 NO contact 25 V / 1 A AC, usage category AC1 30 V / 1 A DC, usage category DC1 Sampling time 1 ms Operating delay approx. 10 ms 	✓
	17			
Voltage supply	5	+24 V DGND ¹⁾	<ul style="list-style-type: none"> Auxiliary voltage $U_V = 24$ V DC, short-circuit-proof Tolerance ± 20 % $I_{max} = 100$ mA (overall, also includes driver currents for outputs OSD0x) External 24V supply to control electronics in case of power failure possible, Current consumption $I_{max} = 1$ A 	✓
	6, 13			

	No.	Des.	Specification	Isolation
Motor holding brake	18	VCC03	<ul style="list-style-type: none"> Digital +24 V output, high-active Short-circuit-proof Suitable for actuation of a motor holding brake (specification, see section 3.3.3) $I_{max} = 2.0$ A (current overload causes shut-off) to $v_{Umax}=45$ °C; reduction of I_{max} at $v_U > 45$ °C. $I_{min} = 150$ mA ($I < I_{min}$ cable break causes shut-off) Separate voltage supply required: $U_{IN} = +24$ V \pm 10 % $I_{IN} = 2.1$ A Also usable as configurable digital output 	✓
	19	GND03		
	20	OSD03		

1) Functional isolation between digital (DGND) and analog (AGND) ground. For more information see section 3.7.3 "Isolation".

Additional voltage supply X30:

	No.	Des.	Specification	Isolation
Voltage source	1,2	24 V	24 V DC short-circuit-proof $I_{max} = 500$ mA	✓
	4,5	DGND ¹⁾		

1) Functional isolation between digital (DGND) and analog (AGND) ground. For more information see section 3.7.3 "Isolation".

3.7.2 Standard terminal assignment

Terminal assignment in **factory setting**.

Features

- Preset solution, speed control with ± 10 V setpoint input (ISA00)

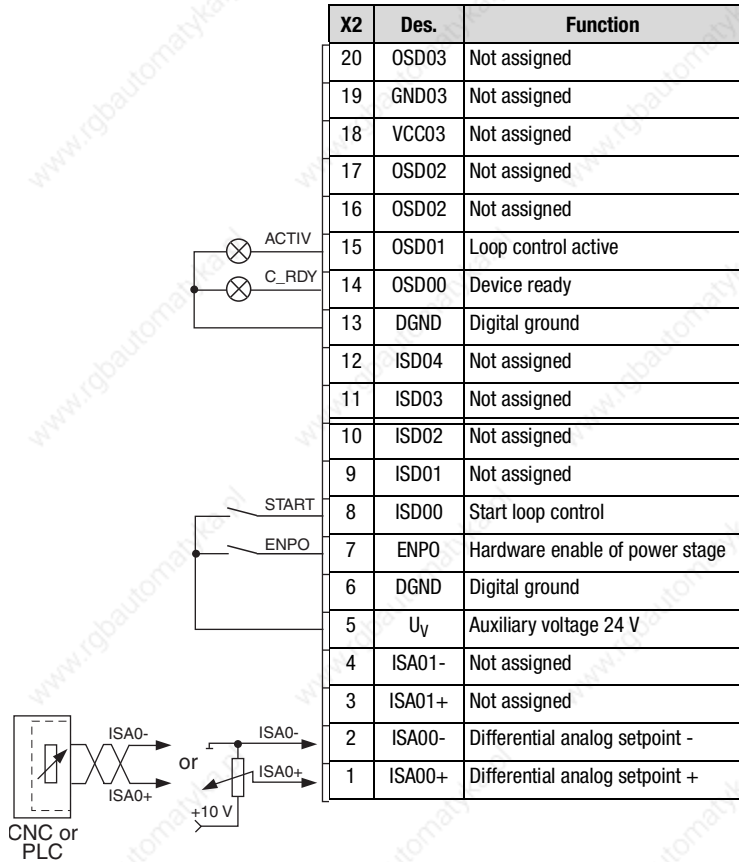


Figure 3.12 Standard terminal assignment

Note the following points:

- For terminal assignments for further preset solutions refer to CDD3000 Application Manual.



3.7.3 Isolation

The analog and digital inputs are isolated from each other in order to avoid transient currents and interference over the connected lines. The analog inputs are connected to the potential of the HF drive processor. The digital inputs and outputs are isolated, thereby keeping interference away from the processor and the analog signal processing.

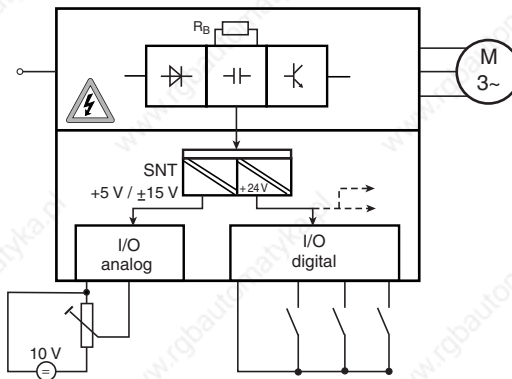


Figure 3.13 Voltage supply to I/Os

When selecting the cable, note that the cables for the analog inputs and outputs must always be shielded. The cable or wire core shield on shielded pairs should cover as large an area as possible in respect of EMC considerations, thereby providing safe discharge of high-frequency interference voltages (skin effect).

For special cases refer to the CDD3000 Application Manual.

3.8 Effective EMC installation

Drive controllers are components that are intended for installation in industrial and commercial systems and machines.

Commissioning (i.e. putting the device to its intended use) is only permitted in compliance with the EMC Directive (2004/108/EC).

Verification of conformance to the safety targets laid down in the EMC Directive must be provided by the company installing/operating a machine and/or system.



Attention: If the installation instructions set out in this Operation Manual are followed, and the appropriate RFI filters are used, conformance to the stipulated EMC safety targets is normally achieved.

All CDS4000 drive controllers have a sheet steel housing with an aluminium/zinc finish to enhance interference immunity to IEC61800-3, environments 1 and 2.

To conform to the EMC product standard IEC61800-3, the device can be ordered with a mains filter (CDS44.xxx,NF). This ensures conformance to the limit curve for residential areas up to a motor cable length of 10 metres for devices with restricted availability.

3.9 Encoder simulation - Master encoder input

The plug connection **X5** of the HF drive controller is designed alternatively to provide the

- incremental encoder simulation **or**
- incremental master encoder input

function. The signals are isolated from the control electronics.

Step	Action	Comment
1	Define the function of the connection: <ul style="list-style-type: none"> • Encoder simulation • Master encoder input 	see section 3.9.1 see section 3.9.2
2	Specify the cable according to the application. A cable cross-section of less than 0.14 mm ² should not be chosen. The differential signals (A, B and R) must be connected to twisted pair cables.	Mount shielding at both ends to reduce interference emission.
3	Wire the circuit according to the application.	

3.9.1 Encoder simulation

Encoder simulation forms incremental encoder-compatible pulses from the position of the rotary encoder connected to the motor. Accordingly, pulses are delivered in two 90° offset signals A and B as well as a zero pulse R.

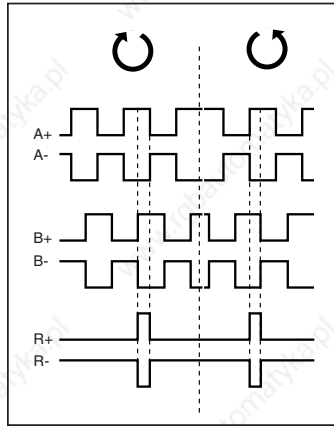
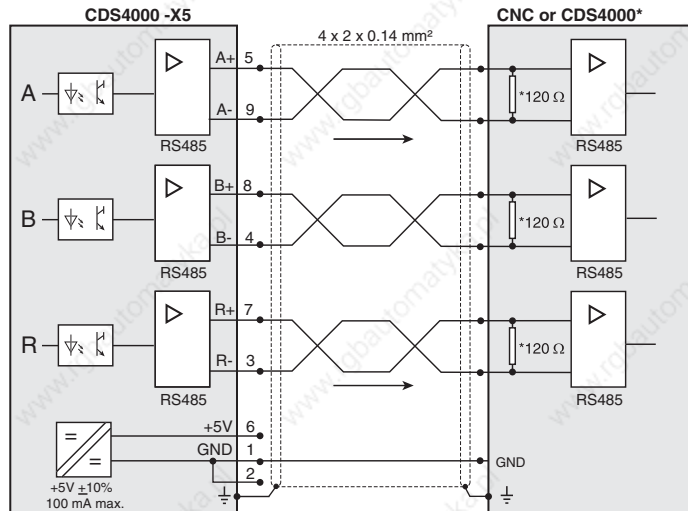


Figure 3.14 Encoder simulation signals looking onto the motor shaft (at left when motor rotating clockwise)

The resolution of the encoder simulation is adjustable when a resolver is used; when incremental encoders are used it corresponds to the resolution of the connected encoder. Rotary encoders of type G2-G6 emit no zero pulse.



* The CDS4000 does not include the wave terminating resistor. It must be wired externally.

Figure 3.15 Encoder simulation connection and signal description

Electrical specification

Interface: RS422

Recommended cable cross-section > 0.14 mm²
(e.g. 3x2x0.14 mm²)

Max. cable length 10 m

Connector: 9-pin D-SUB, socket

	Min.	Max.	Comments
Output frequency	0 Hz	500 kHz	
Output voltage			
<ul style="list-style-type: none"> • High level • Low level • Differential 	<p>2.5 V</p> <p>-</p> <p>2.0 V</p>	<p>-</p> <p>0.5 V</p> <p>-</p>	<p>(I_{OH} = -20 mA)</p> <p>(I_{OL} = 48 mA)</p>

Table 3.11 Encoder simulation electrical specification



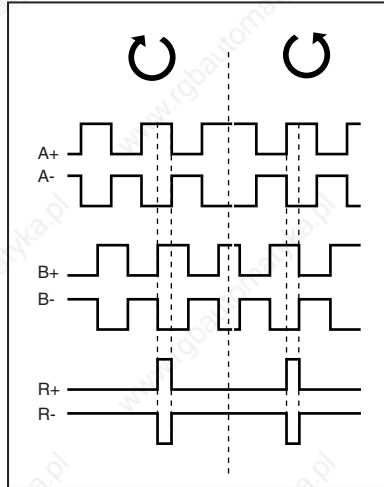
The controller connected to the encoder simulation must be able to process its output frequencies.

Example: $f = \frac{3000 \text{ rpm} \cdot 2048 \text{ pulses}}{60 \text{ rpm/s}} = 102.4\text{kHz}$

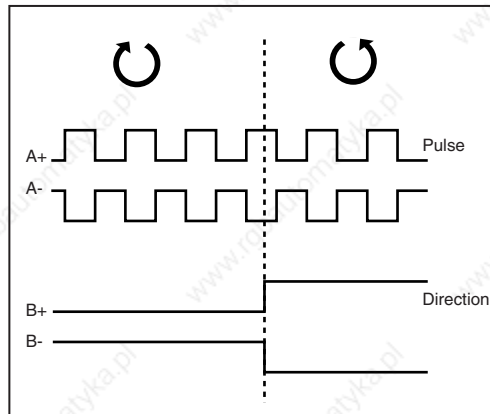
3.9.2 Master encoder (in preparation)

The master encoder input **X5** permits incremental setpoint input for loop control. The setpoint generator is either the encoder simulation of another CDS4000 high-frequency drive controller, a standard commercially available incremental encoder or a stepper motor controller. The signal shape corresponds either to

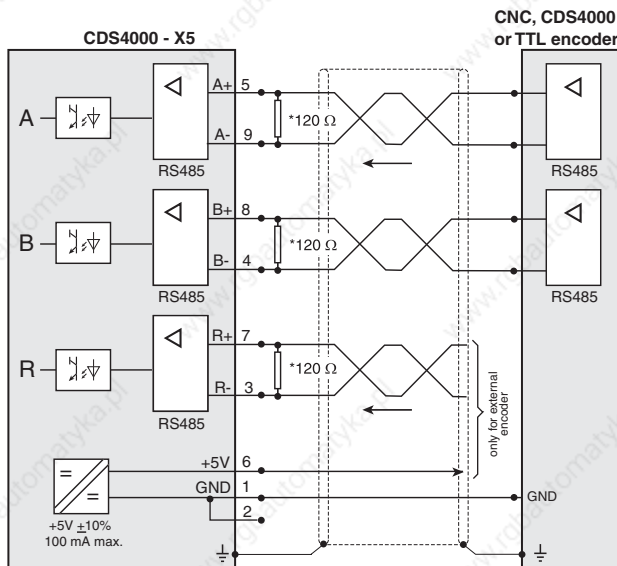
- **A/B incremental encoder signals** or



- **pulse direction signals** when a stepper motor controller is connected.



Parameters to evaluate the signals can be set for signal type, lines per revolution and transmission ratio.



* For the CDS4000 the wave terminating resistor must be connected externally.

Figure 3.16 Master encoder input connection and signal description

Electrical specification

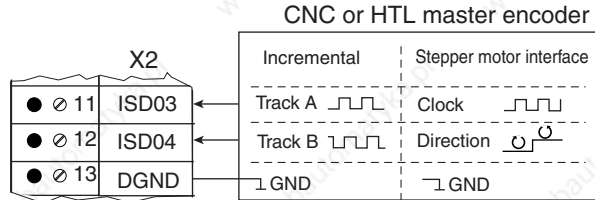
- Interface: RS422
- Recommended cable cross-section > 0.14 mm²
(e.g. 3 x 2 x 0.14 mm²)
- Max. cable length 10 m
- Connector: 9-pin D-SUB, socket

	Min.	Max.	Type
Input frequency	0 Hz	500 kHz	
Input voltage			
• High level	0.2 V		
• Low level		- 0.2 V	
• Differential	-	± 6 V	
Wave terminating resistance	-	-	120 Ω
Voltage supply to external encoder	4.5 V	5.5 V	5 V / 100 mA

Table 3.12 Master encoder input electrical specification

HTL master encoder

A master encoder with HTL level (24V) can alternatively be connected via control terminal **X2**. Digital inputs ISD03 and ISD04 are used for this.



You will find the specification of the digital inputs of control terminal **X2** in section 3.7 “Control connections”.



Note: When a HTL master encoder is in use, both the encoder simulation and the master encoder input at **X5** are inactive.

TTL master encoder

A rotary encoder with TTL level can also be connected to master encoder input **X5**. For the terminal assignment refer to Figure 3.16.



Attention: Operation of synchronous HF motors with a TTL encoder additionally requires setting of the autocommutation parameters (for more information on this refer to the CDD3000 Application Manual). This setting is not required for asynchronous motors.

3.10 Water cooling

For devices with water cooling (variant code 'LC') the water circuit must be connected.



Attention: Before switching on the mains voltage, check the water feed pipe and connections for leaks!

The inlet and outlet can be selected at will on the device. For flow rate and other technical data relating to water cooling see Appendix.

1

2

3

4

5

A

EN

4 Commissioning

4.1	Choice of commissioning	4-2
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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
<ul style="list-style-type: none"> Project planning and commissioning are already complete. Loading of an existing data set. 	Serial commissioning	Page 4-2
<ul style="list-style-type: none"> Initial project planning and commissioning of the drive system. 	First commissioning	Page 4-5
<ul style="list-style-type: none"> Project planning and basic setting of the drive system have been carried out. 	Test run	Page 4-17

4.2 Serial commissioning

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

If you already have a complete data set, skip the paragraphs headed “Save data set from device to file.” (with DRIVEMANAGER, steps 1-4) and “Saving a data set to a SmartCard” (with KEYPAD).

A test run is essential, see section 4.4.



Note: Different units (Hz; rpm) can be selected for speed setpoint and actual values (see section 4.3.1). When downloading a data set to a device, it is only accepted if the preset unit in the data set matches the current unit setting in the device. Devices are shipped with rpm as the unit by default. The unit cannot be changed on the KEYPAD; the DRIVEMANAGER must be used (see section 4.3.1).

4.2.1 Serial commissioning with DRIVEMANAGER

Preconditions:







- All high-frequency drive controllers are fully connected.
- The **first** drive is already fully commissioned into operation.
- A PC with the DRIVEMANAGER user software (V3.50 or higher) installed is connected to the HF drive controller via the RS232 interface.

Save data set from device to file.

Download data set from file into device.

Remember to save the setting.



Step	Action	Comments
1	Connect your PC to the HF drive controller of the first drive and switch on the power to the the HF drive controller.	Use a standard serial cable (9-pin D-SUB, socket/pin) e.g. LTI accessory CCD-SUB90x .
2	Start DRIVEMANAGER. If the connection fails, check the bus settings on the Communication > Bus Configuration menu and try again by clicking on the icon. 	Automatically connects to the linked HF drive controller.
3	Save the current settings by clicking on the icon  , either in the parameter database (directory: c:/../userdata) of the DRIVEMANAGER or on a storage device such as a SmartCard.	Clicking on the icon always saves the current settings of the connected device. Give the file a name of your choice. If you are using the “Positioning, fully programming” preset, also save the positioning programs and data. ¹⁾ 1) For details of save operation see Section 4.3.8.
4	Disconnect with 	
5	Connect your PC to the high-frequency drive controller of the next drive and switch on the power to the HF drive controller.	
6	Click on the icon  to make a connection between the DRIVEMANAGER and the newly connected device.	
7	Choose the icon  to load the data set saved in step 3 into the device (select all files).	The data set is stored in the device. The selection box shows all the stored files in the data set.
8	Save the setting by clicking on the “Save setting in device” button. 	

Repeat steps 5 ... 8 on each additional HF drive controller.

Note: For more information refer to the DRIVEMANAGER manual.

4.2.2 Serial commissioning with KEYPAD



Note: Serial commissioning with KEYPAD is not possible with a position controlled **preset solution**.

Preconditions:

- All high-frequency drive controllers are fully connected.
- The **first** drive is already fully commissioned into operation.

By choosing Save from the main menu the edited parameters can be definitively saved. The data set can be saved in the drive controller, in the KeyPAD or on the SC-XL SmartCard.

For serial commissioning, the data set stored in the KeyPad can be loaded into any other drive controller. No SmartCard SC-XL is necessary for this copy operation.



Note: For more information on the KeyPad KP300 refer to the Operation Manual (ID no.: 1080.00B.X-XX).

4.3 Initial commissioning



DRIVEMANAGER

Connect

or:

Communication > Connect...

Preconditions:

- The HF drive controller is fully connected; see Section 3.
- DRIVEMANAGER version V3.50 or higher installed.
- Device is connected to PC via RS232 interface (X4).

Attention: Never wire or disconnect electrical connections while they are live!
Before working on the device disconnect the power. Wait for the DC-link capacitors to discharge. Work may only be carried out on the device when the residual voltage (between terminals L+ and L-) is below 60 V!

Connect input ENPO = Low level at terminal 7 (X2) to prevent unintentional startup of the motor (power stage disabled, high-frequency drive controller power on).

Preparations:

- Power up the CDS4000 high-frequency drive controller
- Start the DRIVEMANAGER
- Connect to the device



DRIVEMANAGER
CDS4000 Setup

or:

Active device > Change settings

Open the “CDS4000 Setup” function window:

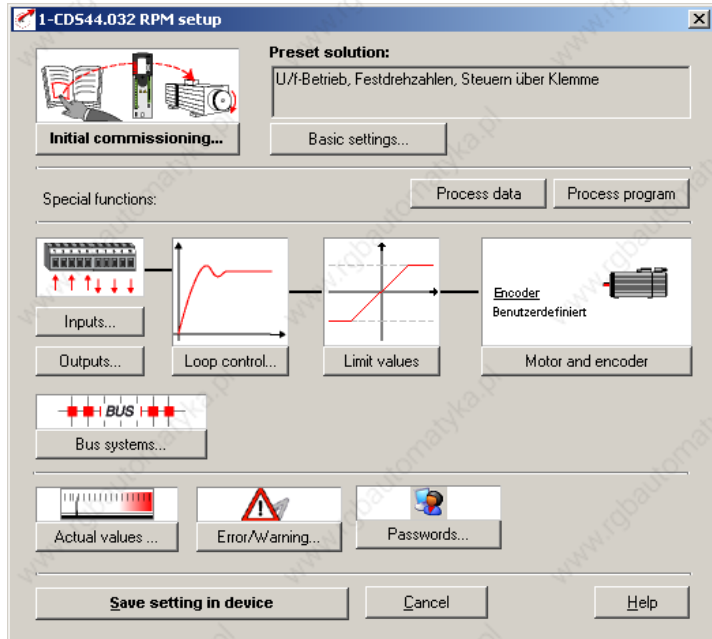
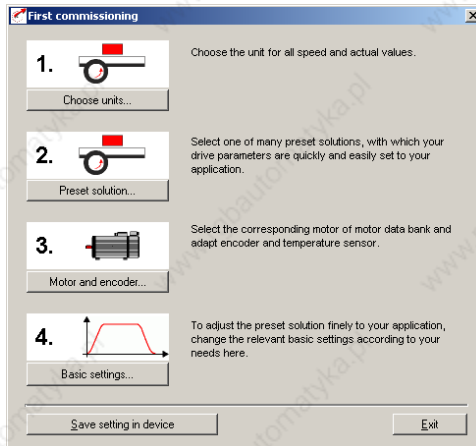


Figure 4.1 Function window in DRIVEMANAGER.

Continue with:



4.3.1 Selecting a unit for speed values

The CDS4000 offers the option to evaluate all speed setpoint and actual values in the units [Hz] or [rpm].

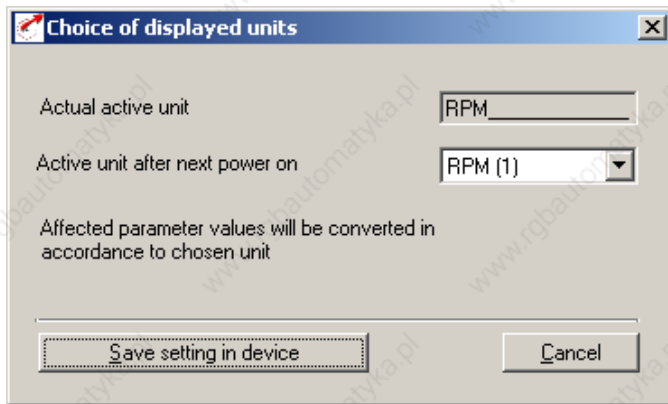


Figure 4.2 Select display units

Under “Select display units” the desired unit can be set. All affected parameters are converted to the newly selected unit.



Note: The display unit should be selected when starting initial commissioning. Changing it subsequently may lead to errors.

4.3.2 Selecting a preset solution

Preset solutions

The preset solution is selected according to the type of drive task. A preset solution is a presetting of the drive controller which can subsequently be adapted to the application.

The CDS4000 high-frequency drive controller provides a wide range of preset solutions, each described briefly in the DRIVEMANAGER. The application preset by a preset solution can optionally be controlled via the control terminals or over a field bus.

The preset solutions are:

- Torque control, ± 10 V setpoint (TCT_1)
- Speed control with external position control (SCT_1)
- Speed control, ± 10 V setpoint (SCT_2, SCB_2)
- Speed control, fixed speeds (SCT_3, SCB_3)
- Speed control, pulse input (SCT_4, SCB_4)
- Speed control, setpoint and control via field bus (SCB_5)
- Electronic gearing (PCT_1, PCB_1) (in preparation)
- Positioning via field bus (PCB_2)
- Positioning, fixed positions (PCT_3, PCB_3)
- Positioning, fully programmable (PCT_4, PCB_4)

With the DRIVEMANAGER the desired preset solution can be selected and modified.

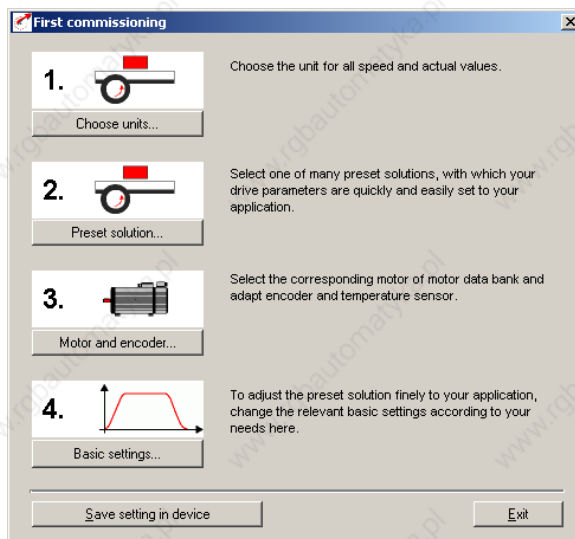
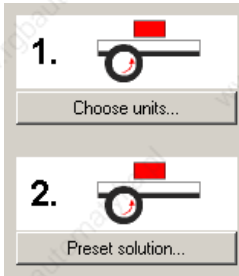


Figure 4.3 Initial commissioning



Select the preset solution matching your application. The various screens list the application and functional features offered by the individual solutions.

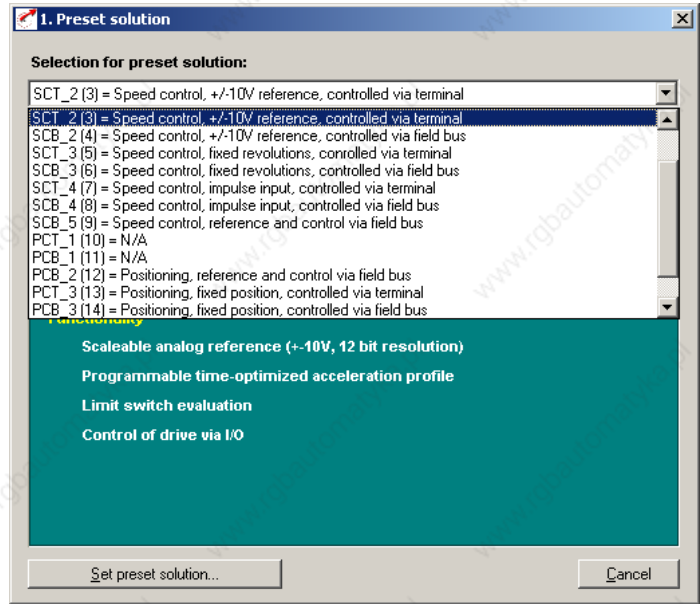


Figure 4.4 Selection of preset solution



Note: For detailed information on preset solutions and on terminal assignment refer to the CDD3000 Application Manual.

4.3.3 Setting the motor and encoder

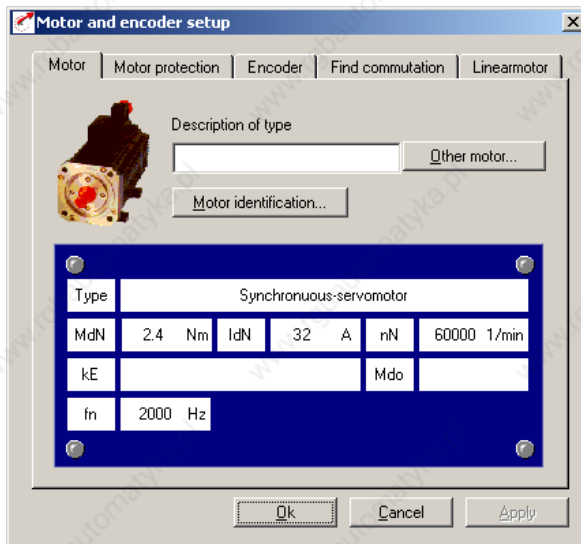
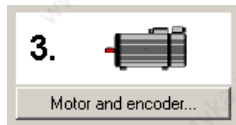


Figure 4.5 Motor and encoder setup

Setting the motor data

A database is available containing the settings for all LTi DRiVES motors. Using the correct motor data set ensures

- that the electrical parameters of the motor are correctly set,
- that the motor protection ("Motor protection" tab) is correctly set and
- that the control circuits of the drive are preset.



Note: The torque controller is set up optimally, so no further adjustments are necessary. The setting of the speed controller is based on the assumption that the machine moment of inertia reduced onto the motor shaft is equal to the motor moment of inertia. The speed and position controllers offer a high degree of damping, and so are also suitable for loop control of elastic mechanisms.

For special settings to optimize the speed and position control loops, please use the CDD3000 Application Manual.

Click on the "Different Motor" button on the "Motor" tab to select the right motor from your installed database. If the motor data set is supplied on a data carrier (floppy disk, CD-ROM), it can be loaded directly by clicking on the "Different Directory" button.

If you are using a motor which is not in the database, LTI DRiVES offers custom data sets as a special service. Please consult your project engineer on this.

Setting of the encoder

The encoder connected to the motor is set up on the Encoder tab. Resolvers are assigned the abbreviation Rx, encoders Gx. The encoder used is entered on the motor rating plate.

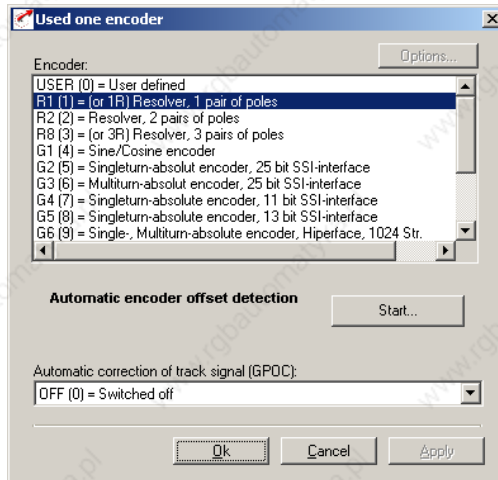


Figure 4.6 Selecting an encoder

Example:

Type ASM-11-20**R23** specifies the setting by the designation **R2** (resolver, 2 pole pairs), here shown in bold as an example.

When selecting a user-defined encoder type, the settings are entered under “Options...”.

The automatic track signal correction enhances the smooth running of the drive. It can be applied with values stored once on the basis of a teach-in process, or in online adaptive mode.

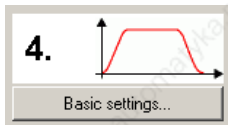
For more information on setting up user-defined encoders and on automatic track signal correction refer to the CDD3000 Application Manual.

Checking the encoder

To check the encoder the motor shaft is rotated by hand. The viewing angle when checking is from the front onto the shaft end (flange). The “CDS4000 setpoint and actual values” status display, under “ n_{act} [rpm]”, must indicate a positive speed in clockwise rotation and a negative speed in counter-clockwise rotation. If the speed is incorrect, the following points must be checked (see also section 3.3.4):

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

4.3.4 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 CDD3000 Application Manual.

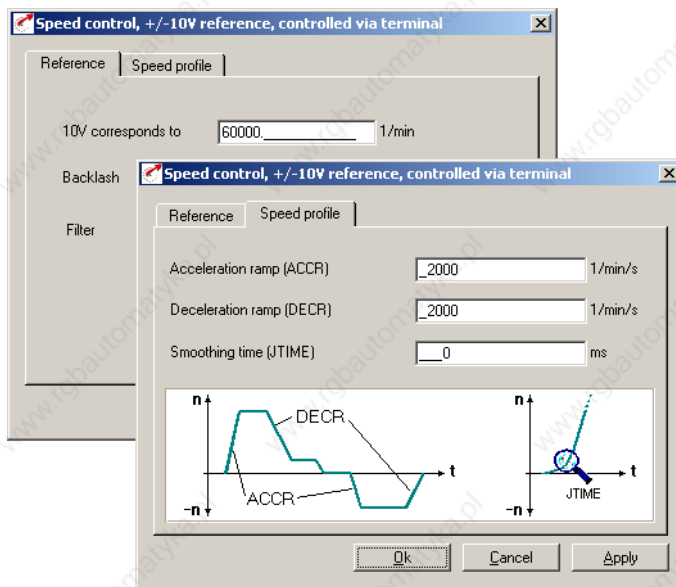


Figure 4.7 Making basic settings

4.3.5 Setting function parameters

Once the preset solution, its basic settings and the motor data have been set, general function settings can also be made.

In contrast to the basic settings, the functions are independent of the preset solution.

Example:

Setting “max. torque”

The required functions, such as the maximum torque, can be programmed using the DRIVEMANAGER. When you select “Limit values”:

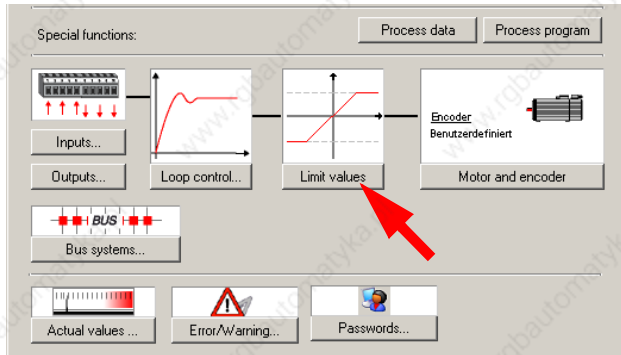


Figure 4.8 Parameter setting

This window opens up:

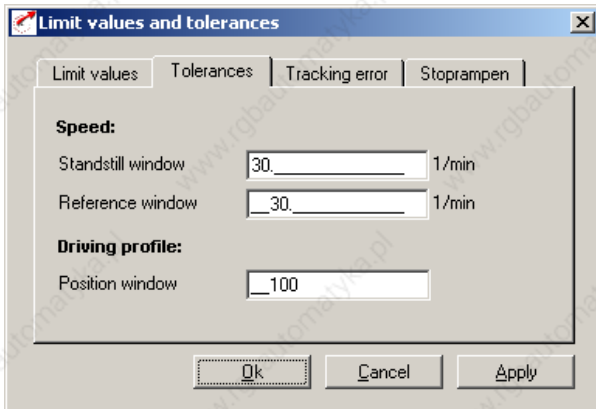


Figure 4.9 Limit values and tolerances

The maximum torque can be set on the “Limit values” tab.

4.3.6 Safety functions

Check the safety-related parameters.

Under the “Limit values” function, in addition to the max. torque you can also enter limit values for the max. speed or overspeed threshold.

Also check the motor protection data in the “Motor and encoder” function. In the “Motor protection” window you can set the warning and maximum temperatures of the motor sensor (KTY).

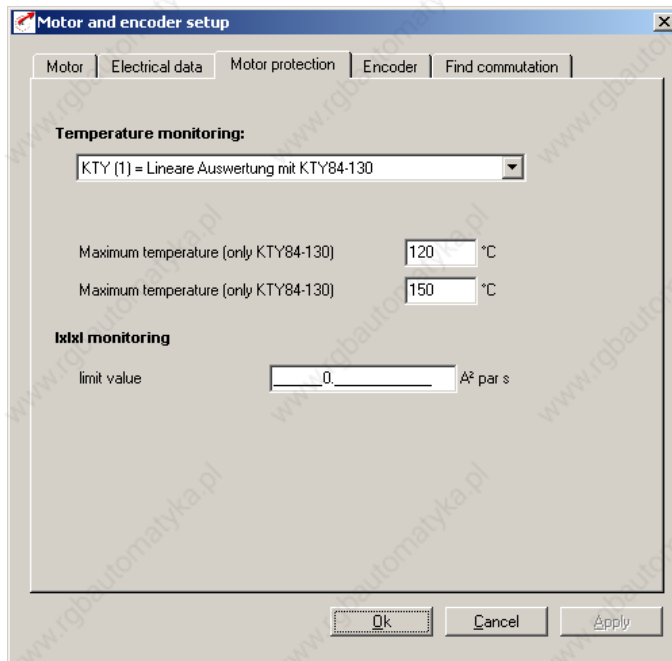


Figure 4.10 Motor protection

4.3.7 Switching frequency

In high-frequency applications the switching frequency of the power stage should be at least 10 times the output frequency.

The switching frequency can be selected under “Closed-loop control - Power stage”. Take account of the overload capability of the power stage at the various switching frequencies (see Appendix A.1).

4.3.8 Saving the settings



DRIVEMANAGER
CDS4000 Setup or:
Active device >

Change settings

Saving the settings in the device

Any changes which are to be stored permanently in the device must be saved by way of the *CDS4000 setup* screen.



The changes made can also be saved to a file.



DRIVEMANAGER
CDS4000 Setup
or:

Active device > Save device
settings to > file

Saving the settings to a file

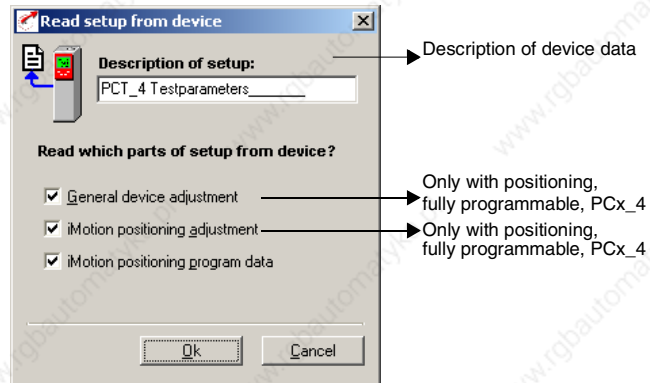


Figure 4.11 Save settings to file

Depending on the preset solution, the CDS4000 has a range of data sets which together form the device configuration.

Save ...	Necessary with preset solution	With KEYPAD TO SMARTCARD	With DRIVEMANAGER in file
Device data (= "Settings") (device settings and motor data)	All	Yes	Yes (*.00D), (*.00T), (*.00X)
Positioning data (variables, flags and table position of sequence control)	Positioning, fully programmable (PCT_4 PCB_4)	No	Yes (*.01D), (*.01T), (*.01X)
Sequence programs	Positioning, fully programmable (PCT_4 PCB_4)	No	Yes (*.prg)

Choose the file name (e.g. mydata). Then the data sets are selected depending on the preset solution. All files are saved under the chosen file names (e.g. mydata) with the appropriate extension (*.00D). The device data can be assigned a description prior to saving.

Continue with: "Test run", see section 4.4.

4.4 Test run

The drive is tested without the coupled mechanism. The test run is carried out in speed controlled mode, independently of the chosen preset solution.

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



Attention: Test run with installed motor:

In this case it must be ensured that the test does not damage the system! In particular, pay attention to the positioning range limits.

Please note that you yourself are responsible for safe operation. LTI DRIVES GmbH cannot be held liable for any damage incurred.

Danger to life from uncontrolled rotation!

Before motors with a feather key at the shaft end are commissioned, the feather key should be secured against being ejected, if this cannot be prevented by drive elements such as pulleys, couplings, or the like.

Preset solution, torque control:

In this preset solution the drive must not be run without load torque, otherwise the motor shaft would accelerate uncontrolled up to the preset speed limit.



Attention: Destruction of the motor:

Surface temperatures above 100 °C may occur on motors. Temperature-sensitive items should therefore not be placed on top of or attached to the motors. Protective measures may be needed to prevent touching.

The temperature sensor installed in the winding must be connected to the high-frequency drive controller in order to prevent overheating of the motor without temperature monitoring.

The brake (if installed) should be checked for fault-free functioning before installation of the motor.

The optionally installed standstill holding brake is only designed for a limited number of emergency braking operations. Use as a working brake is prohibited.

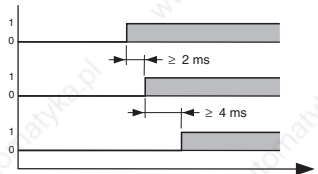
1. Set ENPO power stage enable

High level at terminal 7 (X2)

ENPO input

Start input

Device status: "Loop control active"



Pay attention to the time response of the inputs.

2. Control with DRIVEMANAGER:

Set the ENPO input, select "Speed control" and start the drive, e.g. with setpoint value 100 rpm.



DRIVEMANAGER
Open-loop control

or:

Active device > Open-loop control > Basic operation modes

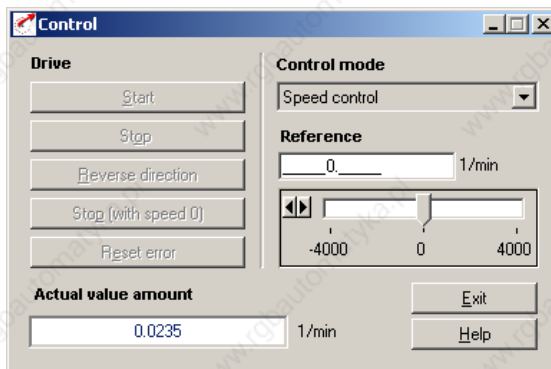


Figure 4.12 Controlling the device with the DRIVEMANAGER



DRIVEMANAGER
Digital scope

or:

Active device > Monitoring >
Quickly changing digital scope
values

Check the drive response

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

Select the following four recording variables:

- 0: Speed: Setpoint
- 1: Speed: Actual
- 2: Torque: Setpoint
- 3: Torque: Actual

Trigger condition:

Channel 0; rising edge, pretrigger 10 %; level: 30 rpm

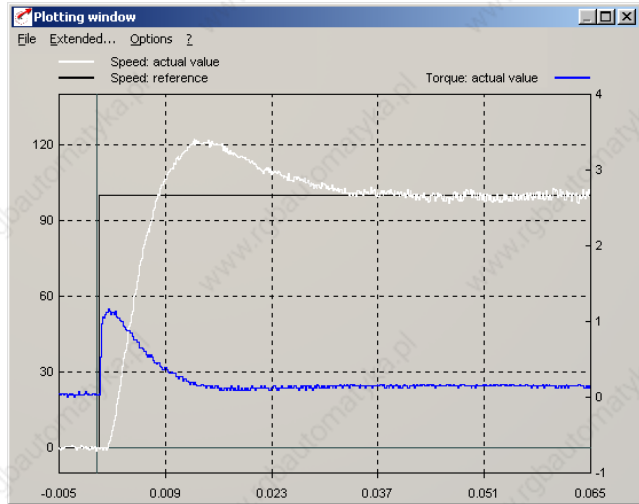


Figure 4.13 Triggering

Start the drive with a setpoint value of 100 rpm for example.

Compare the step response of your drive with the diagram. With resolvers the overshoot of the actual speed should be around 20 %; with sin/cos incremental encoders around 30 % (referred to the setpoint value). Make sure the drive system exhibits small signal response (the torque setpoint value must be less than the maximum).

If the torque setpoint 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 more or less matches the diagram, you can be sure that the motor phases are correctly wired, the encoder is correctly connected, and the CDS4000 parameters are set to the correct motor.

If the step response deviates severely from the diagram, it is to be assumed that

- the motor data set was selected incorrectly or
- the cabling is faulty.

Check the individual steps from Section 3 “Electrical installation” and Section 4.3 “Initial 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 CDD3000 Application Manual.

4.5 Operation with DRIVEMANAGER

Precondition:

DRIVEMANAGER user software (version V3.50 or higher) installed on the PC.

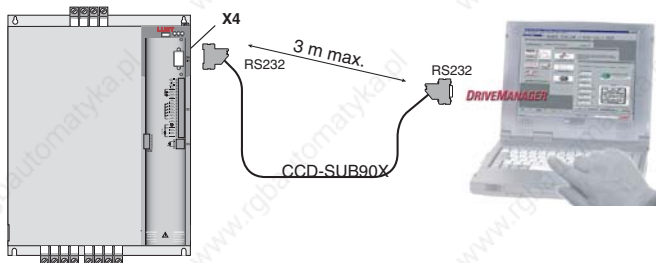


Figure 4.14 CDS4000 connection to PC






High-frequency drive controller connection to PC/DRIVEMANAGER

The key functions



For more information refer to the DRIVEMANAGER Manual.

Icon	Function	Menu
	Connect to device	Communication > Connect > Single device
	Change device settings	Active device > Change settings
	Print parameter data set	Active device > Print settings
	Control drive	Active device > Open-loop control > Basic operation modes, no position setpoints
	Digital scope	Active device > Monitoring > Quickly changing digital scope values

Icon	Function	Menu
	Save settings from device to file	Active device > Save device settings to
	Load settings from file into device	Active device > Load device settings from
	Bus initialization (change settings)	
	Disconnect from device	Cut all device connections
	Compare device settings	Active device > Compare settings

4.6 Operation with KEYPAD



Note: For information on the KeyPad KP300 refer to the Operation Manual (ID no.: 1080.00B.X-XX).

1

2

3

4

5

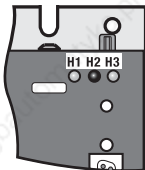
A

EN

5 Diagnosis/Troubleshooting

5.1	LEDs	5-1
5.2	Error reaction	5-2
5.3	Error messages	5-3
5.4	Resetting errors	5-5
5.5	User errors in KEYPAD operation	5-6
5.6	User errors in SMARTCARD operation	5-6
5.7	Errors in power switching	5-6
5.8	Reset	5-6

5.1 LEDs



At the top right of the high-frequency drive controller there are three status LEDs coloured red (H1), yellow (H2) and green (H3).

Device status	Red LED (H1)	Yellow LED (H2)	Green LED (H3)
Power on	○	○	●
High-frequency drive controller ready (ENPO set)	○	●	●
Control enabled	○	*	●
Error	* (flash code)	○	●
Warning (in "ready" condition)	●	●	●
Warning (in "control enabled" condition)	●	*	●

○ LED off, ● LED on, * LED flashing

5.2 Error reaction

When an error occurs the high-frequency drive controller responds with a specific function sequence. This is allocated to a corresponding **reaction number**.

KEYPAD Display	Reaction no.	Function
WARN	0	Signal error only, no further response (warning)
STOPD	1	Activate quick stop, disable power stage and secure against restarting.
STOP	2	Signal error and disable power stage
STOP	3	Signal error, quick-stop and wait for cancellation of start signal
LOCKH	4	Signal error, disable power stage and secure against restarting ¹⁾
LOCKS	5	Signal error, quick-stop, wait for cancellation of start signal and secure against restarting ¹⁾
RESET	6	Signal error, disable power stage and wait for error reset; error reset only possible by complete cutting of power.

1) Only relevant with programmed autostart function.

5.3 Error messages

If an error occurs in operation it is indicated by a flash code from LED H1 (red) on the high-frequency drive controller. If a KP200 is connected the KP200 indicates the error type as an abbreviation. When the DRIVEMANAGER is active the error is additionally reported in plain text.

Flash code of red LED H1	KEYPAD Display	Reaction No.	Explanation	Cause/Remedy
1x	Various messages	0-5	Various errors	See CDD3000 Application Manual, Appendix B, Troubleshooting.
2x	E-OFF	1	Undervoltage shut-off	Check power supply. Also occurs briefly in response to normal power-off.
3x	E-OC	3	Current overload shut-off	Short-circuit, ground fault: Check cabling of connections, check motor coil, check neutral conductor and grounding (see also section 3, Installation). Device setup not correct: Check parameters of control circuits. Check ramp setting.
4x	E-OV	3	Overvoltage shut-off	Voltage overload from mains: Check mains voltage. Restart device. Voltage overload resulting from feedback from motor (regenerative operation): Slow down braking ramps. If not possible, use a braking resistor.
5x	E-OLM	3	Motor protection shut-off	Motor overloaded (after I x t monitoring): Slow down process cycle rate if possible. Check motor dimensioning.
6x	E-OLI	3	Device protection shut-off	Device overloaded: Check dimensioning. Possibly use a larger device.
7x	E-OTM	3	Motor temperature too high	Motor PTC correctly connected? Motor PTC evaluation correctly set? Motor overloaded? Allow motor to cool down. Check dimensioning.
8x	E-OTI	3	Overheating high-frequency drive controller	Ambient temperature too high: Improve ventilation in switch cabinet. Load too high during driving/braking: Check dimensioning. Possibly use a braking resistor.

Table 5.1 Error messages

Helpline

If you have any technical queries about project planning or commissioning of the drive device, please contact our Helpline.

You can reach us:

Mon.-Thur.: 8 a.m. - 4.30 p.m.

Fri.: 8 a.m. - 4 p.m.

Tel.: +49 (0) 6441/966-180

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

E-mail: helpline@lt-i.com

Service/Repairs

If you need further assistance we - the LTI Service specialists - will be glad to help.

You can reach us:

Mon.-Thur.: 8 a.m. - 4.30 p.m.

Fri.: 8 a.m. - 4 p.m.

Tel.: +49 (0) 6441/966-171

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

E-mail: service@lt-i.com

5.4 Resetting errors

Resetting errors (after eliminating the cause)

Starting the drive after an error

Resetting errors with reaction number 1 to 4 (WRN-LOCKS):

- In control via terminals: rising edge at **input ENPO** (Attention: control is shut off!) or: with input Ixxx, to which the function Flxxx = RSERR (Reset Error) is assigned
 - In control via KEYPAD: press **stop/return** key on KEYPAD for approx. 3 seconds
 - In control via DRIVEMANAGER: click on "Reset error" button
 - In control via field bus: set "Reset error" bit in bus control word
-
- Cancel start signal and reapply it.
 - With programmed auto-start function:
 - In error reactions 1 and 2 the drive automatically restarts when the error is reset.
 - In error reactions 3 and 4 the drive does not restart until the start signal has been withdrawn and re-sent.

Resetting errors with reaction number 5 (RESET):

Errors with reaction number 5 (RESET) are serious device errors. They can only be reset by switching all supply voltages (mains, possibly 24 V) off and back on again.

5.5 User errors in KEYPAD operation

See KP300 Operation Manual, ID no.: 1080.00B.X-XX

5.6 User errors in SMARTCARD operation

See KP300 Operation Manual, ID no.: 1080.00B.X-XX

5.7 Errors in power switching

Error	Cause	Remedy
Power on. High-frequency drive controller shows no response (LEDs off).	If switching is too frequent, the device protects itself by means of high-resistance isolation from the system.	After a rest phase of a few minutes the device is ready to start once again.

5.8 Reset

In the DRIVEMANAGER:

In the focused setup window by pressing the F1 key. The factory setting of the parameter is indicated on the "Value range" tab and is to be entered there.

Factory setting

Reset to factory settings of drive controller and KEYPAD:

Switch on the power supply and at the same time press the cursor keys \leftarrow and \rightarrow .

DRIVEMANAGER:

Select the "Reset to factory setting" function from the "Active device" menu.



Note: Important! Resetting the factory defaults will delete the motor data settings and the preset solution "SCT_2-Speed control, ± 10 V setpoint, control via terminal" will be loaded. Pay attention to the terminal assignment and the functionality of the high-frequency drive controller in this preset solution.

A Appendix

A.1	Technical data	A-2
A.2	Ambient conditions	A-4
A.2.1	Transportation	A-4
A.3	Mechanical conditions	A-5
A.3.1	Transportation	A-5
A.4	Change in system load through use of a line reactor	A-7
A.5	UL approbation	A-9

A.1 Technical data

CDS44.017 to CDS44.072

Designation	CDS44.017	CDS44.032	CDS44.072
Technical data			
Output, motor side			
Device rated power	11.8 kVA	22.2 kVA	50 kVA
Voltage	3 x 0 ... 400/460 V		
Continuous current (RMS) (I_N) to $T_U = 45\text{ °C}$	16 A	32 A	72 A
Continuous current (RMS) (I_N) to $T_U = 55\text{ °C}$	16 A	32 A	55 A
Peak current for 30 s at T_U to 45 °C	26 A ($1.6 \times I_N$) ¹⁾ 21 A ($1.3 \times I_N$) ²⁾	51 A ($1.6 \times I_N$) ¹⁾ 41 A ($1.3 \times I_N$) ²⁾	87 A ($1.2 \times I_N$) ¹⁾ 79 A ($1.1 \times I_N$) ²⁾
at T_U to 55 °C	$1.0 \times I_N$		
Rotating field frequency	0 - 4000 Hz		
Switching frequency of power stage	16, 32, 64 kHz		
Input, mains side			
Mains voltage	3 x 460 V -22 % +10 %		
Current (with line reactor)	17,9 A	33,7 A	76 A
Frequency	50/60 Hz $\pm 10\%$		
Power loss at 32 / 64 kHz [W]	345 / 340	650 / 900	1100 / 1500
Braking chopper power electronics			
Peak braking power with int. braking resistor (only with version CDS44 ..., W, BR)	6.0 kW at 90 Ω		No internal braking resistor
Minimum ohmic resistance of an externally installed braking resistor	47 Ω	22 Ω	12 Ω
1) power stage clock frequency 16/32 kHz 2) Power stage clock frequency 64 kHz			

The maximum permissible controller output current and the peak current of the servocontroller are dependent on the mains voltage, the motor cable length, the power stage switching frequency and the ambient temperature. If the conditions change, the maximum permissible current capacity of the high-frequency drive controllers also changes. For details of which current load on the power stage modules is permissible under which changed background conditions, refer to the following characteristic diagrams and tables.

Current capacity of HF drive controllers

(1) Continuous

(2) Intermittent* > 5 Hz rotating field frequency

HF drive controller 17 A to 32 A:

$I/I_N = 1.3$ (for 30 s at 64 kHz)

$I/I_N = 1.6$ (for 30 s at 32 kHz)

HF drive controller 72 A:

$I/I_N = 1.1$ (for 30 s at 64 kHz)

$I/I_N = 1.2$ (for 30 s at 32 kHz)

(3) Intermittent* 0 to 5 Hz rotating field frequency

HF drive controller 17 A to 32 A:

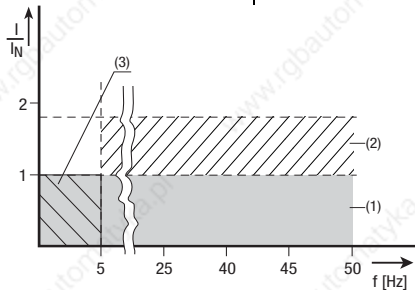
$I/I_N = 1.0$ (for 30 s at 64 kHz)

$I/I_N = 1.0$ (for 30 s at 32 kHz)

HF drive controller 72 A:

$I/I_N = 1.0$ (for 30 s at 64 kHz)

$I/I_N = 1.0$ (for 30 s at 32 kHz)



*Intermittent $I_N > I_{\text{eff}}$
$$I_{\text{eff}} = \sqrt{\frac{1}{T} \cdot \sum_{i=1}^n I_i^2 \cdot t_i}$$

A.2 Ambient conditions

Climatic conditions

Transportation

EN 61800-2, IEC60721-3-2 class 2K3	
Temperature:	-25 °C to +70 °C
Relative air humidity	95 % at +40 °C



Note: In IEC60721-3-2 class 2K3 the absolute air humidity is limited to a maximum of 60 g/m³. That means, for example, that at 70 °C the relative air humidity may be a maximum of 40 %.

Storage

EN61800-2, IE 60721-3-1 class 1K3 (Relative humidity) and 1K4 (Temperature)	
Temperature:	-25 °C to +55 °C
Relative air humidity	5 to 95 %



Note: In IEC60721-3-1 class 1K3 the absolute air humidity is limited to a maximum of 29 g/m³. So the maximum values for temperature and relative air humidity stipulated in the table must not occur simultaneously.

Operation

EN61800-2, IEC60721-3-3 class 3K3	
Temperature:	+5 °C to +40 °C
Relative air humidity	5 to 85 % without condensation



Note: Devices operable up to $T_a = 55$ °C, for derating see A1. In class 3K3 the absolute air humidity is limited to 25 g/m³, i.e. at $T_a = 55$ °C the relative humidity may be max. 25 %.



Note: In IEC60721-3-3 class 3K3 the absolute air humidity is limited to a maximum of 25 g/m³. That means that the maximum values for temperature and relative air humidity stipulated in the table must not occur simultaneously.

A.3 Mechanical conditions

Transportation

Vibration limits in transportation

EN61800-2, IEC60721-3-2 class 2M1		
Frequency / Hz	Amplitude / mm	Acceleration m/s ²
$2 \leq f < 9$	3,5	Not applicable
$9 \leq f < 200$	Not applicable	10
$200 \leq f < 500$	Not applicable	15

Shock limit in transportation

EN61800-2, IEC60721-3-2 class 2M1
Maximum drop height of the packed device 0.25 m.

Vibration limits of the system in operation



Note: The devices are only designed for stationary use

EN61800-2, IEC60721-3-3 class 3M1		
Frequency / Hz	Amplitude / mm	Acceleration m/s ²
$2 \leq f < 9$	0,3	Not applicable
$9 \leq f < 200$	Not applicable	1

For the detailed specifications refer to the standards listed in this section:

EN61800-2 Adjustable speed electrical power drive systems.
 Part 2: General requirements - Specifications for low-voltage adjustable frequency ac power drive systems.

IEC60721-3-1 Classification of environmental conditions.
 Part 3: Classification of groups of environmental parameters and their severities
 Section 1: Storage

IEC60721-3-2 Classification of environmental conditions.
 Part 3: Classification of groups of environmental parameters and their severities
 Section 2: Transportation

IEC60721-3-3 Classification of environmental conditions.
 Part 3: Classification of groups of environmental parameters and their severities
 Section 3: Stationary use at weather-protected locations

Characteristic		High-frequency drive controller
Protection	Device	IP20 (NEMA 1)
	Cooling method	Water cooling: IP20 Air cooling: IP20
Touch protection		BGV A3
Mounting height		To 1000 m above MSL, over 1000 m above MSL with power reduction 1 % per 100 m, max. 2000 m above MSL
Max. holding brake current 2 A to $T_U = 45\text{ }^\circ\text{C}$, derating 50 mA/ $^\circ\text{C}$ to $T_{Umax} = 55\text{ }^\circ\text{C}$		
Voltage load on the motor winding		Typical voltage steepness 3 - 6 kV/ μs

Technical data – Water cooling	
Max. inlet temperature	50 °C
Min. inlet temperature	> Ambient temperature
Min. volumetric flow	4 l/min
Max. pressure	6 bar
Connection	3/8" inside thread, flat-sealing

A.4 Change in system load through use of a line reactor

System load

	Without line reactor	With line reactor	Change
	7.3 kVA high-frequency drive controller, mains impedance 0.6 mH	7.3 kVA high-frequency drive controller, mains impedance 6 mH	Without line reactor compared to with line reactor
Voltage distortion (THD) ¹⁾	99 %	33 %	-67 %
Mains current amplitude	18.9 A	9.7 A	-48 %
Mains current effective	8.5 A	6.23 A	-27 %
Commutation notches referred to the mains voltage	28 V	8 V	-70 %
Service life of the DC link capacitors	Nominal life	2 to 3 times nominal life	+100 to 200 %

Change in system load through use of a line reactor with 4 % short-circuit voltage based on the example of a 7.3 kVA HF drive controller CDD34.010-HF operating in the part load range

1) THD = Total Harmonic Distortion ($U_5 \dots U_{41}$)

Mains voltage asymmetry

	Without line reactor			With line reactor		
	7.3 kVA high-frequency drive controller, mains impedance 0.6 mH			7.3 kVA high-frequency drive controller, mains impedance 6 mH		
Asymmetry of mains voltage	0 %	+3 %	-3 %	0 %	+3 %	-3 %
Mains current amplitude	18.9 A	25.4 A	25.1 A	9.7 A	10.7 A	11 A
Mains current effective	8.5 A	10.5 A	10.2 A	6.2 A	6.7 A	6.8 A

Effect of line reactor with asymmetric mains voltage based on the example of a 7.3 kVA HF drive controller CDD34.010-HF operating in the part load range



Recommended:

The example shows that the benefits of a line reactor with 4 % short-circuit voltage are multi-faceted. We therefore recommend that you use a line reactor as a matter of course.



Line reactors are required:

- Where the drive controller is used in applications with disturbance variables corresponding to environment class 3, as per EN 61000-2-4 and above (hostile industrial environment).
 - To comply with the limit values for adjustable-speed power drive systems (standard EN61800-3 / IEC1800-3; see section 3.8).
-

Characteristics of environment class 3 include:

- Mains voltage fluctuations $> \pm 10\% U_N$
- Short-time interruptions between 10 ms and 60 s
- Voltage asymmetry $> 3\%$

Environment class 3 typically applies where:

- a major part of the load is supplied by power converters (dc choppers or soft-start equipment),
- welding machines are present,
- induction or arc furnaces are present,
- large motors are started frequently or
- loads fluctuate rapidly.

A.5 UL approbation

Measures to maintain UL approbation

1. Switch cabinet mounting with IP54 protection and contamination level 2 is mandatory.
2. The devices may only be operated on systems of overvoltage category III.
3. Only UL listed fuses (UL 248) and switches (UL489) may be used. The power switches must be approved for "branch circuit protection".
4. The devices are operable in systems with a maximum power capacity of 5000 A, to 25,000 A.
5. The devices may only be operated on systems with earthed neutral points. Outer conductor voltage -> $M_p < 265 \text{ V}$.
6. The connecting cables (mains power, motor and control cables) must be UL approved.

CDS44.xxx: Min. 600 V cables (mains/motor), Cu 75° C min.

Device	CDS44.017	CDS44.032	CDS44.072
Cable cross-section	AWG12 N and M	AWG8 N and M	AWG2 N and M
Tightening torque of mains terminals	0.5 ... 0.6 Nm	1.2 ... 1.5 Nm	2.5 Nm
Tightening torque of protective conductor terminals	0.5 ... 0.6 Nm	1.2 ... 1.5 Nm	2.5 Nm
Fuse rating (max)	3 x 25 A	3 x 50 A	3 x 100 A
Fuse type to 5 kA (UL248)	H or K5	H or K5	RK1
Fuse type to 25 kA (UL248)	CC, G, J, R or T		RK1
Power switch (UL 489)	-	-	NZM N1 (Moeller or comparable)

Tabelle A.2 Cable cross-sections - mains (N), motor (M) and protection



Attention: The high-frequency drive controllers can typically be overloaded with $1.3 \times I_N$, or $1.1 \times I_N$ in the case of CDS44.072, for 30 seconds. The effective servo capacity utilization (I_{eff} , δI_N) must never be greater than I_N (rated current).

Minimum cross-section of the PE conductor to DIN VDE 0100 Part 540

Cross-section	PE mains connection
Mains power cable < 10 mm ²	PE conductor cross-section of at least 10 mm ² or lay a second electrical conductor parallel to the existing PE conductor, because the operational leakage current is > 3.5 mA.
Mains power cable > 10 mm ²	PE conductor with cross-section of mains power cable - see VDE 0100 Part 540

Table A.3 Minimum cross-section of the PE conductor

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Hinweis zur EN 61000-3-2 DE	Notes on EN 61000-3-2 EN
<p>(rückwirkende Netzbelastung durch Oberwellen) Unsere Frequenzrichter und Hochfrequenzantriebsregler sind im Sinne der EN61000 "professionelle Geräte", so dass sie bei einer Nennanschlussleistung $\leq 1\text{kW}$ in den Geltungsbereich der Norm fallen. Beim direkten Anschluss von Antriebsgeräten $\leq 1\text{kW}$ 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.</p>	<p>(limits for harmonic current emissions) Our frequency inverters and high-frequency drive controllers are "professional devices" in the sense of the European Standard EN 61000, and with a rated power of $\leq 1\text{kW}$ obtained in the scope of this standard. Direct connection of drive units $\leq 1\text{kW}$ 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.</p>

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