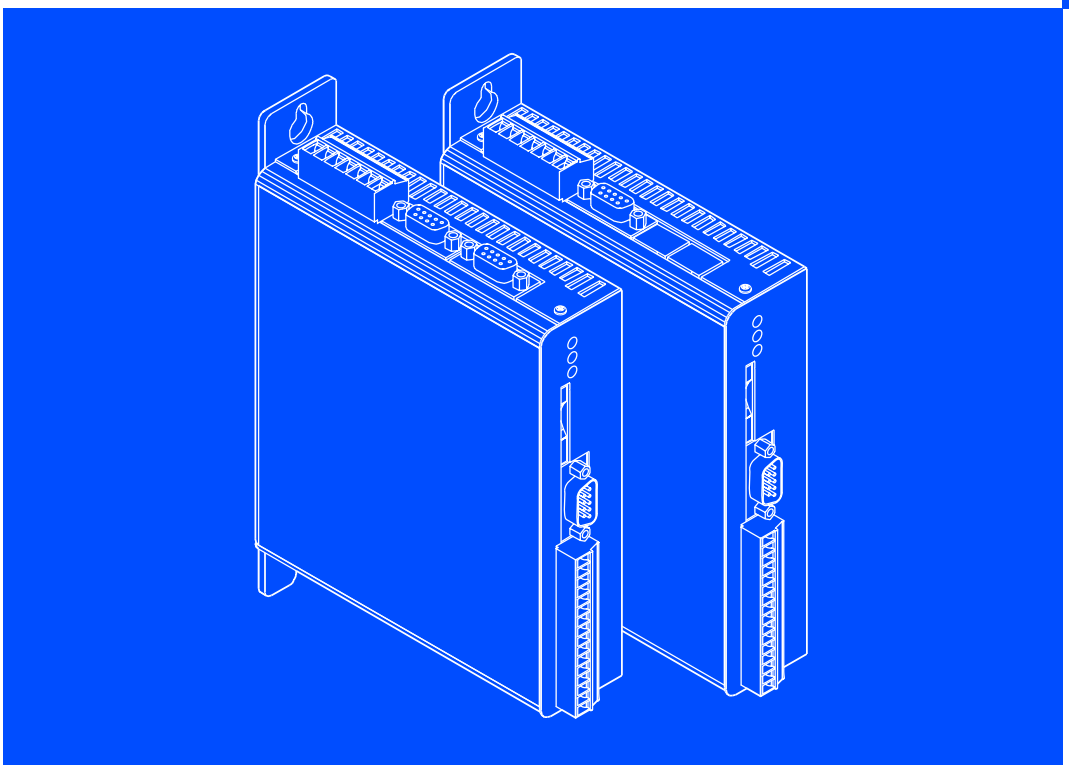
GHB 13.0001-EN
13232303

Hardware Manual



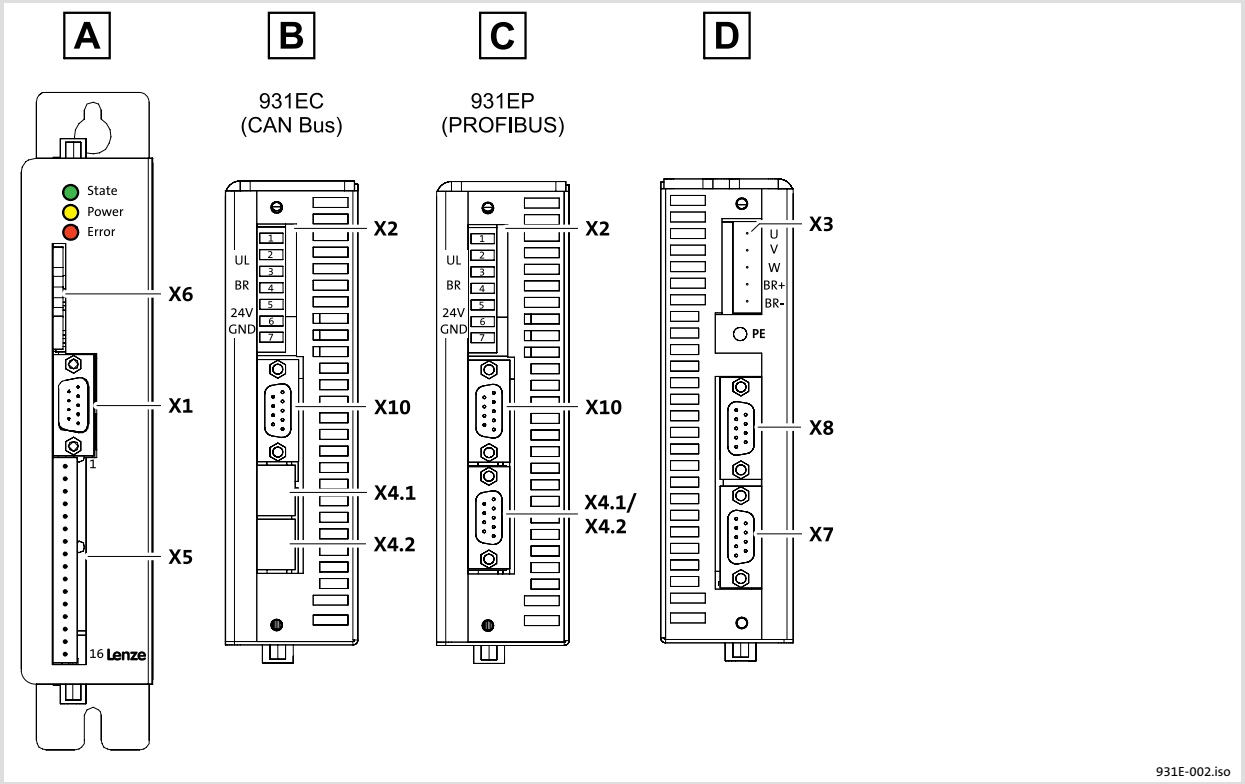
E931Ex

Servo inverters for extra-low voltages

Lenze

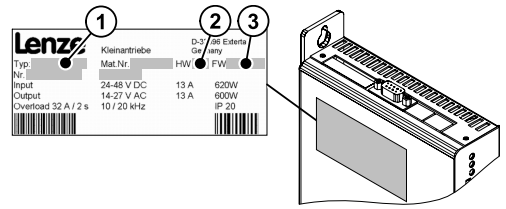
Please read these instructions before you start working!
Follow the enclosed safety instructions.

Overview



This documentation is valid for ...

931 ... servo inverters as of nameplate data:



931E_008

	①							②	③
	93	1	E	x	K	1	0	2.0	3.2

Product range

930

Size/power range

1 = up to 600 W

Design

E = built-in unit for IP 20 control cabinet

Communication

C = CAN bus integrated
P = PROFIBUS integrated

Voltage class

K = design for low voltage

Options

1 = with digital inputs and outputs
with analog inputs and outputs

Installation

0 = installation in control cabinet

Hardware version

Software version

Key for the overview

A View from the front	
Pos.	**Description**
X1	RS232
X5	Digital inputs and outputs / analog inputs and outputs
X6	Slot for multimedia memory card

B 931EC – View from above	
Pos.	**Description**
X2	Voltage supply
X4.1 X4.2	CAN interfaces
X10	Digital frequency interface

C 931EP – View from above	
Pos.	**Description**
X2	Voltage supply
X4.1/X4.2	PROFIBUS interface
X10	Digital frequency interface

D View from below	
Pos.	**Description**
X3	Motor connection
X7	Resolver input
X8	SinCos encoder input

LED	Colour	State	Note
State	Green	on	The control is correctly supplied by a 24 V control voltage, the drive is ready for operation.
		blinking	Data is written on or read from the memory card.
		off	No voltage
Power	Yellow	on	The power section is enabled, the motor is supplied with voltage. The drive works with the set control.
		off	The drive does not work, the output stage is inactive.
Error	Red	off	No fault
		blinking	Internal drive error [1)] After the cause of the error has been eliminated, you have to acknowledge the error message: ● Either by using the parameterisation software, or via an edge at DIN9 (controller enable). ● If no error is active anymore, the LED goes out.
	Green Yellow Red	on	● The drive is in the initialisation phase after the control voltage has been switched on. ● A new firmware is being installed.

1) Detailed description of the blink codes: 📖 40

Note!

The light-emitting diode ”Error” constantly blinks if a fault is active:

► It only displays one fault at a time.

► If several faults are active at the same time, the fault that occured first is displayed.

What is new, what has changed ?

Material No.	Version			Description
13232303	3.0	12/2007	TD35	Advanced by the 931EP (PROFIBUS) device variant
13058894	2.0	08/2005	TD09	Complete revision for the series
-	1.0	03/2003	LKA	Preliminary version

Tip!

Current documentation and software updates concerning Lenze products can be found on the Internet in the ”Services & Downloads” area under

http://www.Lenze.com

1 Preface and general information

1.1 About this Manual

Target group

This manual addresses to all persons designing, mounting, commissioning and setting the servo inverters of the 931 series.

Together with the catalogue, it presents the project documents for the mechanical engineer and the system engineer.

Contents

The manual complements the mounting instructions included in the scope of supply:

- The features and functions are described in detail.
- It provides detailed information on the possible applications.
- The parameter setting is clarified by examples.
- In case of doubt, the supplied mounting instructions always apply.

Finding information

- Via the contents and index, you quickly find the information regarding a specific problem.
- Descriptions and data with regard to other Lenze products can be gathered from the respective catalogues, Operating Instructions, and Manuals.
- You can request Lenze documentation from your responsible Lenze sales partner, or download it from the Internet as a PDF file.

1.2 Terminology used

Term	In the following text used for
Controller	931E servo inverter
Device	931E servo inverter
Drive	931E servo inverter with connected motor
SDC	»Small Drive Control« parameterisation software

1.3 Scope of supply

- ► 931E servo inverter
- ► Mounting instructions

After receipt of the delivery, check immediately whether the items delivered match the accompanying documents. Lenze does not accept any liability for deficiencies claimed at a later date.

Claim

- ► visible transport damage immediately to the forwarder.
- ► visible deficiencies / incompleteness immediately to your Lenze representative.

1.4 Legal regulations

Labelling	Nameplate	CE identification	Manufacturer
	Lenze drive controllers are definitely identified by the contents of the nameplate.	In compliance with the EC Low-Voltage Directive	Lenze GmbH & Co KG Kleinantriebe Postfach 10 13 52 D-31763 Hameln
Application as directed	**931E servo inverters** ● must only be operated under the operating conditions prescribed in these Instructions. ● are components – for open and closed loop control of variable speed drives with synchronous motors. – for installation in a machine – for assembly with other components to form a machine. ● are electric units for the installation into control cabinets or similar closed electrical operating areas. ● comply with the requirements of the Low-Voltage Directive. ● are not machines for the purpose of the Machinery Directive. ● are not to be used as domestic appliances, but only for industrial purposes. **Drive systems with 931E servo inverters** ● comply with the EMC Directive if they are installed according to the guidelines of CE-typical drive systems. ● can be used – for operation on public and non-public mains – for operation in industrial premises. ● The user is responsible for the compliance of his application with the EC Directives. **Any other use shall be deemed as inappropriate!**		
Liability	● The information, data, and notes in these instructions met the state of the art at the time of printing. Claims on modifications referring to controllers which have already been supplied cannot be derived from the information, illustrations, and descriptions. ● The specifications, processes, and circuitry described in these Instructions are for guidance only and must be adapted to your own specific application. Lenze does not take responsibility for the suitability of the process and circuit proposals. ● Lenze does not accept any liability for damage and operating interference caused by: – disregarding the Operating Instructions – unauthorised modifications to the drive controllers – operating errors – improper working on and with the drive controllers		
Warranty	● Terms of warranty: see Sales and Delivery Conditions of Lenze GmbH & Co KG Kleinantriebe. ● Warranty claims must be made to Lenze immediately after detecting the deficiency or fault. ● The warranty is void in all cases where liability claims cannot be made.		

2 Safety instructions

2.1 General safety and application notes for Lenze controllers

(in accordance with Low-Voltage Directive 2006/95/EC)

For your pesonal safety

During operation, Lenze controllers (frequency inverters, servo inverters, DC speed controllers) and their corresponding components can be live, moving and rotating according to their degree of protection. Surfaces can be hot.

Non-authorized removal of the required cover, inappropriate use, incorrect installation or operation creates the risk of severe injury to persons or damage to material assets.

Additional information can be obtained from the documentation.

High amounts of energy are released in the controller. Thus, it is required to always wear a personal protective equipment (body protection, headgear, eye protection, ear protection, hand guard).

All operations concerning transport, installation, and commissioning as well as servicing must be carried out by qualified, skilled personnel only (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC-Report 664 or DIN VDE 0110. National regulations for the prevention of accidents must be observed.).

According to this basic safety information, skilled personnel are persons who are familiar with the installation, mounting, commissioning, and operation of the product and who have the necessary qualifications for their occupation.

Application as directed

Drive controllers are components designed for the installation in electrical systems or machinery. They must not be used as household appliances. They are intended exclusively professional and commercial purposes according to EN 61000-3-2.

When installing the controllers into machines, commissioning (i.e. starting of operation as directed) is prohibited until it is certain that the machine complies with the regulations of EC Directive 98/37/EC (Machinery Directive). EN 60204 must be observed.

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with EMC Directive (89/336/EEC).

The controllers meet the requirements of the Low-Voltage Directive 2006/95/EC.

The technical data and information on the connection conditions can be obtained from the nameplate and the documentation. They must be followed in any case.

Warning: Drive controllers are products with restricted availability according to EN 61800-3. These products can cause radio interferences in residential areas. In this case, special measures are required.

Transport, storage

Please observe the notes on transport, storage and appropriate handling.

Observe the climatic conditions according to the technical data.

Installation

The controllers must be installed and cooled according to the instructions given in the corresponding documentation.

Ensure proper handling and avoid mechanical stress. Do not bend any component and do not change any insulation distance during transport or handling. Do not touch any electronic component or contact.

Controllers contain electrostatically sensitive components which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical component since doing so might endanger your health!

Electrical connection

When working on live controllers, the valid regulations for the prevention of accidents (e.g. VBG 4) must be observed.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross/sections, fuses, PE connection). Additional information can be obtained from the documentation.

The documentation contains information concerning installation in compliance with EMC (shielding, earthing, filter arrangement, and cable installation). These notes must also be observed for CE-marked controllers. The manufacturer of the system or machine is responsible for ensuring compliance with the limit values demanded by the EMC legislation. The controllers must be installed in housings (e.g. control cabinets) to comply with the limit values for radio interferences valid at the site of installation. The housings must enable an EMC-compliant installation. Make sure in particular that e.g. the control cabinet doors have a circumferential metal connection to the housing. Reduce housing openings and cutouts to a minimum.

Operation

If necessary, systems including controllers must be equipped with additional monitoring and protection devices according to the valid safety regulations (e.g. law on technical equipment, regulations for the prevention of accidents). You are allowed to adapt the controllers to your application. Please observe the corresponding information given in the documentation.

After the controller has been disconnected from the voltage supply, all live components and power connections must not be touched immediately because capacitors can still be charged.

All protection covers and doors must be kept shut during operation.

Maintenance and servicing

The controllers do not require any maintenance if the prescribed conditions of operation are observed.

If the ambient air is polluted, the cooling surfaces of the controller may contaminate, or the air vents of the controller may be blocked. Therefore, the cooling surfaces and air vents must be cleaned periodically under these operating conditions. Do not use sharp or pointed tools for this purpose!

Waste disposal

Recycle metal and plastic materials. Assembled PCBs must be disposed of professionally.

The product-specific safety and application notes given in these instructions must be observed!

2.2 Residual hazards

Protection of persons

After power-off, the power terminals UL, BR and GND still carry hazardous voltages for at least 3 minutes!

- ► Before working on the controller, check that no voltage is applied to the power terminals.
- ► Always protect the power terminals against contact.

The discharge current to ground (PE) is > 3.5 mA, according to EN 50178.

- ► If a fixed installation is required, design the PE conductor with a cable cross-section of at least 1.5 mm^2 or use a design with double PE conductor.

Make sure that cables are installed correctly, and that bolted connections and plug connections are faultless.

Due to the high currents with regard to low-voltage applications, current-carrying parts can be strongly heated.

Device protection

- ► Connect or disconnect all pluggable terminals in a deenergised state only!
- ► A cyclic connection and disconnection of the supply voltage can overload and destroy the input current limitation of the drive controller:
  - – When effecting a cyclic switching of the supply voltage over a longer period, the period between two switch-on processes at least has to be one minute!

Motor protection

Drive systems can reach dangerous overspeeds (e.g. setting of high field frequencies for motors and machines which are not qualified for this purpose):

- ► The controllers do not offer any protection against these operating conditions. Use additional components for this.

Protection of the machine/system

A missing or incorrect resolver adjustment can bring about undefined control states. The perfect operation is no longer guaranteed.

2.3 Definition of notes used

The following pictographs and signal words are used in this documentation to indicate dangers and important information:

Safety instructions

Structure of safety instructions:

Danger!

(characterises the type and severity of danger)

Note

(describes the danger and gives information about how to prevent dangerous situations)

Pictograph and signal word	Meaning
 **Danger!**	**Danger of personal injury through dangerous electrical voltage.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Danger!**	**Danger of personal injury through a general source of danger.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Stop!**	**Danger of property damage.** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph and signal word	Meaning
 **Note!**	Important note to ensure troublefree operation
 **Tip!**	Useful tip for simple handling
	Reference to another documentation

3 Technical data

3.1 General data and operating conditions

Conformity	CE	2006/95/EC	Low-Voltage Directive
Regulations	EN 61800-3	Interference level B	
Climatic conditions	Air humidity max. 90 % without condensation		
Cooling	Passively via housing surface and rear panel		
Admissible temperature range			
Transport	-25 °C... +70 °C		
Storage	-25 °C... +70 °C		
Operation	0 °C ... +50 °C	above +40 °C, reduce the power by 20 W/°C	
Permissible installation height	0 ... 1000 m amsl	above 1000 m amsl, reduce the rated output current by 5 %/1000 m	
Mounting position	Vertical		
Installation clearances			
above/below	≥ 100 mm		
sidewise	Directly alignable		
Monitoring	Overvoltage / undervoltage in the DC bus, overcurrent or short circuit of the output stage, motor temperature and output stage temperature, I^2xt-monitoring of the motor, encoder monitoring		
Type of protection	IP 20		
Inputs	6 digital inputs, 2 analog inputs (adjustable via software)		
Outputs	2 digital outputs, 2 analog outputs (adjustable via software)		
Memory cards	Multimedia card		

3.2 Rated data

Supply voltage				
Rated voltage	24V DC		48V DC	
Permissible range	19.2 V DC - 0 % ... 57.6 V DC + 0 %			
Supply current at rated power	approx. 13 A			
Max. supply current	35 A			
Rated power	310 W		620 W	
Efficiency	up to 95 %			
PWM frequency (switchable)	10 kHz	20 kHz	10 kHz	20 kHz
Rated output current	0 ... 13 A_{eff}	0 ... 10 A_{eff}	0 ... 13 A_{eff}	0 ... 10 A_{eff}
Output surge current for 2 s	32 A_{eff}	25 A_{eff}	32 A_{eff}	25 A_{eff}
Rated output voltage	0 ... 14 V_{eff}		0 ... 27 V_{eff}	
Output frequency	0 ... 200 Hz			
Control voltage [1)]	24 V DC ±20 %			
Control current	min. 0.25 A (control section only) max. 1.5 A (all outputs connected)			
Brake chopper switching threshold				
On	approx. 63 V DC			
Off	approx. 60 V DC			
Overvoltage monitoring switching threshold	approx. 70 V DC			
Internal brake resistor				
Resistance R	17 Ω			
Permanent power P_N	10 W			
Peak power P_{pulse}	200 W for 50 ms			
External brake resistor				
Resistance R	> 5 Ω			
Permanent power P_N	10 ... 600 W			
Motor holding brake	24 V / 1 A			
Positioning range	± 2^{19} revolutions			
Savable positions	64			
Scanning times of the control loops				
Current controller	100 µs			
Speed controller	200 µs			
Position controller	400 µs			

1) Observe minimum voltage of the brake!

3.3 Communication

3.3.1 Controller with CAN bus

Area	Values
Communication profile	DS 301, DSP 402
Communication medium	RS232
Network topology	Without repeater: line / with repeaters: line or tree
CAN node	Slave
Baud rate (in kbps)	10, 20, 50, 100, 125, 250, 500
Maximum cable length per bus segment	1200 m (dependent on baud rate and cable type used)
Bus connection	RJ45

3.3.2 Controller with PROFIBUS

Area	Values
Communication profile (DIN 19245 part 1 and part 3)	PROFIBUS-DP-V0
Communication medium	RS485
Drive profile	PROFIdrive
Network topology	Without repeater: line / with repeaters: line or tree
PROFIBUS-DP station	Slave
Baud rate [kbps]	9.6 ... 12000
Maximum cable length per bus segment	1200 m (dependent on the baud rate and cable type used)
Bus connection X4.1, X4.2	9-pin Sub-D socket

4 Mechanical installation

4.1 Important notes

- Use the controllers as built-in units only!
- In case of contaminated cooling air (dust, lints, greases, aggressive gases):
  - Take suitable preventive measures, e.g. separate air duct, installation of filters, regular cleaning, etc.

Stop!

Do not install drives on top of each other in the control cabinet!

- Observe installation clearances!
  - You can install several controllers next to each other without free space in a control cabinet.
  - Ensure unimpeded ventilation of cooling air and outlet of exhaust air!
  - Allow a free space of 100 mm at the top and at the bottom.
  - If possible, the rear panel of the drive controller should be provided with a good thermal connection to the control cabinet wall.
  - In case of high load and a bad heat dissipation, the drive controller reduces the drive power, or possibly switches off.
- Do not exceed the range of the ambient operation temperature specified in the Technical Data.
- In case of permanent oscillation or agitation:
  - Check whether shock absorbers are necessary.

Possible mounting positions:

Vertically on the control cabinet rear panel with mains terminals at the top.

4.2 Dimensions

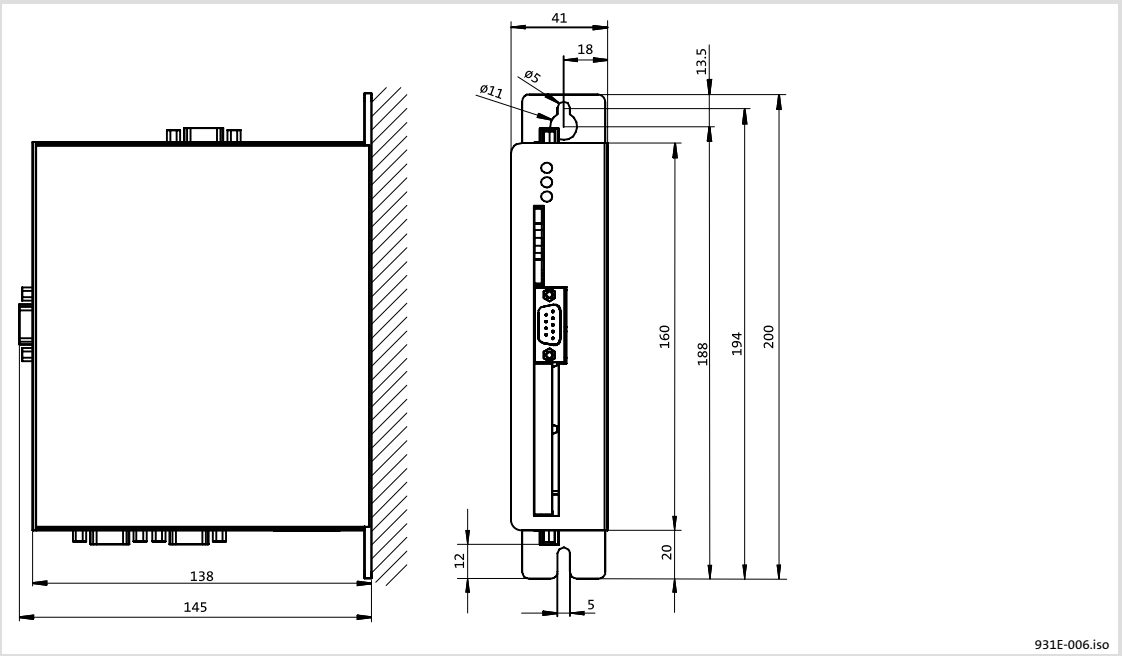


Fig. 1 Drive dimensions

4.3 Mounting clearance

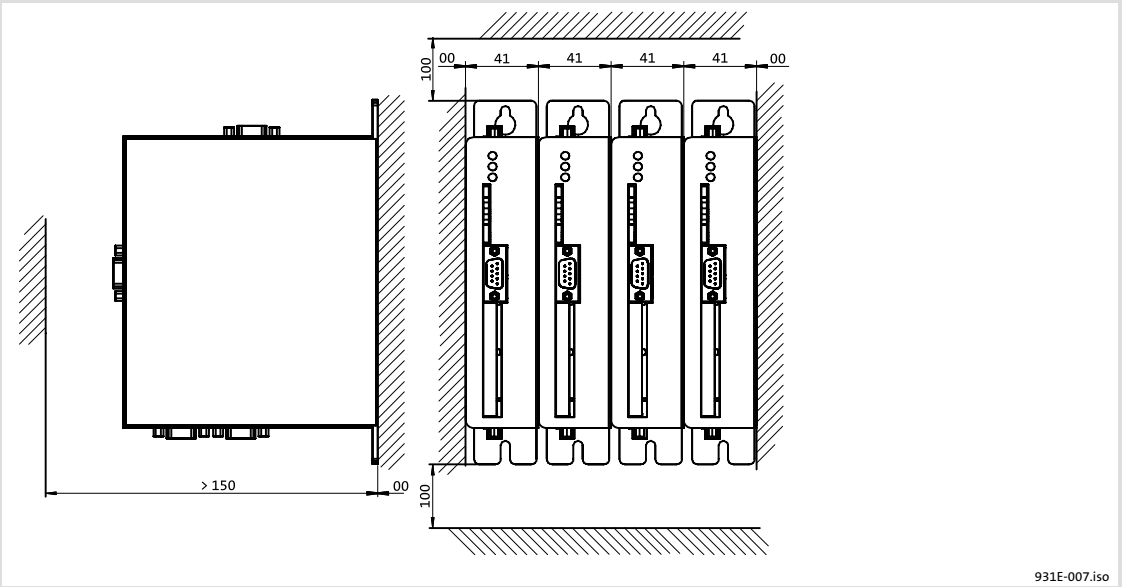


Fig. 2 Installation clearances

5 Electrical installation

5.1 Important notes

Stop!

The drive controller contains electrostatically sensitive components.

The personnel must be free of electrostatic charge when carrying out assembly and service operations.

Danger!

- ► The connection of all pluggable terminals has to be effected in a deenergised state.
- ► Connecting and disconnecting the voltage supply (X2) due to the charging processes of the DC bus capacitor may cause traces of burning on the plug-in connection, and may result in a destruction of the internal electronic circuit.
- ► A false polarity of the DC supply can bring about the destruction of the drive. Before switching the drive on, ensure that the polarity of the DC supply is correct.

Note!

The following requirements have to be met with regard to the trouble-free operation:

- ► An installation according to EMC.
- ► The shield of the motor cable has to be applied to PE potential on a preferably large surface in order to prevent negative effects.
- ► The resolver cable, encoder cable, and the motor cable may have a maximum length of 15 m!
- ► The feeding power supply units have to be sufficiently dimensioned. The power supply units have to be protected against overcurrent by means of appropriate input fuses.

5.2 Installation according to EMC (installation of a CE-typical drive system)

Important notes

The electromagnetic compatibility of a machine depends on the type of installation and on the care that is taken. Special attention should be paid to:

- Assembly
- Shielding
- Grounding

For diverging installations, the conformity to the EMC Directive requires a check of the machine or system regarding the EMC limit values. This, for instance, applies to the use of unshielded cables.

The compliance of the machine application with the EMC Directive is in the responsibility of the user.

- If you observe the following measures, you can assume that the machine will operate without any EMC problems caused by the drive system, and that compliance with the EMC Directive and the EMC law is achieved.
- If devices which do not comply with the CE requirements concerning noise immunity EN 50082-2 are operated close to the controller, these devices may be electromagnetically disturbed by the controllers.

Design

Contact drive controller extensively to the grounded mounting plate:

- Mounting plates with conductive surfaces (zinc-coated, stainless steel) allow permanent contact.
- Painted plates are not suitable for installation in accordance with EMC.
- If you use several mounting plates, connect them extensively to one another in a conductive manner (e. g. by using copper strips).

Shielding

- Connect the shield of the motor cable on the drive controller to the shield connection of the drive controller.
- Extensively connect the shield in the terminal box on the motor or on the motor housing to PE:
  – Metal glands at the motor terminal box ensure an extensive connection of the shield and the motor housing.

Earthing

Ground all metallically conductive components (controller, motor filter) using suitable cables connected to a central earthing point (PE bar).

Maintain the minimum cross-sections prescribed in the safety regulations:

- With regard to EMC, however, not the cable cross-section is important, but the surface of the cable and the contact with a cross-section as large as possible, i.e. large surface.

Principle circuit diagram

Note!

The described terminal assignment complies with the delivery status. You can alter the terminal assignment via the operating software.
(📖 Software Manual 931 E)

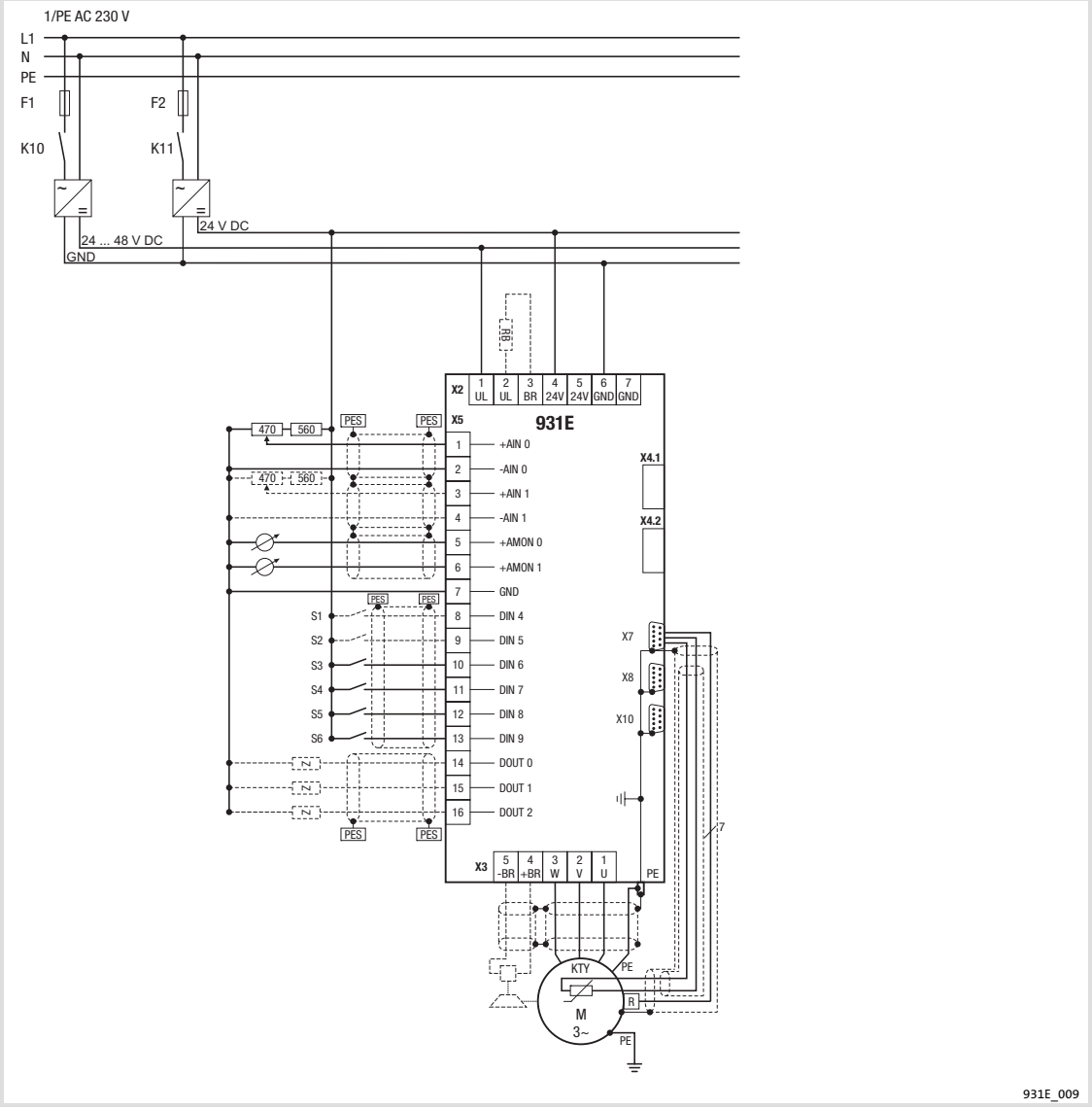


Fig. 3 Basic circuit diagram: installation according to EMC

F1, F2 primary-side fusing of the power supply units, consider the rules of conductor protection
RB external brake resistor
PES large-surface connection of the shield to PE
——— minimum wiring required for operation
S1 = reversal of rotation direction
S2 = jog value selection
S3 = quick stop
S4 = limit switch 1
S5 = limit switch 2
S6 = controller enable

5.3 Voltage supply

The drive controller requires two voltage supplies on X2 for the operation:

- the control voltage (24 V DC) for the supply of the internal processors as well as of the digital outputs, and - if available - the holding brake.
- the supply voltage of the power unit with 24 V or 48 V DC

Both voltages have the same reference potential in the drive controller. They are not isolated. The connections for the control voltage and the supply voltage of the power unit are equipped with polarity protection and are additionally secured by means of a fuse or by a polyswitch in the drive.

Note!

In principle, it is recommended to use 2 separate DC power supply units for the control voltage (24 V DC) and the supply voltage (24 V DC ... 48 V DC). If the power unit is also operated with 24 V DC, you can use a common 24 V DC power supply unit under the following conditions:

- The 24 V DC power supply unit has to be highly dynamic and robust and has to provide the required current without voltage dip even with regard to quick changes in current (e. g. 30 A within 0.5 ms). In this respect, also the behaviour of further loads integrated in the DC supply system has to be taken into consideration (e. g. a further drive controller). Furthermore, the power supply unit has to be sufficiently dimensioned with regard to the maximum current.
- With regard to longer DC supply cables, a backup capacitor has to be switched between UL and GND, in order to stabilise the supply voltage. You can easily check the stability of the supply voltage by means of the oscilloscope integrated in the parameterisation software.

Stop!

The maximum permissible current loading of the terminal strip X2 is 16 A per terminal. If required, the supply voltage has to be connected in parallel!

X2 supply voltage			
Pin No.	**Designation**	**Value**	**Specification**
1	UL	24 ... 48 V	DC-bus voltage output stage
2			As 1, loop through of the supply to further drives
3	BR		Connection external brake resistor against UL
4	24 V	+24 V / 1.5 A	Control voltage for control section, DOUT0, DOUT1, DOUT2 and holding brake, max. 1.5 A
5			As 4, loop through of the supply to further drives
6	GND	0 V	Common reference potential for the DC-bus voltage and control voltage
7			As 6, loop through of the GND potential to further drives

Terminal data						
		Max. conductor cross-section		**Tightening torque**		**Screw drive**
Cable		**[mm²]**	**[AWG]**	**[Nm]**	**[lb-in]**	
Flexible With wire end ferrule		2.5	12	0.5 ... 0.6	4.4 ... 5.3	Slot 0.6 x 3.5

External brake resistors

Stop!

The drive controller does not monitor the temperature of the external resistor. For this purpose, additional safety measures are to be considered!

The drive controller is provided with an integrated brake resistor which is designed for a permanent power of 10 W or for a pulse power of 200 W for 50 ms.

If higher permanent or pulse powers are required, you can connect an additional external brake resistor to the integrated brake chopper.

If the switching threshold of the brake chopper is exceeded, both resistors are energised.

Parameter	Value
Switching threshold brake chopper on	Approx. 63 V
Switching threshold brake chopper off	Approx. 60 V
Resistance, external	> 5 Ω
Rated power	10 W ... 600 W

5.4 Motor connection

- For trouble-free operation, we recommend to use Lenze standard cables.
- Ensure a proper shielding of the motor and feedback cable to avoid interferences.

X3 motor connection			
Pin No.	**Designation**	**Specification**	
1	U	Motor phases Fundamental wave in case of overload for 2 s up to 32 A_{eff}	approx. 0 V ... 27 V_{eff}
2	V		0 V ... 13 A_{eff}
3	W		0 Hz ... 200 Hz
4	BR+	Brake	24V DC
5	BR-		0 V

Terminal data						
		Max. conductor cross-section		**Tightening torque**		**Screw drive**
Cable		**[mm²]**	**[AWG]**	**[Nm]**	**[lb-in]**	
Flexible With wire end ferrule		2.5	12	0.5 ... 0.6	4.4 ... 5.3	Slot 0.6 x 3.5

Stop!

The brake is supplied by the control voltage at X2. In order to ensure the trouble-free operation of the brake, the control voltage has to be in the tolerance range of the brake used!

5.5 Control terminals

The digital and analog inputs and outputs are placed in the plug X5. The digital and analog inputs and outputs have the same reference potential.

X5 inputs and outputs

Pin No.	Signal	Function		Specification	
		Lenze	Alternatively adjustable via SDC		
1	+AIN0 (DIN0)	Analog input 0 differential (speed setpoint, current setpoint)	DIN0	Input voltage	-10 V ... +10 V
				Overvoltage protection	-30 V ... +30 V
2	-AIN0 (DIN1)		DIN1	Input impedance	> 20 kΩ
				Resolution	12 Bit
3	+AIN1 (DIN2)	Analog input 1 differential	DIN2	Offset error	< ± 50 mV
				Gain error	< 5 %
4	-AIN1 (DIN3)		DIN3	Limiting frequency	~ 1 kHz
5	+AMON0	Analog monitors output of internal quantities (current, speed, etc.)		Output signal	0 V ... 10 V, max. 2 mA
6	+AMON1				
7	GND	Reference potential for pin 1 ... 6, pin 8 ... 16			
8	DIN4	Digital input 4		Rated voltage	+24V DC
9	DIN5	Digital input 5		Voltage range	0 ... +30 V DC
10	DIN6	Digital input 6		HIGH signal	> +8 V DC
11	DIN7	Digital input 7		LOW signal	< +4 V DC
12	DIN8	Digital input 8		Input impedance	> 4.7 kΩ
13	DIN9	Digital input 9 (controller enable / delete error)		Switching delay (LOW-HIGH transmission)	< 1 ms
14	DOUT0	Digital output 0 (ready for operation)		Output voltage	0 V / 24 V
				LOW signal	0 ... 4 V DC
				HIGH signal	18 V ... 30 V
15	DOUT1	Digital output 1		Output current	max. 10 mA
				Load impedance	> 2.2 kΩ
16	DOUT2	Digital output 2		Switching delay (LOW-HIGH transmission)	< 1 ms

Terminal data

Cable		Max. conductor cross-section [mm²]	Max. conductor cross-section [AWG]	Tightening torque [Nm]	Tightening torque [lb-in]	Screw drive
Flexible		2.5	12	0.5 ... 0.6	4.4 ... 5.3	Slot 0.6 x 3.5
With wire end ferrule						

5.6 Feedback connection

5.6.1 Resolver at X7

- ► You can connect a resolver to X7 in order to record the speed and position.
- ► Use Lenze system cables in order to provide for a trouble-free operation.
- ► Self-prepared cables have to be provided as follows:
  - – Only use cables with cores that are twisted in pairs and shielded, featuring the specified cable cross-sections.
  - – Apply the shield to both sides.

Features

Features	Values
Connection on the drive controller	9-pole Sub-D socket
Monitoring	Monitoring of the resolver and resolver cable with regard to open circuit
Positioning resolution	16 bit
Encoder detection resolution	12 Bit
Connectable resolvers	2-pole, U = 10 V, f = 10 kHz
Ratio	0.3 (standard) or 0.5 (as of hardware version 1.1)
Carrier frequency	8 ... 10 Nm
Permissible exciting voltage	7 V_{eff} ... 12 V_{eff}
Impedance of the excitation (at 10 kHz)	≥ (30 + j150) Ω
Impedance of the stator (at 10 kHz)	≥ (500 + j1000) Ω

Connection plan

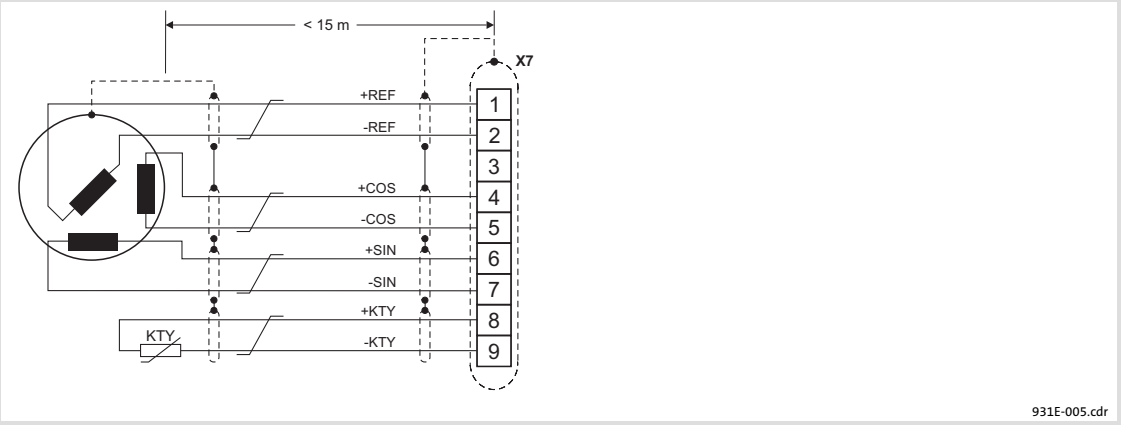


Fig. 4 Resolver connection

Cores twisted in pairs

Assignment of the 9-pin Sub-D socket (X7) at the controller									
Pin	1	2	3	4	5	6	7	8	9
Signal	+REF	-REF	GND	+COS	-COS	+SIN	-SIN	+KTY	-KTY
	0.5 mm² (AWG 20)		–	0.14 mm² (AWG 26)					

5.6.2 SinCos encoder at X8

- ► You can connect a SinCos encoder with serial communication (single turn or multi turn) to X8.
- ► Use Lenze system cables in order to provide for a trouble-free operation.
- ► Self-prepared cables have to be provided as follows:
  - – Only use cables with cores that are twisted in pairs and shielded, featuring the specified cable cross-sections.
  - – Apply the shield to both sides.

Features

Field	Values
Connection on the drive controller	9-pole Sub-D socket
Input frequency:	Max. 100 kHz
Current consumption per channel:	6 mA
Supply of the incremental encoder	● Via X8/4 (V_{CC}, DC 5 V), X8/5 (GND) ● Max. current consumption at X8/4: 200 mA
Encoder with number of increments	128 - 1024 periods / revolution
Angular resolution	● Interpolation min. 10 Bit ● Speed measurement 20 Bit ● Positioning 16 Bit ● Angular error < 2’
Recommended encoders	Sick-Stegmann SKS / SKM36

Connection plan

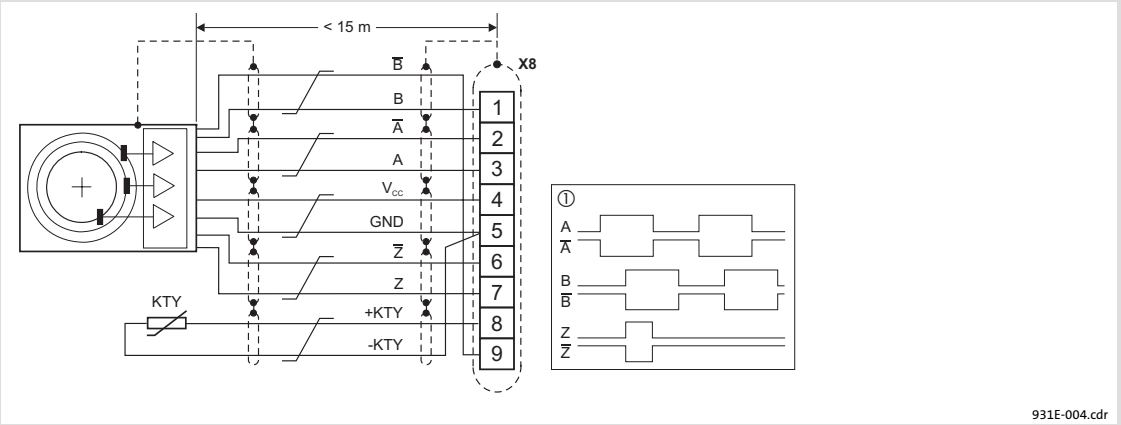


Fig. 5 Connection of incremental encoder with TTL level

① Signals for CW rotation
Cores twisted in pairs

Assignment of 9-pin Sub-D socket (X8) at the controller									
Pin	1	2	3	4	5	6	7	8	9
Signal	B	$\overline{A}$	A	V_{CC}	GND (-KTY)	$\overline{Z}$	Z	+KTY	$\overline{B}$
	0.14 mm² (AWG 26)			1 mm² (AWG 18)		0.14 mm² (AWG 26)			

5.7 Communication

- ► In order to provide for a perfect operation, we recommend the use of Lenze system cables. (📖 42)
- ► Check the plug connections of the bus cables with regard to a tight fit.

5.7.1 Connection of digital frequency coupling at X10

- ► Master frequency features:
  - – Angular resolution / number of increments max. 12 bits / 1024 increments switchable to 512 / 256 / 128 / 64 and 32 increments
  - – Track signals A, B, Z in accordance with RS422 standard
  - – Output impedance $R_{a,diff}$ = 120 Ω

Technical data master frequency	
Output X10	**Input X10**
● Output frequency: 0 ... 500 kHz ● Current capacity per channel: max 20mA. ● Two-track with inverse 5 V signals (RS422) and zero track ● In case of a parallel connection maximally three slave drives can be connected ● By LOW level, PIN 8 (enable) indicates the initialisation of the master drive (e. g. when the mains has been switched off in the meantime). This enables the slave drive to monitor the master.	● Input frequency: – 0 ... 500 kHz for TTL level ● Max. 5 mA ● Two-track with inverse signals and zero track – With regard to incremental encoders with HTL level, also operable without reversed signals

Connection plan

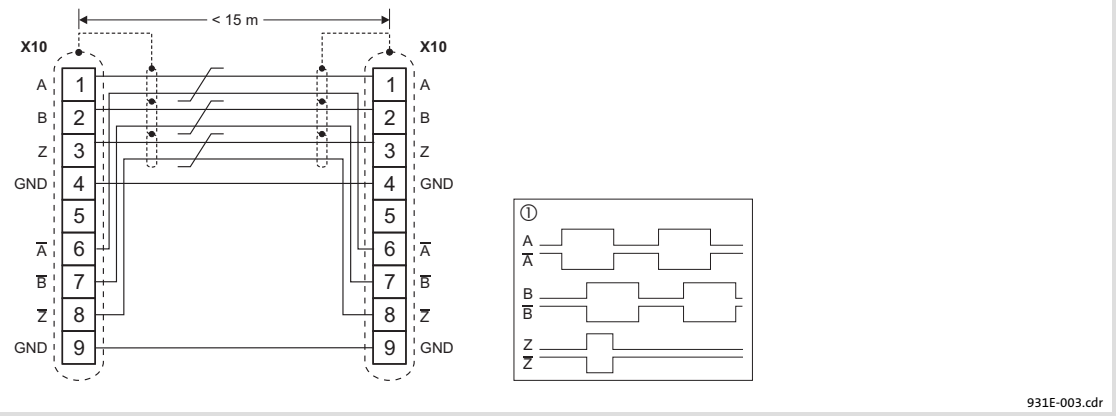


Fig. 6 Connection of digital frequency input and digital frequency output (X10)

X10 Slave drive
X10 Master drive
① Signals with CW rotation
Cores twisted in pairs

Assignment of 9-pin Sub-D socket (X10) at the controller for digital frequency coupling									
Pin	1	2	3	4	5	6	7	8	9
Signal	A	B	Z	GND	n. c.	$\overline{A}$	$\overline{B}$	$\overline{Z}$	GND
	0.14 mm² (AWG 26)			0.5 mm² (AWG 20)		0.14 mm² (AWG 26)		0.5 mm² (AWG 20)	0.14 mm² (AWG 26)

5.7.2 Connection of CAN bus at X4.1 and X4.2

Features

- Parameter presettings
- Data exchange from controller to controller
- Connection of operator and input devices
- Connection of external controls and control systems
- Baud rate 125, 250, 500 kBaud

Stop!

For the termination of the bus system, an external 120 Ω terminating resistor is required.

Connection plan

X4.1 / X4.2

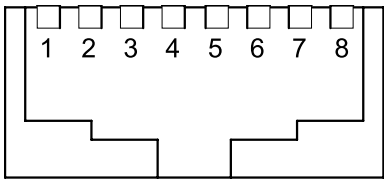


Fig. 7 Connection of CAN bus (X4.1, X4.2)

Pin no.	Meaning	Comment
1	CAN-HIGH	CAN-HIGH (high is dominant)
2	CAN-LOW	CAN-LOW (low is dominant)
3	CAN-GND	CAN ground
4	—	Reserved
5	—	Reserved
6	CAN-SHLD	CAN shield (hardware version 1.1 and higher)
7	CAN-GND	CAN ground
8	—	Reserved

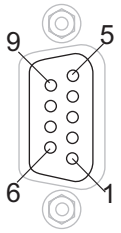
Tip!

An RJ45 bus terminating connector is available for the 931E drive controllers. Please contact Lenze.

5.7.3 Connection of PROFIBUS

Assignment of Sub-D socket

The controller is connected to the PROFIBUS via the 9-pin Sub-D socket X4.1/X4.2.

View	Pin	Designation	Explanation
	1	-	-
	2	-	-
	3	RxD/TxD-P	Data line B (received/transmitted data plus)
	4	RTS	Request to send (received/transmitted data, no differential signal)
	5	M5V2	Data reference potential (ground to 5V)
	6	P5V2	5 V DC / 30 mA (bus termination)
	7	-	-
	8	RxD/TxD-N	Data line A (received/transmitted data minus)
	9	-	-

5.7.4 Connection of RS232 serial interface to X1

The serial interface is designed as a 9-pole Sub-D-plug. The signal levels comply with the RS232 specification.

X1 RS232		
Pin No.	**Designation**	**Value**
1	n. c.	Not assigned
2	R x D	0 V / 10 V
3	T x D	0 V / 10 V
4	n. c.	Not assigned
5	GND	
6	n. c.	Not assigned
7		
8		
9		

6 Commissioning

6.1 Before switching on

Stop!

Avoid injury to persons and damage to material assets during commissioning!

- ► Necessarily observe the switch-on sequence.
- ► During the resolver adjustment, the drive has to be able to rotate freely without load!

Tip!

For faults during commissioning, see chapter Troubleshooting and fault elimination. (📖 38)

Before the first commissioning and before commissioning after longer downtimes, check:

Check	Checked
Have all necessary electrical connections been established?	
Are there no short circuits and earth faults?	
Are all plug connections fixed?	
Are all plugs secured with the bolted connections specified for this purpose?	
Are all bolted connections tightened?	
Are control voltage and power supply connected with the right polarity?	
Are the output voltages of the power supply units set correctly?	
+24 V DC for the control	
+24V DC or +48 V DC for the power supply	
Is the shield of the motor cable and that of the feedback cable correctly applied?	
Are the correct signals assigned to the digital inputs and outputs?	
Are at least DIN9 (controller enable), DIN6 (start positioning) assigned?	
If limit switches are connected, are they connected to DIN7 and DIN8?	
If you use the analog inputs for the setpoint selection or for torque limitation	
Are the correct signals assigned to the analog inputs?	
Is the voltage for the analog inputs settled in the permissible range 0 ... 10 V?	

6.2 Initial switch-on

Note!

The described terminal assignment complies with the delivery status. You can alter the terminal assignment via the operating software.

(📖 Software Manual 931 E)

Tip!

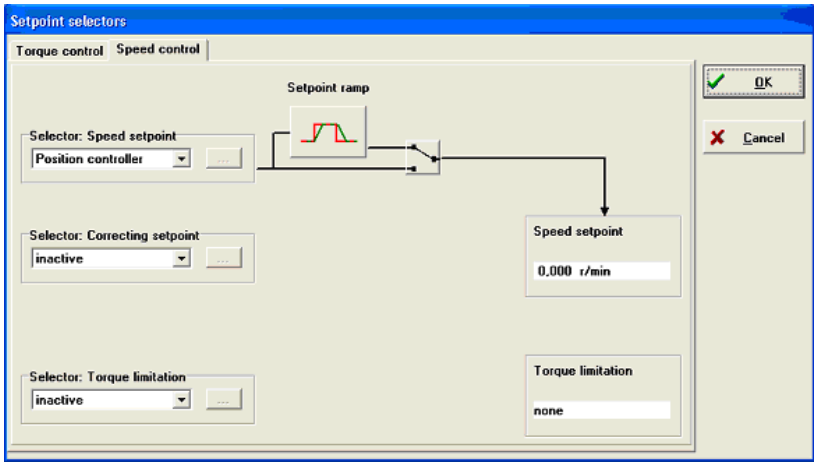
The windows to the individual menu items in the »Small Drive Control (SDC)« parameterisation software remain open after you have entered and adopted changes.

Close the windows when you have edited a menu item, so that the monitor operations remain clearly visible.

When carrying out initial commissioning, some basic settings have to be effected before the drive can be started.

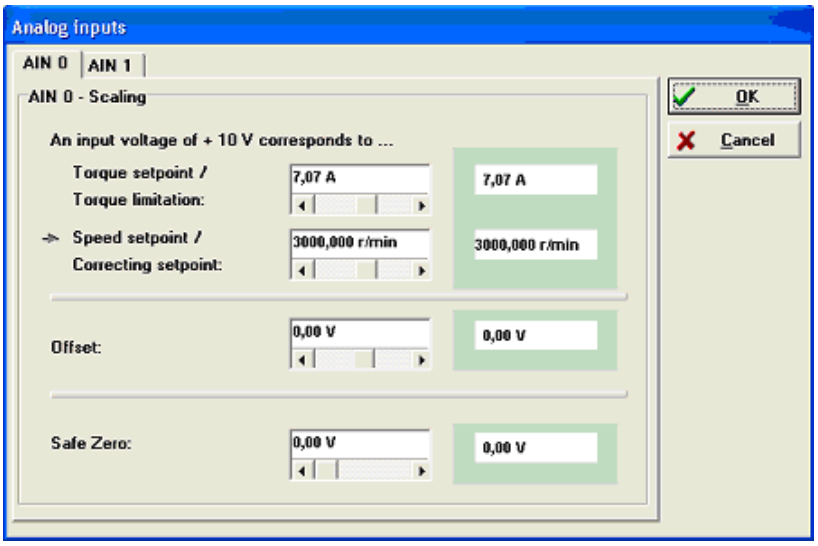
Basic settings:

1. Connect the serial interface on the drive controller and on the PC to a null modem cable.
2. Switch on the control voltage, but not yet the **power supply**!
   – If the green LED (state) is blinking, the voltage is in the permissible range.
3. Start the »Small Drive Control (SDC)« parameterisation software.
   – If you are not able to effect a connection between the PC and the drive controller, check the setting of the serial interface on the PC (see Software Manual).
   – If communication is defective, a message is displayed on the user interface.
4. Select the item ”Select as commissioned” in the window ”Initial commissioning”.
   – Ignore the error messages which are displayed due to the power supply that is not yet existent.
5. Select the connected motor in the ”Parameters → Drive parameters → Motor data...” menu.
   – If you select a motor from the integrated motor data base, you do not have to enter the motor parameters manually.
   – If you do not find the connected motor in the motor data base, you have to enter the motor parameters manually. The data can be gathered from the nameplate of the motor.
6. Select and parameterise the connected encoder system in the ”Parameters → Drive parameters → Resolver settings...” menu.
7. Select the operating mode ”Speed control” in the window ”Commands”.
8. Assign the setpoint sources in the ”Operating mode → Setpoint selection...” menu:
   – analog speed setpoint (±10 V DC) via AIN0



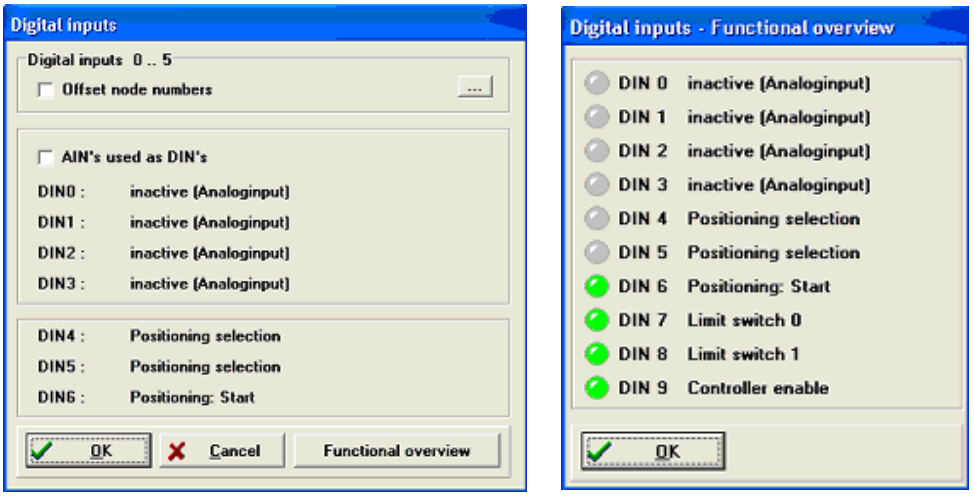
931E_013

9. Parameterise the analog terminals in the ”Parameters ➞ I/Os... ➞ Analog inputs” menu:
   – Here you assign the setpoint quantity to the voltage level.
   – By means of the offset, you can adjust the potentiometer.
   – By means of the slide control ”safe null”, you can define a range where the motor is safely stopped.



931E_012

10. Parameterise the digital terminals in the ”Parameters ➞ I/Os... ➞ Digital inputs” menu.
    – Terminal assignment see connection example. (📖 22)
    – The analog inputs may not be configured as digital inputs. Therefore, in the ”Parameters ➞ IOs ➞ Digital inputs” menu, check whether the selection ”Interprete AINs as DINs” is not set! Otherwise you are not able to evaluate the analog setpoint.
    – The function of the digital inputs can be displayed under the menu item ”Function overview”. Check the right function here.
    – The 931E Software Manual decribes how you configure analog inputs as digital inputs.



931E_011

11. Set the threshold for the undervoltage recognition in the ”Parameters ➞ Drive parameters ➞ DC bus monitoring...” menu.
    – Adjust the threshold according to the application and the supply voltage (e. g. 16 V for 24 V DC power supply).

The basic settings are now completed.

Now you calibrate the feedback system and the controller parameters.

Calibrating the feedback system and the controller parameters:

12. Make sure that the controller is inhibited!
    – DIN9 = LOW
13. Switch on the power supply.
14. Check whether error messages are pending.
    – First of all, eliminate and acknowledge the errors, or alter the error tracking system.
15. Make sure that the drive can rotate without load!
16. Select the resolver adjustment in the ”Parameters → Drive parameters → Resolver settings...” menu.
    – Caution: the motor shaft rotates during the adjustment!
17. Parameterise the controller in the ”Parameters → Controller parameters → Speed controller... menu.

Note!

If you have selected a Lenze servo motor from the motor data base, the current controller parameters are already optimised.

If required, the parameters have to be slightly adapted to your application.

18. **Use the icon ”Save parameters” in the menu bar, in order to save the settings in the EEPROM of the drive controller in a powerfail-proof manner.**

The settings are completed.

You can now start the drive.

Starting the drive:

19. Set a speed setpoint on AIN0.
20. Enable controller.
    – DIN9 = HIGH
21. The drive now operates in speed-controlled operation.
22. If you want to change the direction of rotation during operation:
    – Change in potential on AIN0
    – HIGH signal on DIN4

Detailed information can be found in the 931E Software Manual.

7 Troubleshooting and fault elimination

7.1 Status of the drive

The current operating status of the drive controller is displayed by 3 light-emitting diodes. Thus, a quick diagnostics is possible. Details with regard to diagnostics information are supplied by the parameterisation software.

LED	Colour	State	Note
State	Green	on	The control is correctly supplied by a 24 V control voltage, the drive is ready for operation.
		blinking	Data is written on or read from the memory card.
		off	No voltage
Power	Yellow	on	The power section is enabled, the motor is supplied with voltage. The drive works with the set control.
		off	The drive does not work, the output stage is inactive.
Error	Red	off	No fault
		blinking	Internal drive error [1)] After the cause of the error has been eliminated, you have to acknowledge the error message: ● Either by using the parameterisation software, or via an edge at DIN9 (controller enable). ● If no error is active anymore, the LED goes out.
	Green Yellow Red	on	● The drive is in the initialisation phase after the control voltage has been switched on. ● A new firmware is being installed.

1) Detailed description of the blink codes: 📖 40

Note!

The light-emitting diode ”Error” constantly blinks if a fault is active:

► It only displays one fault at a time.

► If several faults are active at the same time, the fault that occured first is displayed.

7.2 Error message

Various monitoring functions protect the drive against impermissible operating conditions. If a monitoring function is activated, a response corresponding to the protection of the drive is actuated. The following things are monitored:

- Temperature of the output stage
- Motor temperature
- I2t monitoring of the motor
- Overcurrent / short circuit of the output stage
- DC-bus voltage (under- and overvoltage)
- Following error with regard to position control
- Error with regard to the reference run
- Error with regard to the angle encoder system
- Communication error
- Initialisation error
- Check sum error of the parameters

Some responses to failures can be set within the SDC parameterisation software. Possible responses are:

Reaction	Meaning	Reaction of the drive
A	Immediate disconnection of the output stage	The motor coasts.
h	Emergency stop	The motor is braked to zero speed at the current limit. If there is a motor holding brake, it is applied. The output stage switches off.
W	Warning	The controller keeps operating, the output stage remains switched on. The warning signal can be read out via the CAN bus or via the serial RS232 interface.
O	Off	The warning signal is inhibited - no response.

Used symbols:

Symbol	Meaning
☑	Default setting
☐	Response parameterisable in SDC
-	Selection not possible

Red LED is blinking	Reaction				Cause	Remedy
	A	h	W	O		
15x	☑	-	-	-	Parameter set inconsistent	Check parameter set of the drive by means of the parameterisation software (📖 931E Software Manual).
10x	☑	☐	☐	☐	I^2t error	• Adjust the i^2t time of the motor. (📖 931E Software Manual) • Effect resolver adjustment. (📖 931E Software Manual) • Check set motor data. (📖 931E Software Manual) • Optimise controller setting. (📖 931E Software Manual) • Adjust travel profile (e. g. adjust acceleration ramps). • Reduce load torque of the motor.
9x	☑	☐	☐	☐	Following error position control	• Optimise controller setting to improve the running precision. (📖 931E Software Manual) • Adjust travel pofile (e. g. reduce acceleration and braking ramps. (📖 931E Software Manual) • Amplify following error window/increase switch-in delay. (📖 931E Software Manual)
8x	☑	-	-	-	Resolver or SINCOS encoder error; as the case may be, definite recognition only possible after approx. ½ motor revolution	• Check correct fit of the resolver plug. • Check resolver cable with regard to cable breakage, short circuit. • Check PIN assignment of the resolver cable plug. • Parameterise encoder correctly. (📖 931E Software Manual)
7x	☑	-	-	-	Overvoltage in the DC bus > 70 V	• Check whether power supply unit operates correctly, and whether the supply voltage of the power unit is settled in the permissible range (19.2 V DC ... 57.6 V DC). • Decrease the steepness of the braking ramp. (📖 931E Software Manual) • Connect external brake resistor to X2. • Check whether other drives connected to the DC supply of the power unit have caused this overvoltage.

Red LED is blinking	Reaction				Cause	Remedy
	A	h	W	O		
6x	☑	-	-	-	Overcurrent / short circuit	Check motor cable and motor phases with regard to a short circuit of the phases or the drive
5x	☑	-	-	-	System error	Switch off and then reconnect control voltage. If the error re-occurs, send in the drive.
4x	☑	☐	-	-	Overtemperature drive controller	• Check correct mounting in the control cabinet: – Heatsink has to fit extensively to the housing of the control cabinet. – Are further heat sources mounted near the drive controller, bringing about an increased ambient temperature of the inverter? • Check whether the ventilation slots of the drive controller are soiled or blocked. If required, clean. • Optimise controller settings (bad settings result in an unnecessary heating). (📖 931E Software Manual) • Check resolver adjustment. (📖 931E Software Manual) • Reduce load torque of the motor.
3x	☑	☐	☐	☐	Overtemperature motor	• Check whether the motor cooling via the motor housing is prevented by deposits, etc.(if required, cleaning of the motor). • Are there further heat sources near the motor, bringing about an additional increase in the predominant ambient temperature, and thus contributing to a diminution of the dissipation of lost heat? • Check controller settings, bad settings result in an unnecessary heating. (📖 931E Software Manual) • Reduce load torque of the motor. • Check setting of the thermal sensor. • Check resolver cable or encoder cable with regard to open circuit. • Check resolver adjustment. (📖 931E Software Manual)
2x	☑	☐	☐	☐	Undervoltage in the DC bus	• Check DC-bus voltage, if required, adjust undervoltage trigger level. (📖 931E Software Manual)
1x	☐	☐	☑	☐	MMC not connected	• Check setting of multimedia card (MMC). • Connect MMC. • Change setting of the error tracking system by means of the parameterisation software.

8 Accessories

8.1 System cables and plugs

Connector plugs

Set connector plugs	Use	Rated current / max. cross-section	Order number
X3	Motor connection	16 A / 2.5 mm²	13041955
x2	Voltage supply	16 A / 2.5 mm²	
X5	Inputs and outputs	1 A / 1.5 mm²	

Motor connection system cables

Motor - servo inverter			
Connection on the servo inverter	**Length [m]**	**Connection on the motor**	**Order number**
X3 (U, V, W, PE)	2.5	6-pole socket	13009636
	5		13011101

Resolver feedback			
Connection on the servo inverter	**Length [m]**	**Connection on the motor**	**Order number**
X7 Sub-D plug, 9-pole	2.5	M23 socket, 12-pole	13009635
	5		13011242

Absolute value encoder feedback			
Connection on the servo inverter	**Length [m]**	**Motor connection side**	**Order number**
X8 Sub-D socket, 9-pole	2.5	M23 socket, 12-pole	13041367
	5		13041363

Communication system cables

CAN system cable			
CAN input	**Length [m]**	**CAN output**	**Order number**
X4.1 RJ 45 plug	3	X4.2 RJ 45 plug	492234

Serial null modem connection RS232			
Connection on the servo inverter	**Length [m]**	**Connection on the PC**	**Order number**
x1 Sub-D socket, 9-pole	1.8	Sub-D socket, 9-pole	492232

8.2 Power supply units

Technical data of the power supply units				
Secondary side		**Primary side**		**Order number**
DC 24 V (DC 2.5 ... 28.5 V)	5A	AC 85 V - 0 % ... 264 V + 0 % 45 Hz - 0 % ... 65 Hz + 0 %	Approx. 1.6 A (AC 120 V) Approx. 0.84 A (AC 230 V)	EZV1200-000
	10 A		Approx. 2.34 A (AC 120 V) Approx. 1.2 A (AC 230 V)	EZV2400-000
	20 A		Approx. 4.76 A (AC 120 V) Approx. 2.3 A (AC 230 V)	EZV4800-000
DC 24 V (DC 2.5 ... 28.5 V)	5A	3 AC 320 V - 0 % ... 575 V + 0 % 45 Hz - 0 % ... 65 Hz + 0 %	Approx. 3 × 0.36 A (AC 400 V) Approx. 3 × 0.34 A (AC 480 V)	EZV1200-001
	10 A		Approx. 3 × 0.63 A (AC 400 V) Approx. 3 × 0.57 A (AC 480 V)	EZV2400-001
	20 A		Approx. 3 × 1.1 A (AC 400 V) Approx. 3 × 1.0 A (AC 480 V)	EZV4800-001
DC 48 V (DC 40 ... 56 V)	5A	AC 85 V - 0 % ... 264 V + 0 % 45 Hz - 0 % ... 65 Hz + 0 %	Approx. 2.2 A (AC 120 V) Approx. 1.2 A (AC 230 V)	EZV2400-002
	10 A	3 AC 320 V - 0 % ... 575 V + 0 % 45 Hz - 0 % ... 65 Hz + 0 %	Approx. 3 × 1.2 A (AC 400 V) Approx. 3 × 1.0 A (AC 480 V)	EZV4800-002
	20 A		Approx. 3 × 2.3 A (AC 400 V) Approx. 3 × 1.9 A (AC 480 V)	EZV9600-000

8.3 Memory cards

Memory cards (on request)		
Format	**Capacity**	**Order number**
MMC (multimedia card)	64 MB	13041516

8.4 Motors for 931E servo inverters

Further information on motors and gearboxes can be gathered from the respective catalogue.

8.4.1 General data and operating conditions

Design	Smooth, round
Design	B14 flange in accordance with DIN 42948 and IEC 72; form C
Cooling	Naturally ventilated
Insulation material class	F
Winding insulation	Max. voltage amplitude 1500 V; du/dt < 5 kV/µs
Permissible temperature ranges	
Operation	-20 °C ... + 40 °C
Type of protection	IP54 in accordance with DIN EN60034-5
Connection	System connector
Temperature monitoring	KTY 110
Speed feedback	Pancake resolver (size 15) Absolute value encoder

8.4.2 Rated data

		Motor type		
		SDSGS 035-22	**SDSGS 035-22**	**SDSGS 047-22**
Rated power	[W]	140	140	210
Rated torque	[Nm]	0.45	0.45	0.8
Rated current	[A]	9.5	4.0	6.2
Rated voltage	[V]	13	30	30
Rated frequency	[Hz]	100	100	83
Rated speed	[min^{-1}]	3000	3000	2500
Power factor		1	1	1
Maximum speed, mechanical	[min^{-1}]	6000	6000	6000
Continuous standstill torque	[Nm]	0.55	0.55	1
Continuous standstill current	[A]	10.4	4.4	6.7
Maximum continuous standstill torque for 2 s	[Nm]	1.0	2.9	4/5
Operating mode		S1	S1	S1
Moment of inertia	[$kgcm^2$]	0.293	0.293	0.444

8.4.3 Mechanical data

		Motor type		
		SDSGS 035-22	SDSGS 035-22	SDSGS 047-22
Weight	[kg]	2.2	2.2	3
Flange	IEC	IEC56 B14 C80	IEC56 B14 C80	IEC56 B14 C80
Shaft end	IEC 72	9 x 20	9 x 20	11 x 20
Locating bearing at the output end		6000	6000	6000
Floating bearing		6000	6000	6000
Max. radial force F_r top of pivot *)	[N]	250	250	300
Max. radial force F_r middle of pivot *)	[N]	260	260	350
Max. axial force F_a *)	[N]	200	200	250

*) Forces determined for bearing service-life of 20000h

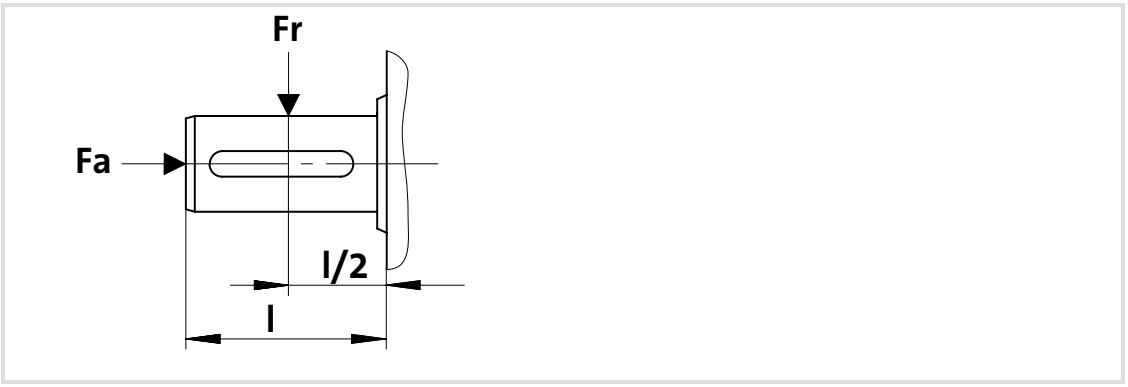


Fig. 8 Points of application of the radial (F_r) and axial force (F_a)

9 Index

CE

Lenze GmbH & Co KG Kleinantriebe
Hans-Lenze-Straße 1
D-32699 Extertal
Germany

☎ +49 (0) 51 54 82-0
☎ Service 00 80 00 24 4 68 77 (24 h helpline)
🖷 Service +49 (0) 51 54 82-1112
E-Mail Lenze@Lenze.de
Internet www.Lenze.com

GHB 13.0001-EN
EN 3.0

TD35

10 9 8 7 6 5 4 3 2 1