BA 13.0011-EN
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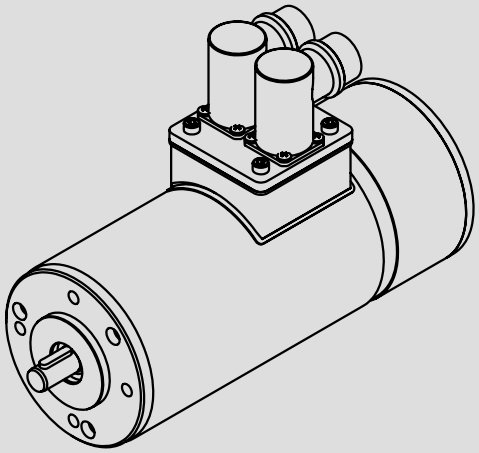
Operating Instructions

SDS..



SDSGS

Synchronous servo motors

Lenze

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

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1 About this documentation

Contents

- The present operating instructions are intended for safe working on and with the motors. They contain safety instructions that must be observed.
- All personnel working on and with the motors must have the operating instructions available during work and observe the information and notes relevant for them.
- The operating instructions must always be complete and in a perfectly readable state.

If the information and notes provided in this documentation do not meet your requirements, please refer to the controller and/or gearbox documentation.

Tip!

Documentation and software updates for further Lenze products can be found on the Internet in the ”Services & Downloads” area under

http://www.Lenze.com

Validity

This documentation is valid for synchronous servo motors:

Type	Designation
SDSGS□□ 035, 047, 056, 063	Synchronous servo motors

Target group

This documentation is directed at qualified skilled personnel according to IEC 60364.

Qualified skilled personnel are persons who have the required qualifications to carry out all activities involved in installing, mounting, commissioning, and operating the product.

1.1 Document history

Material no.	Version			Description
13314243	1.0	07/2009	TD09	First edition of the operating instructions, separate from three-phase AC motors

1.2 Conventions used

This documentation uses the following conventions to distinguish different types of information:

Type of information	Identification	Examples/notes
Spelling of numbers		
Decimal separator	Point	In general, the decimal point is used. For instance: 1234.56
Warnings		
UL warnings	ⓤL	Are only provided in English.
Icons		
Page reference	🕮	Reference to another page with additional information For instance: 🕮 16 = see page 16

1.3 Abbreviations used

Abbreviations			
P_r	Rated power	F_{r1}/F_{r2}	Permissible radial load
M_n	Rated torque	F_a	Permissible axial load
I_r	Rated current	n_r	Rated speed
U	Rated voltage	m_{Mot}	Motor weight (mass)
F	Rated frequency	N	max. speed
J	Moment of inertia	M	max. torque
ω	Angular velocity	M_K	Characteristic torque
I_{tot}	Total moment of inertia	M_L	Load torque
Q	Friction energy	W	Energy
U	Resulting supply voltage	L	Cable length
U_B	Rated voltage of the brake	I_B	Rated current of the brake
L_{phase}	Phase inductance	R_{UV}	Stator resistance

1.4 Terminology used

Term	In this text used for
Motor	Synchronous motor, versions according to product key, 🕮 15
Controller	Any servo inverter
Drive system	Drive systems with servo motors and other Lenze drive components

1.5 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

Special safety instructions and application notes for UL

Pictograph and signal word	Meaning
Warnings!	**Safety note or application note for operating UL approved devices in UL approved systems.** The operation of the drive system may not be UL compliant if the corresponding measures are not taken.

2 Safety instructions

2.1 General safety instructions for drive components

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

At the time of dispatch, the drive components are in line with the latest state of the art and can be regarded as operationally safe.

Scope

The following safety instructions generally apply to Lenze drive components.

The product-specific safety and application notes given in this documentation must be observed!

General hazards

Danger!

Disregarding the following basic safety measures may lead to severe personal injury and damage to material assets!

- Lenze drive components ...
  ... must only be applied as directed.
  ... must never be commissioned if visibly damaged.
  ... must never be technically modified.
  ... must never be commissioned if incompletely mounted.
  ... must never be operated without the required covers.
- All specifications of the corresponding enclosed documentation must be observed.
  This is vital for a safe and trouble-free operation as well as for achieving the specified product features.
- Only qualified, skilled personnel is permitted to work on and with Lenze drive components.
  According to IEC 60364 / CENELEC HD 384, these are persons who ...
  ... are familiar with the installation, mounting, commissioning, and operation of the product.
  ... have the qualifications required for their occupation.
  ... know and are able to apply all national regulations for the preventions of accidents, directives and laws applicable on site.

Transport, storage

- Transport and storage in a dry, low-vibration environment without aggressive atmosphere; preferably in the packaging provided by the manufacturer.
  - Protect against dust and shocks.
  - Comply with climatic conditions according to the technical data.
- Before transport
  - Check that all transport locking devices are mounted.
  - Tighten all transport aids.

Note!

Do not apply extra loads to the product as the transport aids (such as eye bolts or bearing plates) are designed for the weight of the motor only (refer to the catalogue for the weight).

Mechanical installation

- Install the product according to the regulations of the corresponding documentation. In particular observe the section ”Operating conditions” in the chapter ”Technical data”.
- Provide for a careful handling and avoid mechanical overload. During handling neither bend components, nor change the insulation distances.

Electrical installation

- Carry out the electrical installation according to the relevant regulations (e. g. cable cross-sections, fusing, connection to the PE conductor). Additional notes are included in the documentation.
- The documentation contains notes for the EMC-compliant installation (shielding, earthing, arrangement of filters and installation of the cables). The manufacturer of the system or machine is responsible for the compliance with the limit values required in connection with EMC legislation.
- For compliance with the limit values for radio interference emission at the site of installation, the components - if specified in the technical data - have to be mounted in housings (e. g. control cabinets). The housings have to enable an EMC-compliant installation. In particular observe that for example control cabinet doors preferably have a circumferential metallic connection to the housing. Reduce openings or cutouts through the housing to a minimum.
- Only plug in or remove pluggable terminals in the deenergised state!

Commissioning

- If required, you have to equip the system with additional monitoring and protective devices in accordance with the respective valid safety regulations (e. g. law on technical equipment, regulations for the prevention of accidents).
- Before commissioning remove transport locking devices and keep them for later transports.

2.2 Application as directed

Low-voltage machines are no household appliances, they are designed as components for industrial or professional use in terms of IEC/EN 61000-3-2 only.

They comply with the harmonised standards of the series IEC/EN 60034.

Low-voltage machines are components for installation into machines as defined in the Machinery Directive 2006/42/EC. Commissioning is prohibited until the conformity of the end product with this directive has been established (follow i. a. IEC/EN 60204-1).

It is only permissible to use low-voltage machines with IP23 protection or less outdoors if special protective measures are taken.

The integrated brakes must not be used as safety brakes. It cannot be ruled out that interference factors which cannot be influenced cause a brake torque reduction.

- Drives
  - ... must only be operated under the operating conditions and power limits specified in this documentation.
  - ... comply with the protection requirements of the EC Low-Voltage Directive.

Any other use shall be deemed inappropriate!

2.3 Improper use

- Do not operate the motors
  - ... in explosion-protected areas
  - ... in aggressive environments (acid, gas, vapour, dust, oil)
  - ... in water
  - ... in radiation environments

2.4 Residual hazards

Protection of persons

- Do not use the integrated brakes as fail-safe brakes. It cannot be ruled out that certain disruptive factors that cannot be influenced such as oil ingress due to a defective shaft sealing ring at the drive end may reduce the braking torque.

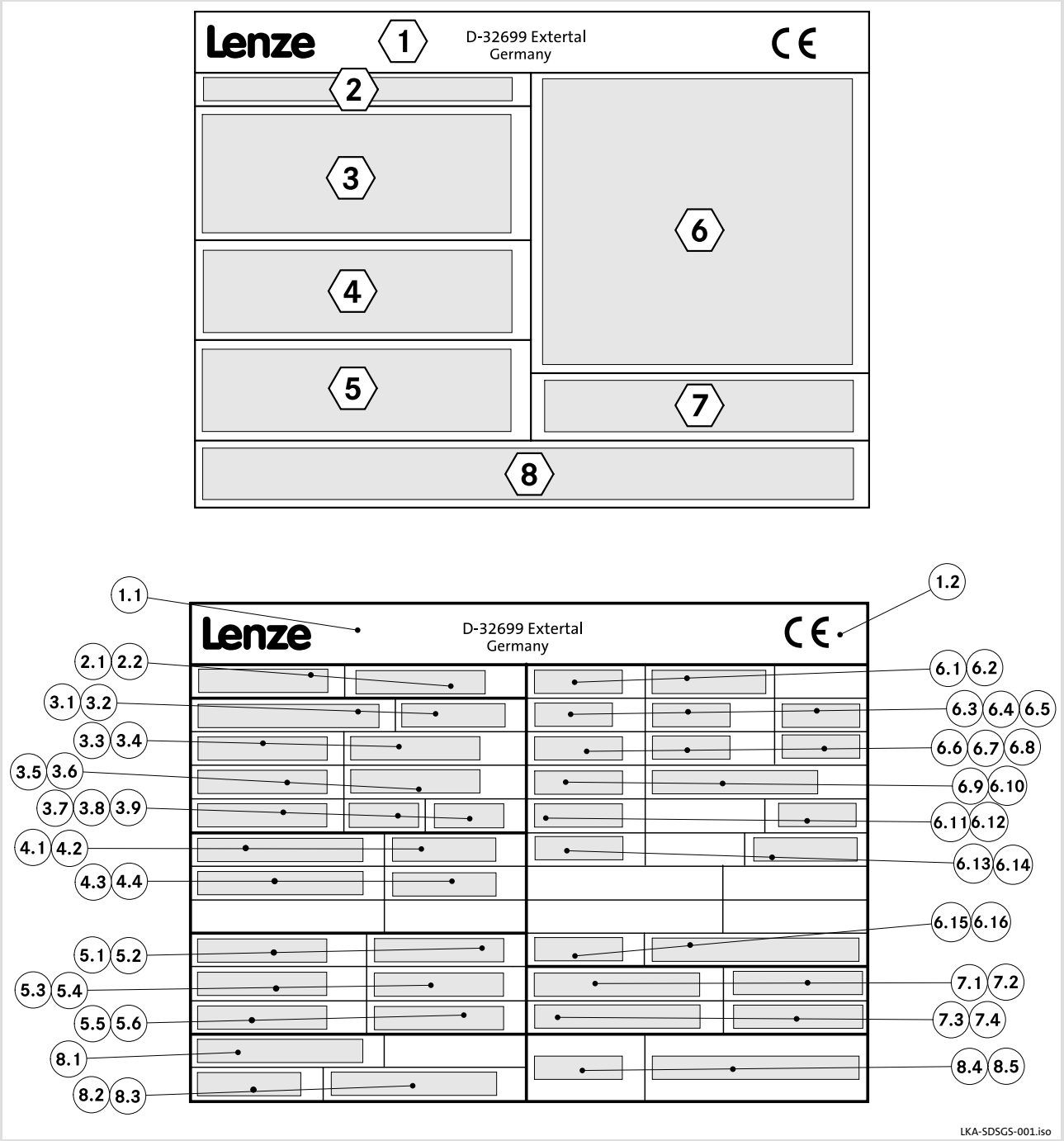
Motor protection

- Integrated temperature sensors do not provide full protection for the machine. If necessary, limit the maximum current. Parameterise the controller so that the motor will be switched off with $I > I_r$ after a few seconds of operation, especially if there is a risk of blocking.
- If deviations from normal operation occur, e.g. increased temperature, noise, vibration, determine the cause and, if necessary, contact the manufacturer. If in doubt, switch off the low-voltage machine.
- Overload protection does not protect against overloading under all conditions.

3 Product description

3.1 Identification

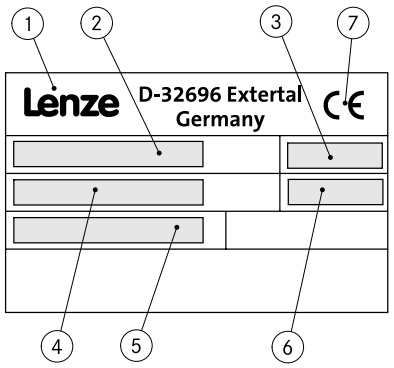
3.1.1 Nameplate



1	**General information**			
1.1	Manufacturer		1.2	Applicable conformity declarations and approvals
2	**Data on the complete drive system**			
2.1	Drives		2.2	Type of drive
3	**Inverter data**			
3.1	Inverter		3.6	Voltage / I=I_{max}
3.2	Type of inverter		3.7	Fieldbus
3.3	FW		3.8	RS232
3.4	HW		3.9	I/O
3.5	Input			
4	**Encoder data**			
4.1	Encoder / feedback		4.3	Encoder voltage
4.2	Type of encoder		4.4	Indicated voltage
5	**Gearbox data**			
5.1	Gearbox		5.4	Ratio
5.2	Gearbox type		5.5	Lubricant
5.3	Torque M_2 [Nm]		5.6	Type of lubricant
6	**Motor data**			
6.1	Motor		6.9	n_{max} (mechanical)
6.2	Motor type		6.10	C86 code
6.3	Motor type		6.11	Circuit, rated voltage
6.4	Rated power [kW]		6.12	Rated frequency
6.5	Degree of protection		6.13	Rated current
6.6	Rated torque		6.14	Rated speed
6.7	Operating mode		6.15	Insulation class of the winding
6.8	cos φ		6.16	Temperature sensor
7	**Brake data**			
7.1	Brake		7.3	Voltage, current, braking torque
7.2	Type of brake		7.4	Material number
8	**Production data**			
8.1	Customer order number		8.4	Serial number
8.2	Year of manufacture		8.5	Bar code
8.3	Ident no. of the drive			

Gearbox

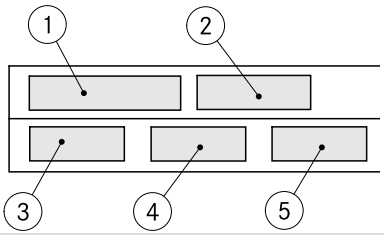
Pos.	Contents
1	Manufacturer
2	Gearbox type
3	Manufacturing date
4	Commission number
5	Torque M_2 [Nm]
6	Ratio
7	CE designation



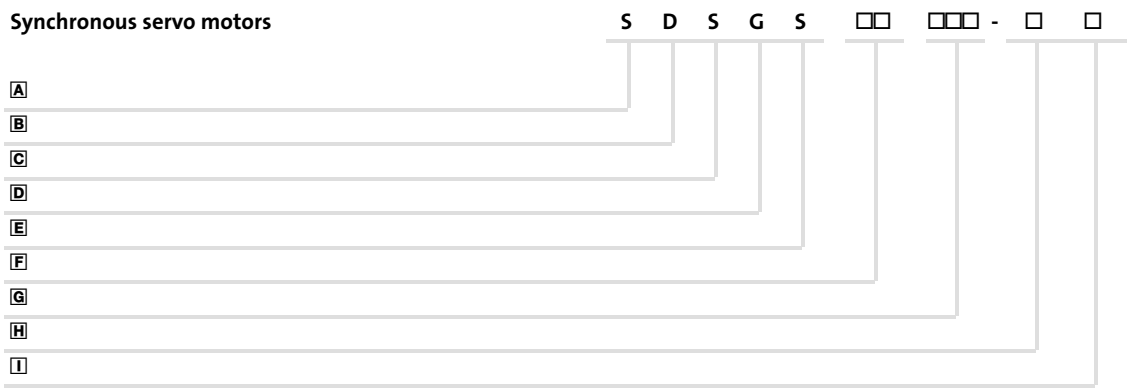
Brakes

Reference to installed brake

Pos.	Contents
1	Type / size of brake
2	Voltage [V] DC
3	Electrical power [W]
4	Braking torque [Nm]
5	Material number



3.1.2 Product key



Product key legend			
A	Product group	S	Small drives
B	Current type	D	Three-phase AC current
C	Ventilation	S	Self ventilation (cooling by convection and radiation)
D	Design/housing	G	Smooth and round housing
E	Machine type	S	Synchronous machine
F	Built-on accessories	RS	Resolver
		AG	Absolute value encoder
		BA	Brake and sin/cos absolute value encoder
		BS	Brake and resolver
G	Frame size	035, 047, 056, 063	
H	Overall length	1	short
		2	medium
		3	long
I	Number of pole pairs	2	

4 Technical data

4.1 General data and operating conditions

4.1.1 General data

Conformity and approval			
Conformity			
CE	2006/95/EC	Low-Voltage Directive	
Approvals			
UL/CSA	File no. E210321		

Protection of persons and equipment			
Degree of protection		See nameplate	
		Degrees of protection only apply to horizontal installation	
		All unused plug-in connections must be sealed with protective caps or dummy connectors.	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA	Observe stipulations and safety instructions!
Total fault current		< 100 mA Earth-leakage circuit breakers of type B can be used.	
Thermal class	F (155 °C) IEC 60034	Exceeding the temperature limit weakens or destroys the insulation	
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	
Protective measures		Short circuit on the motor side, earth fault when switching on the mains and during operation, motor overtemperature (input for PTC or thermal contact, I^2t monitoring)	
Permissible voltage	IEC/EN 60034-25	1.5 kV peak value 10 kV/µs speed of increase	
Vibration		Up to 2.0 g (20 m/s^2) without resonance excitation, e.g. of the fan.	

EMC		
Noise emission	IEC/EN 61800-3	Depending on the controller, see documentation for the controller.
Noise immunity		

4.2 Operating conditions

Ambient conditions			
Climatic			
Transport	IEC/EN 60721-3-2	2K3 (-20 ... +70 °C)	
Storage	IEC/EN 60721-3-1	1K3 (-20 ... +60 °C)	< 3 months
		1K3 (-20 ... +40 °C)	> 3 months
Operation	IEC/EN 60721-3-3	Without brake -15 °C ... +40 °C With brake -10 °C ... +40 °C	Without power reduction
		> +40 °C	With power reduction see, catalogue
Site altitude		< 1000 m amsl - without power reduction > 1000 m amsl < 4000m amsl with power reduction, see catalogue	
Humidity		Average relative humidity 85 %, without condensation	
Electrical			
The motor connection type depends on the controller			
Length of motor cable		See inverter instructions	
Length of cable for speed feedback			

Mounting conditions		
Mechanical		
Mounting positions		
Motor		Suitable for all mounting positions
Geared motor		Only for the ordered mounting position, see nameplate

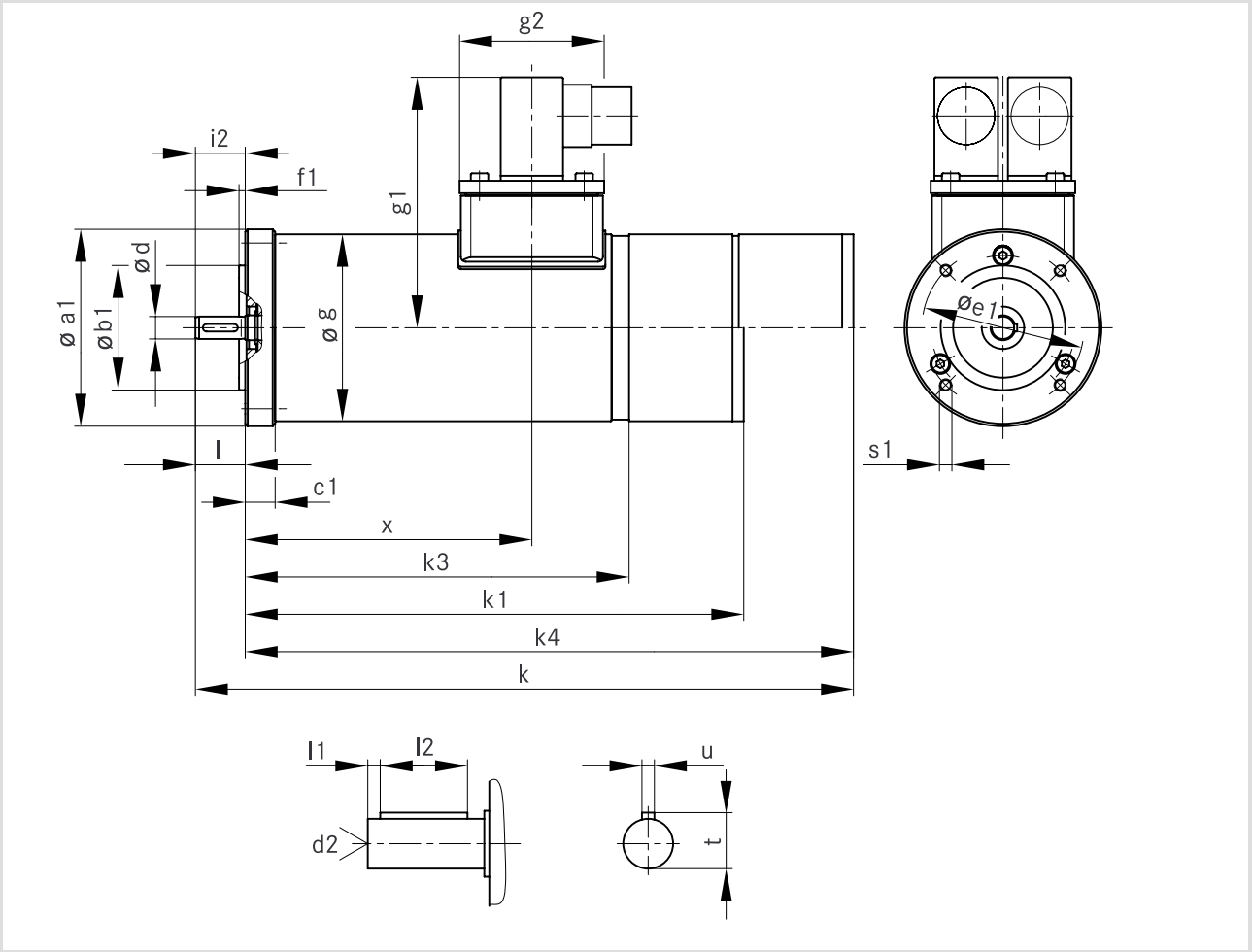
► Other application conditions require a power derating or torque reduction using the factors listed in table 2 and 3 (see below).

Power derating

Power derating for other application conditions					
Cooling air temperature [°C]	40	45	50	55	60
Power derating [k_{υ}]	1.00	0.95	0.90	0.83	0.77
Installation height above sea level [m]	1000	2000	3000	4000	5000
Power derating [k_h]	1.00	0.92	0.83	0.77	0.67

Tab. 1

4.3 Dimensions



Motor type	Frame size	a1	$b1_{j7}$	c1	d_{k6}	d2	e1	f1	G	g1	g2	i2	K BS
SDSGS□□ 035-22	IEC56C80	79	50	12	9	M3	65	2.5	65	95	58	20	224
SDSGS□□ 047-22	IEC56C80	79	50	12	9	M3	65	2.5	75	101	58	20	253
SDSGS□□ 047-22	IEC63C90	89	60	12	11	M4	75	2.5	75	101	58	23	256
SDSGS□□ 056-22	IEC63C90	89	60	12	11	M4	75	2.5	85	106	58	23	271
SDSGS□□ 063-22	IEC71C105	104	70	12	14	M5	85	2.5	95	111	58	30	283

Motor type	Frame size	k1		k3	k4		L	l1	l2	s1	t	U	X	Weight approx. kg
		RS	AG	XX	BS	BA								
SDSGS□□ 035-22	IEC56C80	169	180	138	204	225	20	3	14	M5	10.2	3	95	1.9 - 2.9
SDSGS□□ 047-22	IEC56C80	189	200	156	233	244	20	3	14	M5	10.2	3	115	3.0 - 4.0
SDSGS□□ 047-22	IEC63C90	489	200	156	233	244	23	3	18	M5	12.5	4	115	3.0 - 4.0
SDSGS□□ 056-22	IEC63C90	196	207	163	248	260	23	3	18	M5	12.5	4	120	4.0 - 5.5
SDSGS□□ 063-22	IEC71C105	199	214	168	253	268	30	2.5	25	M6	16	5	130	5.3 - 6.7

Tab. 2 Dimensions in mm

4.4 Rated data

- The most important rated data of the motor are indicated on the nameplate.
  – Further technical data can be obtained from the catalogues.
- The indicated torques and weights are guide values for the selection of the transmission elements and foundations.
- The rated data indicated on the nameplate refer to operation with Lenze servo inverters of the 9300 and 9400 series at an inverter input voltage (mains voltage) of 400 V.

Note!

- The motors can also be connected to inverters others than servo inverters of the 9300 and 9400 series:
  – Depending on the modulation and control performance of the inverter it might be necessary to derate the power if excessive temperatures are detected (see Tab. 1).

4.5 Rated data

SDSGS□□ 035-22

	Unit	Rated voltage [V] AC				
		13	25	30	210	360
Rated power	[W]	140	140	140	140	140
Rated frequency	[Hz]	100	100	100	100	100
Rated current	[A]	8.4	4.4	4.0	0.56	0.36
Power factor cosφ		1	1	1	1	1
Rated speed	[rpm]	3000	3000	3000	3000	3000
Rated torque	[Nm]	0.45	0.45	0.45	0.45	0.45
Degree of protection		54/55	54/55	54/55	54/55	54/55
Thermal class		F	F	F	F	F
Maximum current	[A]	47.5	26.5	22	3.3	2.05
Demagnetising current	[A]	86	48	40	6.0	3.8
Maximum torque	[Nm]	1.6	1.15	2.0	2.46	2.15
Maximum speed	[rpm]	6000	6000	6000	6000	6000
R_{UV} at 20°C	[Ω]	0.22	0.72	1.10	46.6	116.4
L_{phase}	[mH]	0.18	0.59	0.85	37.6	96.3
Moment of inertia	[kg cm²]	0.221	0.221	0.221	0.221	0.221

SDSGS□□ 047-22

	Unit	Rated voltage [V] AC			
		25	30	210	360
Rated power	[W]	170	210	250	250
Rated frequency	[Hz]	67	83	100	100
Rated current	[A]	6.2	6.2	1.1	0.71
Power factor cosφ		1	1	1	1
Rated speed	[rpm]	2000	2500	3000	3000
Rated torque	[Nm]	0.8	0.8	0.8	0.8
Degree of protection		54/55	54/55	54/55	54/55
Thermal class		F	F	F	F
Maximum current	[A]	31	31	5.5	3.55
Demagnetising current	[A]	41	41	7.5	4.8
Maximum torque	[Nm]	2.0	2.4	3.9	3.9
Maximum speed	[rpm]	6000	6000	6000	6000
R_{UV} at 20°C	[Ω]	0.61	0.61	18.6	46.8
L_{phase}	[mH]	0.846	0.846	25.7	63.85
Moment of inertia	[kg cm²]	0.301	0.301	0.301	0.301

SDSGS□□ 056-22

	Unit	Rated voltage [V] AC		
		30	210	360
Rated power	[W]	450	500	500
Rated frequency	[Hz]	100	100	100
Rated current	[A]	12.5	1.93	1.2
Power factorcosφ		1	1	1
Rated speed	[rpm]	3000	3000	3000
Rated torque	[Nm]	1.6	1.6	1.6
Degree of protection		54/55	54/55	54/55
Thermal class		F	F	F
Maximum current	[A]	62.5	9.65	6
Demagnetising current	[A]	146	14.6	9.1
Maximum torque	[Nm]	3.0	8.6	8.52
Maximum speed	[rpm]	6000	6000	6000
R_{UV} at 20°C	[Ω]	0.19	6.92	17.8
L_{phase}	[mH]	0.28	10.85	27.8
Moment of inertia	[kg cm^2]	1.337	1.337	1.337

Characteristics SDSGS□□ 063-22

	Unit	Rated voltage [V] AC	
		210	360
Rated power	[W]	700	700
Rated frequency	[Hz]	100	100
Rated current	[A]	2.45	1.54
Power factor cosφ		1	1
Rated speed	[rpm]	3000	3000
Rated torque	[Nm]	2.2	2.2
Degree of protection		54/55	54/55
Thermal class		F	F
Maximum current	[A]	12.5	7.7
Demagnetising current	[A]	14.0	8.4
Maximum torque	[Nm]	11.5	11.8
Maximum speed	[rpm]	6000	6000
R_{UV} at 20°C	[Ω]	3.98	10.4
L_{phase}	[mH]	7.9	22.1
Moment of inertia	[kg cm^2]	2.032	2.032

4.5.1 Shaft loads

The permissible loads listed in the table (Tab. 3) are either radial forces or axial forces.

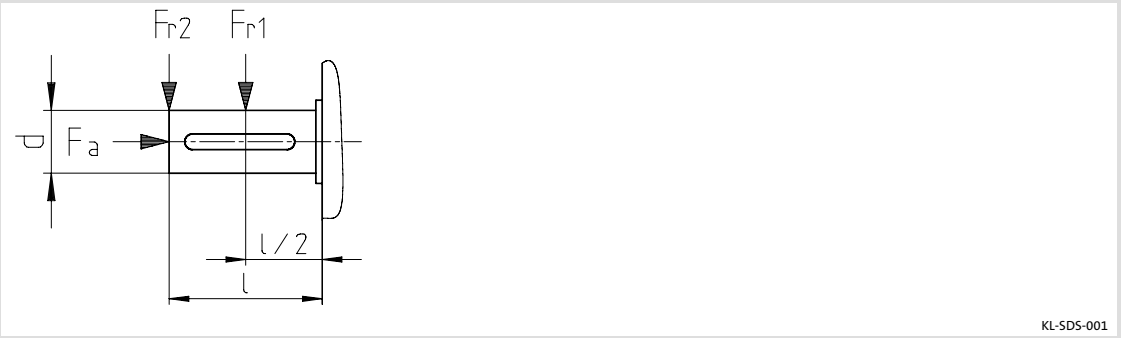


Fig. 1 Points of action of radial and axial loads

F_a	Permissible axial load	Ref. to the nominal bearing service life of 10,000 h
F_{r1}	Permissible radial load, acts on the **middle** of the shaft	
F_{r2}	Permissible radial load, acts on the **end** of the shaft	

Motor type		F_{r1} / F_{r2} N	F_a N
SDSGS□□	035-22	350/300	250
	047-22	560/530	430
	056-22	650/605	510
	063-22 / 32		

Tab. 3 Radial and axial forces

5 Mechanical installation

5.1 Preparation

Remove the corrosion protection from the shaft ends and flanges. If necessary, remove dirt using standard cleaning solvents.

Stop!

Bearings or seals must not come into contact with the solvent - material damages.

After a long storage period (> 1 year) you have to check whether moisture has entered the motor. For this purpose, measure the insulation resistance (measuring voltage 500 V_{DC}). In case of values ≤1kΩper volt of rated voltage, dry the winding.

5.2 Assembly of built-on accessories

Note!

Follow these instructions carefully. Please note that the warranty and product liability will become void in the event of impermissible alterations or modifications to the motors.

Follow the instructions below carefully. Please note that, in the event of impermissible alteration or modification of the motor, you will lose all entitlements to make claims under warranty and to benefit from product liability obligations.

- Mount the transmission elements:
  - Shocks and impacts must be avoided! They could destroy the motor.
  - Always use the centre bore in the motor shaft (in accordance with DIN 332, design D) for mounting.
  - Tolerances of the shaft ends:
    ≤ ∅ 50 mm: ISO k6, > ∅ 50 mm: ISO m6.
- Only use an extractor for the disassembly.
- When using belts for torque/power transmission:
  - Tension the belts in a controlled manner.
  - Provide protection against accidental contact! During operation, surface temperatures of up to 140°C are possible.

5.3 Installation

- ► The mounting surface must be dimensioned for the design, weight and torque of the motor.
- ► The foot and flange faces must rest flat on the mounting surface.
  – Incorrect motor alignment reduces the service life of the roller bearings and transmission elements.

Impacts on shafts can cause bearing damage.

- ► Do not exceed the permissible range of ambient operating temperature (📖 chapter 4.1).
- ► Fasten the motor securely.
- ► Ensure that the ventilation is not impeded. The exhaust air, also the exhaust air of other machines next to the drive system, must not be taken in immediately.
- ► During operation, surfaces are hot, up to 150 °C! Ensure that guard preventing accidental contact is in place!

Ensure an even surface, solid foot/flange mounting and exact alignment if a direct clutch is connected. Avoid resonances with the rotational frequency and double mains frequency which may be caused by the assembly.

Use appropriate means to mount or remove transmission elements (heating) and cover belt pulleys and clutches with a touch guard. Avoid impermissible belt tensions.

5.4 Holding brake (option)

5.4.1 Important notes

As an option, the motors can be fitted with a brake. The installation of brakes (in or on the motor) increases the length of the motor.

Note!

The brakes used are not fail-safe because interference factors, which cannot be influenced (e.g. oil ingress), can lead to a reduction in torque.

The brakes are used as holding brakes and serve to hold the axes at standstill or in the deenergised state.

Emergency stops at higher speeds are possible, but high switching energy increases wear on the friction surfaces and the hub (see wear of brakes, page 27 and 28).

The brakes operate according to the closed-circuit principle, i.e. the brake is closed in the deenergised state. The brakes for DC supply can be fed with a bridge-rectified DC voltage (bridge rectifier) or with a smoothed DC voltage. Information on the permissible voltage tolerance is provided in the respective motor catalogue.

If long motor supply cables are used, pay attention to the ohmic voltage drop along the cable and compensate for it with a higher voltage at the input end of the cable.

The following applies to Lenze system cables:

$$U^* = U_B + \left[\frac{0.08\ \Omega}{m} \cdot L \cdot I_B\right]$$

U^* [V]	Resulting supply voltage
U_B [V]	Rated voltage of the brake
l [m]	Cable length
I_B [A]	Rated current of the brake

Stop!

If no suitable voltage (incorrect value, incorrect polarity) is applied to the brake, the brake will be applied and can be overheated and destroyed by the motor continuing to rotate.

The shortest operating times of the brakes are achieved by DC switching of the voltage and a suppressor circuit (varistor or spark suppressor). Without suppressor circuit, the operating times may increase. A varistor/spark suppressor limits the breaking voltage peaks. It must be ensured that the power limit of the suppressor circuit is not exceeded. This limit depends on the brake current, brake voltage, disengagement time and the switching operations per time unit.

Furthermore, the suppressor circuit is necessary for interference suppression and also increases the service life of the relay contacts (external, not integrated in the motor).

Please refer to the catalogue for servo motors for detailed information about holding brakes.

Note!

The brake cannot be readjusted. When the wear limit is reached, the brake has to be replaced.

5.4.2 Permanent magnet holding brakes

These brakes are used as holding brakes and serve to hold the axes without backlash at standstill or in the deenergised state.

When activating the brake, it must be ensured that the brake is released or engaged at zero speed to avoid unnecessary and rapid wear of the brake.

When used solely as holding brakes, the brakes are virtually wear free on their friction surfaces. If the max. permissible switching energy per emergency stop (see catalogue) is not exceeded, at least 2000 emergency stop functions from a speed of 3000 rpm are possible.

$W = ½ \cdot J_{ges} \cdot \omega^2$	W [J]	Energy
	J_{tot} [kgm²]	Total moment of inertia
	ω [$^1/_s$]	Angular velocity $\omega=2\pi\ ^n/_{60}$, n= speed [rpm]

The holding torques specified in the catalogue only apply when the motor is at standstill. In the case of a slipping brake, the dynamic braking torque always applies which depends on the speed.

Stop!

The holding brake is only designed for a limited number of emergency stops. Utilisation as a working brake, e.g. to decelerate a load, is not permissible.

Note!

The brakes are maintenance-free and cannot be adjusted. In the event of wear, e.g. through emergency stops, the brakes must be replaced.

These brakes operate according to the closed-circuit principle, i.e. the brake is closed in the deenergised state.

Brakes with a rated voltage of DC 24 V are designed for smoothed DC voltages with a ripple of <1 %. It must be ensured that the connector on the motor side is supplied with the minimum voltage of DC 24 V -10 %. If necessary, the voltage drop in the cable should also be considered. If the maximum voltage DC 24 V + 5 % is exceeded, the brake can close again. Supplying the brake with bridge-rectified DC voltage (bridge rectifier without additional smoothing) or a DC voltage with a ripple of >1 % can lead to a malfunctioning of the brake or an increase in the engagement and disengagement times.

Brakes with a rated voltage of DC 205 V are designed for bridge-rectified DC voltage, i.e. for supply via a bridge rectifier from the 230 V mains (half-wave rectifiers are not permissible). Supplying the brake with smoothed DC voltage can lead to malfunctioning or an increase in the engagement and disengagement times. With regard to the minimum and maximum voltages, the same conditions apply as for brakes with 24 V, i.e. the permissible voltage tolerance is 205 V DC +5 %, -10 %.

Wear of permanent magnet brakes

If applied as directed (application as holding brakes), the permanent magnet brakes of the servo motors are wear free and intended for long operating times. The wear on the friction lining is due to e.g. emergency stops.

The table below describes the different reasons for wear and their impact on the components of the permanent magnet brakes.

Component	Effect	Influencing factors	Cause
Friction lining / friction surface at the armature plate and external pole	Wear on the friction lining	Applied friction energy	Braking during operation (impermissible, holding brakes!)
			Emergency stops
			Overlapping wear when the drive starts and stops
			Active braking by the drive motor with the help of the brake (quick stop)
Springs	Fatigue failure of the springs	Number of switching operations of the brake	Axial duty cycle of the springs
Permanent magnet	Useless brake	Temperature, overvoltage	Excessive overvoltages / temperatures

Stop!

In case of wear above the maximum air gap (📖 brake operating instructions), application of the brake cannot be ensured. In this case, no braking process is carried out.

5.4.3 Spring-applied holding brakes

These brakes are used as holding brakes and serve to hold the axes without backlash at standstill or in the deenergised state.

For permissible operating speeds and characteristics, please see the respective valid motor catalogue. Emergency stops at higher speeds are possible, but high switching energy increases wear on the friction surfaces and the hub.

Stop!

The friction surfaces must always be free from oil and grease because even small amounts of grease or oil will considerably reduce the braking torque.

The formula below provides a simplified way to calculate friction energy per switching cycle which must not exceed the limit value for emergency stops that depends on the operating frequency (📖 motor catalogue; Lenze drive solutions: Formulas, dimensioning, and tables).

$$Q = ½ \cdot J_{ges} \cdot \Delta\omega^2 \cdot \frac{M_K}{M_K - M_L}$$

Q [J]	Friction energy
J_{tot} [kgm²]	Total mass inertia (motor + load)
$\Delta\omega$ [$^1/_s$]	Angular velocity $\omega = 2\pi\, ^n/_{60}$, n= speed [rpm]
M_K [Nm]	Characteristic torque
M_L [Nm]	Load torque

Depending on the operating conditions and possible heat dissipation, the surface temperatures can be up to 130 °C.

The spring-applied brakes operate according to the closed-circuit principle, i.e. the brake is closed in the deenergised state. The brakes can be fed with a bridge-rectified DC voltage (bridge rectifier) or with a smoothed DC voltage. The permissible voltage tolerance is ±10%.

For more information on spring-applied brakes, please refer to the corresponding catalogues and operating instructions of the brakes.

Wear on spring-applied brakes

Spring-applied brakes are wear-resistant and designed for long maintenance intervals.

However, the friction lining, the teeth between the brake rotor and the hub, and also the braking mechanism are naturally subject to wear due to the way in which the equipment functions. In order to ensure safe and problem-free operation, the brake must therefore be checked regularly and, if necessary, replaced.

If the brake is used purely as a holding brake, the amount of wear on the friction surfaces is only very small. Emergency stops increase wear on the friction surfaces.

The following table describes the different causes of wear and their effect on the components of the spring-applied brake. In order to calculate the service life of the rotor and brake and determine the required maintenance intervals, the relevant influencing factors must be quantified. The most important factors are the applied friction energy, the starting speed of braking and the switching frequency. If several of the indicated causes of wear on the friction lining occur in an application, their effects are to be added together.

Component	Cause	Effect	Influencing factors
Friction lining	Emergency stops	Wear on the friction lining	Applied friction energy
	Overlapping wear when the drive starts and stops		
	Active braking by the drive motor with the help of the brake (quick stop)		
	Starting wear if motor is mounted in a position with the shaft vertical, even if the brake is open		Number of start-stop cycles
Armature plate and flange	Rubbing of the brake lining	Running-in of armature plate and flange	Applied friction energy
Teeth of the brake rotor	Relative movement and impacts between brake rotor and brake hub	Teeth wear (primarily at the rotor end)	Number of start-stop cycles, level of the braking torque
Armature plate bracket	Load changes and impacts due to reversal error during interaction between armature plate, cap screws and guide bolts	Armature plate, cap screws and bolts are deflected	Number of start-stop cycles, level of braking torque
Springs	Axial load cycle and shearing stress on the springs due to radial reversed error of the armature plate	Fatigue failure of the springs	Number of switching operations of the brake

6 Electrical installation

6.1 Important notes

Danger!

Hazardous voltage on the power connections even when disconnected from mains: residual voltage >60 V!

Before working on the power connections, always disconnect the drive component from the mains and wait until the motor is at standstill.
Verify safe isolation from supply!

Stop!

Electrical connections must be carried out in accordance with the national and regional regulations!

- The connection must ensure a permanent and safe electrical supply, i.e.
  - no loose wire ends,
  - use assigned cable end fittings,
  - establish a safe PE conductor connection,
  - Tighten the plug-in connector to the limit stop.
- The smallest air gaps between uncoated, live parts and against earth must not fall below the following values:

Minimum requirements for basic insulation according to IEC/EN 60664-1 (CE)	Higher requirements for UL design	Motor diameter
3.87 mm	6.4 mm	< 178 mm

- All unused cable entries must be sealed against dust and water.

Voltage supply

- Inverter-optimised motors
  - must be supplied by inverters.
  - connect the encoders mounted to the motor with the corresponding connections of the inverter.
- Holding brake (as option)
- Follow the Operating Instructions for the inverter used to connect it.

Cable cross-section

- Select appropriate connection cables to avoid impermissible heating (DIN 57100/VDE 0100 T523).
- When extremely long cables are used, we recommend to use the next cable cross section up to reduce the power losses. Observe the minimum cross sections to DIN VDE 0298-4.
- Establish the electrical connection as shown in the circuit diagram attached to each motor. The circuit diagrams for the standard designs can be found in chapter 6.3.

Motor protection

- The motor cable cannot be protected by temperature monitorings or PTC thermistors in the motor winding:
  – Take measures to DIN 57100 / VDE 0530.
- The inverter changes current and voltage such that the output current can be considerably higher than the input current. The motor cable cannot be protected via the mains input fuses of the inverter:
  – Take measures to DIN 57100 / VDE 0530.
- Ensure careful earthing of the motor housing!
  – If the motor is inverter driven, high-frequency voltages may be capacitively transferred to the motor housing.

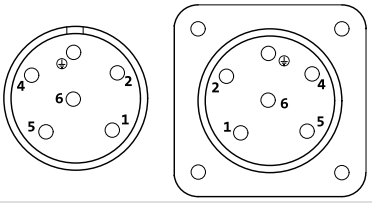
6.2 Wiring according to EMC

The EMC-compliant wiring of the motors is described in detail in the Operating Instructions for the Lenze controllers.

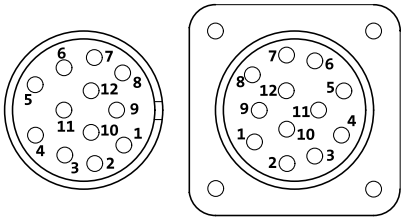
- Use of metal EMC cable glands with shield connection.
- Connect the shielding to the motor and to the device.

6.3 Connection plan

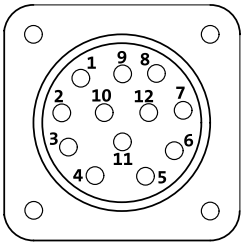
... for motor and brake

SDSGS□□ -	Pin No.	Connection name	Connection to:	Pin assignment
035-22 047-22 056-22 063-22 063-22/32	1	Y1	Brake	
	2	Y2		
	PE	PE	Circuit breaker	
	4	U	Motor phase	
	5	V		
	6	W		

... for resolver and thermal contact

SDSGS□□ -	Pin No.	Connection name	Connection to:	Pin assignment
035-22 047-22 056-22 063-22 063-22/32	1	+ Ref	Resolver	
	2	- Ref		
	3			
	4	+ cos	Resolver	
	5	- cos		
	6	+ sin		
	7	- sin		
	8			
	9			
	10			
	11	+	KTY/thermal switch	
	12	-		

... for absolute value encoder and thermal contact

SDSGS□□ -	Pin No.	Connection name	Connection to:	Pin assignment
035-22 047-22 056-22 063-22 063-22/32	1	B	Track B / + SIN	
	2	$\overline{A}$	Track A inverted / - COS	
	3	A	Track A	
	4	+ 5V	Supply + 5V + 8V	
	5	GND	Earth	
	6	$\overline{Z}$	Zero track inverted / - RS485	
	7	Z	Zero track / + RS485	
	8		Not assigned	
	9	$\overline{B}$	Track B inverted / - SIN	
	10		Not assigned	
	11	+ KTY	Thermal detector +	
	12	- KTY	Thermal detector -	

7 Commissioning and operation

7.1 Important notes

Stop!

- ► Ensure that the drives are disconnected from the power supply when working on them!
- ► The drive must only be commissioned by qualified personnel!
- ► Do not use the drive in rooms exposed to explosion danger!
- ► Danger of fire! Do not use flammable detergents or solvents to clean the drive.
- ► Avoid overheating! Deposits and dirt on the drives impede the necessary heat dissipation and must be removed frequently.

Ensure that no foreign particles ingress into the motor!

For trial run without output elements, lock the featherkey. Do not deactivate the protective devices, not even in a trial run.

Check the correct operation of the brake before commissioning motors with brakes.

7.2 Before switching on

Note!

Before switch-on, you must ensure that the motor starts with the intended direction of rotation.

Lenze motors rotate CW (looking at the driven shaft) if a clockwise three-phase field L1 → U1, L2 →V1, L3 → W1 is applied.

Before initial commissioning, before commissioning after an extended standstill period, or before commissioning after an overhaul of the motor, the following must be checked:

- Measure the insulation resistance, in case of values ≤1 kΩper volt of rated voltage, dry the winding.
- Have all screwed connections of the mechanical and electrical parts been firmly tightened?
- Is the unrestricted supply and removal of cooling air ensured?
- Has the PE conductor been connected correctly?
- Have the protective devices against overheating (temperature sensor evaluation) been activated?
- Is the controller correctly parameterised for the motor? (📖 Controller operating instructions)
- Are the electrical connections o.k.?
- Does the motor connection have the correct phase sequence?
- Are rotating parts and surfaces which can become very hot protected against accidental contact?
- Is the contact of good electrical conductivity if a PE connection on the motor housing is used?

7.2.1 Servo motor parameters

Motor SDSGS□□	Code for 9300 and 9400	
	Mains voltage / AC current	C86
035-22	210 V AC	1409
	360V AC	1413
047-22	210 V AC	1410
	360V AC	1414
056-22	210 V AC	1411
	360V AC	1415
063-22	210 V AC	1412
	360V AC	1416

7.3 Functional test

7.4 Functional test

- Check all functions of the drive after commissioning:
- Direction of rotation of the motor
  – Direction of rotation in the disengaged state (see chapter ”Electrical connection”).
- Torque behaviour and current consumption
- Function of the feedback system

7.5 During operation

Stop!

- Fire hazard! Do not clean or spray motors with flammable detergents or solvents.
- Avoid overheating! Deposits on the drives impede the heat dissipation required and have to be removed regularly.

Danger!

During operation, motor surfaces may not be touched. According to the operating status, the surface temperature for motors can be up to 150°C. For the protection against burn injuries, provide protection against contact, if necessary. Observe cooling-off times!

Perform regular inspections during operation. Check the drives approx. every 50 operating hours. Pay particular attention to:

- Unusual noises
- Oil spots on drive end or leakages
- Irregular running
- Increased vibration
- Loose fixing elements
- Condition of electrical cables
- Speed variations
- Impeded heat dissipation through:
  – Deposits on the drive system

In case of irregularities or faults: 📖 chapter 9.

8 Maintenance/repair

8.1 Important notes

Danger!

Hazardous voltage on the power connections even when disconnected from mains: residual voltage >60 V!

Before working on the power connections, always disconnect the drive component from the mains and wait until the motor is at standstill.
Verify safe isolation from supply!

Shaft sealing rings and rolling-contact bearings have a limited service life.

8.2 Maintenance intervals

Inspections

- If the machine is exposed to dirt, clean the air channels regularly.
- Check the power supply cables on a regular basis.

Motor

- Only the bearings and shaft sealing rings become worn.
  – Check bearings for noise (after approx. 15,000 h at the latest).
- In order to prevent overheating, remove dirt deposits on the drives regularly.
- We recommend carrying out an inspection after the first 50 operating hours. In this way, you can detect and correct any irregularities or faults at an early stage.

Holding brake

The brakes need to be checked on a regular basis to ensure safe and trouble-free operation.

The necessary maintenance intervals primarily depend on the stress to which the brake is subjected in an application. When a maintenance interval is being calculated, all causes of wear must be taken into account (see notes ”Wear on spring-applied brakes”). In the case of brakes which are subjected to low levels of stress, e.g. holding brakes with emergency stop function, regular inspections at a fixed time interval are recommended. In order to reduce the amount of work involved in maintenance, perform the inspection at the same time as other maintenance work carried out cyclically on the machine if possible.

If the brakes are not properly serviced, operating faults, production outages or damage to machinery can occur. A maintenance concept adapted to the operating conditions and the stresses to which the brakes are subjected must therefore be drawn up for every application. For brakes, the maintenance intervals and servicing work listed in the following table are necessary.

Maintenance interval for holding brake with emergency stop	Maintenance work
At least every 2 years	Inspection of the brake integrated in the motor: ● Check ventilation function and activation/deactivation
After 1 million cycles at the latest	
Shorter intervals in the case of frequent emergency stops!	

8.3 Repair

► It is recommended to have all repairs performed by Lenze Service.

9 Troubleshooting and fault elimination

If faults occur during operation of the drive system:

► First check the possible causes of malfunction according to the following table.

Note!

Also observe the corresponding chapters in the operating instructions to the other components of the drive system.

If the fault cannot be remedied using one of the listed measures, please contact the Lenze Service.

Danger!

► Only work on the drive system when it is in a deenergised state!
► Hot motor surfaces of up to 150 °C. Observe cooling times!
► Remove loads acting on motors or secure loads acting on the drive!

Fault	Cause	Remedy
Motor does not start	Voltage supply interrupted	● Check error message at the controller ● Check electrical connection (chapter 6)
	Controller inhibited	● Check display at drive controller ● Check controller enable
	Resolver cable is interrupted	● Check error message at the controller ● Check resolver cable
	Brake does not release	Check electrical connection
		Check continuity of magnetic coil
	Drive blocks	Check components for easy movement, remove foreign particles if necessary
Motor suddenly stops and does not restart	Overtemperature protector switch is activated	● Let motor cool down – Reduce the load by prolonging the acceleration times
	Overload monitoring of the inverter is activated	● Check controller settings ● Reduce the load by prolonging the acceleration times
Incorrect direction of rotation of the motor, correct display on the controller	Reversed motor cable and resolver cable	Exchange 2 phases of the motor cable **and** the +COS/-COS connections of the resolver
Motor rotates slowly in one direction and cannot be influenced by the controller	Polarity reversal of motor or resolver cable	Exchange 2 phases of the motor cable **or** the +COS/-COS connections of the resolver
Motor does not rotate, gearbox output is not running	Defective wheel-hub connection	Check the connection, replace the keyway, if necessary, repair by the manufacturer
	Toothing worn out	Repair by manufacturer
Irregular running	Insufficient shielding of motor or resolver cable	Check shielding and grounding (chapter 6)
	Drive controller gain too large	Adjust the gains of the controllers (see Drive controller operating instructions)
Vibrations	Insufficiently balanced coupling elements or machine	Rebalance
	Poor alignment of the drive train	Realign machine unit, check foundation if necessary
	Loose fixing screws	Check and tighten screw connections
Running noises	Foreign particles inside the motor	Repair by manufacturer, if necessary
	Bearing damage	Repair by manufacturer, if necessary
Surface temperature > 150 °C	Overload of the drive	Check load and, if necessary, reduce load by prolonging the acceleration times
	Heat dissipation impeded by deposits	Clean surface and cooling fins of the drives

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