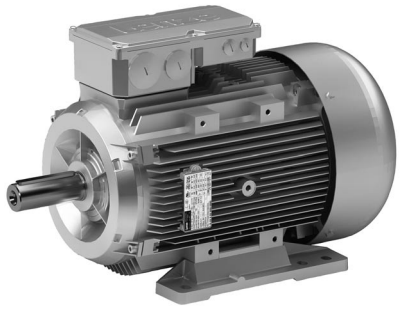


AC motors

m540-P |
1.1 kW ... 55 kW

Three-phase AC motors

Operating instructions EN

Lenze

Please read these instructions before you start working!

Follow the safety instructions enclosed.

Note!

For safety-rated built-on accessories, the manufacturer’s operating instructions have to be observed!

i Contents

Contents

- Die vorliegende Dokumentation dient dem sicheren Arbeiten an und mit den Antrieben. Sie enthält Sicherheitshinweise, die Sie beachten müssen.
- Alle Personen, die an und mit den Antrieben arbeiten, müssen bei ihren Arbeiten die Dokumentation verfügbar haben und die für sie wesentlichen Angaben und Hinweise beachten.
- Die Dokumentation muss immer komplett und in einwandfrei lesbarem Zustand sein.

Note!

Sollten die Angaben dieser Dokumentation in Ihrem Fall nicht ausreichen, sehen Sie bitte in der Dokumentation der Getriebe nach.

Tip!

Information and tools concerning the Lenze products can be found in the download area at

www.lenze.com

Validity

This documentation is valid for three-phase AC motors:

Type	Name
m540-P	Three-phase AC motors (squirrel-cage induction motor)

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 number	Version			Description
	1.0	06/2021	TD09	First edition together with the Ecodesign Directive

1.2 Conventions used

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

Type of information	Writing	Example/notes
Numeric notation		
Decimal	Standard notation	Example: 1234
Decimal separator	Point	The decimal point is always used. For example: 1234.56
Icons		
Page reference	🕮	Reference to another page with additional information For instance: 🕮 16 = see page 16
Documentation reference	🌍	Reference to another documentation with additional information Example: 🌍 EDKxxx = see EDKxxx documentation
Wildcard	□	Wildcard for options, selection data

1.3 Terminology used

Term	Describes the following
Motor	Three-phase AC motor (squirrel cage induction motor) in versions according to product key, 🕮 13 .
Inverter	Any servo inverter Any frequency inverter
Drive system	Drive systems including three-phase AC motors and other Lenze drive components

1.4 Notes used

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

Safety instructions

Layout of the 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 trouble-free operation
 **Tip!**	Useful tip for easy handling
	Reference to another document

2.1 General safety instructions for drive components

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 general safety instructions apply to all Lenze drive and automation 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 and automation components ...
  ... must only be used for the intended purpose.
  ... must never be operated if damaged.
  ... must never be subjected to technical modifications.
  ... must never be operated unless completely assembled.
  ... must never be operated without the covers/guards.
  ... can - depending on their degree of protection - have live, movable or rotating parts during or after operation. Surfaces can be hot.
- All specifications of the corresponding enclosed documentation must be observed.
  This is vital for safe and trouble-free operation and for achieving the specified product features.
- Only qualified skilled personnel are permitted to work with or on Lenze drive and automation components.
  According to IEC 60364 or CENELEC HD 384, these are persons ...
  ... who are familiar with the installation, assembly, commissioning and operation of the product,
  ... possess the appropriate qualifications for their work,
  ... and are acquainted with and can apply all the accident prevent regulations, directives and laws applicable at the place of use.

Storage

- In a dry, low-vibration environment without aggressive atmosphere;
- In the original packaging;
- Protect against dust and impacts;
- Observe climatic conditions according to the technical data.

Storage conditions

- Up to one year:
  – Shafts and uncoated surfaces are delivered with rust protection. Aftertreatment is required where the corrosion protection has been damaged.
- More than one year, up to two years:
  – Apply a long-term corrosion preventive (e.g. Anticorit BW 366 from the Fuchs company) to the shafts and uncoated surfaces before storing the motor away.

Transport

Before transport

- Make sure that all components are securely mounted;
- Make sure that all components with a loose fastening are secured or removed;
- Tighten all transport aids (eyebolts or support plates).

Use lifting devices for the transport! (📖 19)

Stop!

Danger by tipping or falling loads!

Observe carrying capacities!

- The payload of the hoists and load handling devices must at least correspond to the weight of the load, for weights see the delivery documents.
- Secure the load to prevent it from tipping over or falling down.
- Standing beneath suspended loads is prohibited!

Risk of breakage!

The motors are partly equipped with transport eyebolts that are **solely** intended for mounting/dismounting the motor to/from the gearbox and that **must not** be used for transport of the geared motor!

Danger!

Completely screw in transport aids (such as eye bolts or bearing plates), they must be flat and applied over their entire surface!

If possible, the transport aids (such as eye bolts or bearing plates) must be stressed vertically in the direction of the screw axis! Angular tension or tension to the sides reduces the payload! Observe the information provided in DIN 580!

Use additional appropriate lifting aids, if required, to achieve a direction of loading which is as vertical as possible (highest payload). Secure lifting aids against shifting!

Corrosion protection

Lenze offers paints with different resistance characteristics for drive systems. Since the resistance may be reduced when the paint coat is damaged, defects in paint work (e.g. through transport or assembly) must be removed professionally to reach the required corrosion resistance.

Mechanical installation

- Provide for 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.
- 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

All products which this documentation applies to are no household appliances but are exclusively intended as components for re-utilisation for commercial use or professional use in terms of IEC/EN 61000-3-2. They meet the requirements of the Low-Voltage Directive 2014/35/EU and the requirements of the harmonised standards of the IEC/EN 60034 series.

Only use the products under the operating conditions and power limits specified in this documentation.

Do not use the brakes installed as fail-safe brakes. It cannot be ruled out that the braking torque is reduced by disruptive factors which cannot be influenced.

Low-voltage machines with IP23 protection or less are only intended for outdoor use when applying special protective features.

Products included in the scope of application of the EU regulations (EG) 640/2009 and (EU) 4/2014 (and hence ErP Directive 2009/125/EG) and which did not comply with minimum efficiency requirements when first put into circulation, are not CE compliant and will not receive CE marking. The product is for exclusive use outside the European Economic Area (EEA) only.

Motors of efficiency class IE2 with a rated power of 7.5 kW ... 375 kW, which are included in the scope of application of the EU regulations (EG) 640/2009 and (EU) 4/2014 and which were put into circulation in the European Economic Area (EEA) after December 31, 2014 (7.5 kW ... 375 kW) or after December 31, 2016 (0.75 kW ... 375 kW), may be exclusively used there on a frequency inverter for speed control only. These motors receive the following additional marking.

Any other use shall be deemed inappropriate!

2.3 Foreseeable misuse

- Do not use motors/geared motors
  - ... in explosion-protected areas
  - ... in aggressive environments (acids, gases, vapours, dusts, oils)
  - ... under water
  - ... under radiation

Note!
Increased surface and corrosion protection can be achieved by using adapted coating systems.

2.4 Residual hazards

Protection of persons

- The motor surfaces can become very hot. Danger of burns when touching!
  - Provide protection against accidental contact, if necessary.
- Danger of unintentional starting or electrical shocks
  - Connections must only be made when the equipment is deenergised and the motor is at standstill.
  - Installed brakes are no fail-safe brakes.

Motor protection

- Installed thermal detectors are **no full protection** for the machine.
  - Installed overload protection does not prevent an overload under any conditions.
- Installed brakes are **no fail-safe brakes**.
  - The torque may be reduced by disruptive factors that cannot be influenced such as contamination by oil.
- Fuses are no motor protection.
  - Use current-dependent motor protection switches at average operating frequency.
  - Use installed thermal detectors at high operating frequency.
- Too high torques cause a fraction of the motor shaft.
  - The maximum torques according to catalogue must not be exceeded.
- Lateral forces from the motor shaft may occur.
  - Align shafts of motor and driving machine exactly to each other.
- 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 motor.

Fire protection

- Fire hazard
  – Prevent contact with flammable substances.

2.5 Disposal

Sort individual parts according to their properties. Dispose of them as specified by the current national regulations.

3.1 Identification

3.1.1 Motor name

Each motor has a motor name and a motor code. In the sales documents, the motors are identified by the motor name. The technical documentation and nameplate show the motor code.

The table below shows a list of the motor names and the first eleven digits of the corresponding motor code:

m540-P	
Motor name	**Motor code**
m540-P90/M4	M54AP090M04
m540-P90/L4	M54AP090L04
m540-P100/M4	M54AP100M04
m540-P100/L4	M54AP100L04
m540-P112/M4	M54AP112M04
m540-P132/M4	M54AP132M04
m540-P132/L4	M54AP132L04
m540-P160/M4	M54AP160M04
m540-P160/L4	M54AP160L04
m540-P180/M4	M54AP180M04
m540-P180/L4	M54AP180L04
m540-P200/M4	M54AP200M04
m540-P225/M4	M54AP225M04
m540-P225/L4	M54AP225L04
m540-P250/M4	M54AP250M04

3.1.2 Motor code

Three-phase AC motor m540-P

Example		M	54	A	P	090	M	04	5	E	0	0	C	C
Product type	Motor	M												
Product family			54											
Product generatio				A										
Efficiency class	Premium - IE3				P									
Size						090								
						100								
						112								
						132								
						160								
						180								
						200								
						225								
						250								
Overall length	Medium						M							
	Long						L							
Number of poles	4-pole							04						
Enclosure	IP55								5					
	IP65								6					
Cooling	Self-ventilation									E				
	Forced ventilation									F				
Brake attachment	No brake										0			
	Spring-applied brake										F			
Act. value encoder	No encoder											0		
	Incremental encoder											E		
Approvals	No approval												N	
	CE												C	
	CE, cURus												U	
Design version	Internal key													C

3.1.3 Encoder code

Encoder code

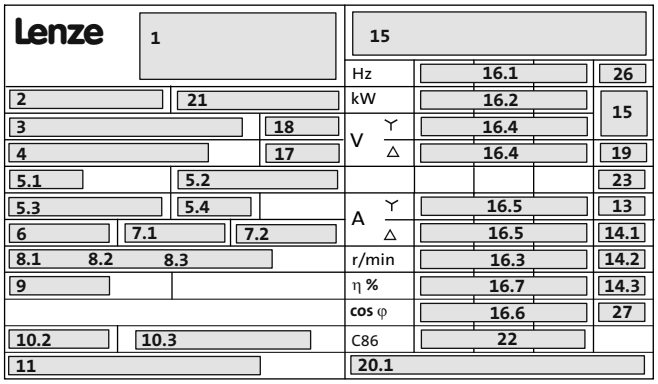
Example		SFC	1024	-	8V	-	K	2
Meaning	**Type**	**Encoder code**						
Product line	Resolver	RS						
	Resolver for safety function	RV						
	Incremental encoder	IG						
	Incremental encoder with commutation signal	IK						
	Singleturn absolute value encoder	SFC						
	Multitum absolute value encoder	AM						
Number	2-pole resolver for servo motors		0					
	2-pole resolver for three-phase AC motors		1					
	Number of pole pairs for resolvers		2, 3, 4,...					
	Number of steps / increments per revolution		32, 128, 512, 1024, 2048, ...					
Voltage	Medium supply voltage			-	5V, 8V, 15V, 24V, ...			
Interface or signal level	Standard							
	TTL						T	
	HTL (for incremental encoders)						H	
	Hiperface (for absolute value encoders)						H	
	EnDat						E	
	sin/cos 1 V_{ss}					-	S	
	For safety function							
	TTL						U	
	HTL (for incremental encoders)						K	
	Hiperface (for absolute value encoders)						K	
	EnDat						F	
	sin/cos 1 V_{ss}						V	
	Safety integration level (SIL)							1
								2
								3
								4

Note!

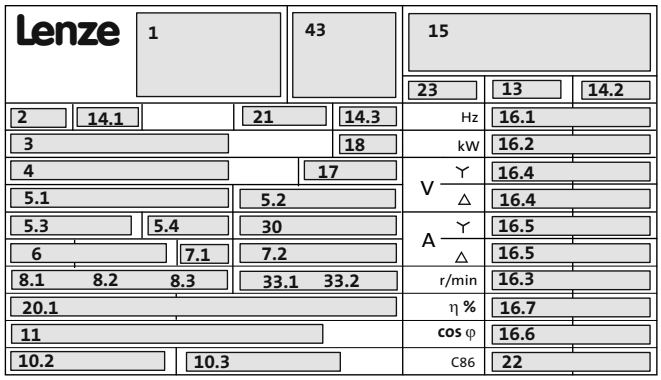
If feedback systems for safety functions are used, the manufacturer's documentation must be observed!

3.1.4 Nameplate

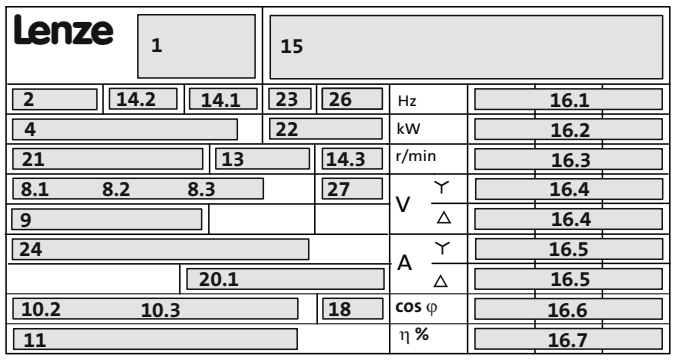
Geared motor with a directly mounted motor (layout A)



Geared motor with a directly mounted motor (layout B, with QR code)



Three-phase AC motor with a standard output flange



Pos.		Contents
1		Manufacturer / production location
2		Type of motor / standard
3		Gearbox type
4		Motor type
5		Technical data
5	5.1	Ratio
5	5.2	Rated torque
5	5.3	Rated speed
5	5.4	Rated frequency
6		Position of system modules / mounting position
7		Lubricant details
7	7.1	Lubricant amount
7	7.2	Lubricant type
8		Brake data
8	8.1	Type
8	8.2	AC/DC brake voltage
8	8.3	Braking torque, electrical power input
9		For feedback / pulse encoder or resolver data, 🕮 15
10		Production data
10	10.2	Material number
10	10.3	Serial number
11		Bar code
13		Information with regard to the operating mode
14		Additional motor specifications
14	14.1	Temperature class
14	14.2	Enclosure
14	14.3	Motor protection
15		Applicable conformities, approvals and certificates
16		Rated data for various frequencies
16	16.1	Hz = frequency
16	16.2	kW = motor power
16	16.3	rpm = motor speed
16	16.4	V = motor voltage
16	16.5	A = motor current
16	16.6	$\cos \varphi$ = motor power factor
16	16.7	η = motor efficiency: at a rated power of 100%
17		Application factor / load capacity
18		Year of manufacture / week of manufacture
19		UL file number
20		Customer data
20	20.1	Additional customer data
21		UL category (e.g. inverter duty motor)
22		C86 = motor code for inverter parameterisation (code 0086)
23		Efficiency class
24		Partial load efficiencies for 50Hz operation at a rated power of 50% and 75%
26		CC number Department of Energy (optional)
27		Permissible ambient temperature (e.g. Ta $\leq$ 40°C)
30		Weight
43		Internal key: QR code

4.1 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
	2009/125/EC	ErP Directive Regulation No. 4/2014 and No. 640/2009 on the ecodesign of electric motors	
	2014/30/EU	EMC Directive	
EAC	TP TC 004/2011 (TR CU 004/2011)	On safety of low voltage equipment	Eurasian Conformity TR CU: Technical Regulation of Customs Union
EAC	TP TC 020/2011 (TR CU 020/2011)	Electromagnetic compatibility of technical means	Eurasian Conformity TR CU: Technical Regulation of Customs Union

Approvals			
UL	UL 1004-8	File No. E210321	Inverter Duty Motors Motors and Generators
CSA	CSA C22.2 No. 100		
Energy Verified	CFR Part 431.23	File No. E210321 CC1278B	Energy Efficiency Program for Certain Commercial and Industrial Equipment
	CSA C390-10		Energy Efficiency Test Methods for Three-Phase Induction Motors
CCC	GB Standard 12350-2009	Safety requirements of small-power motors	

The applicable approvals for the product you have ordered require labelling and are specified on the nameplate.

Protection of persons and devices			
Enclosure	IEC/EN 60034-5	See nameplate	
		Degrees of protection only apply to horizontal installation	
		All unused connectors must be closed with protection covers or blanking plugs.	
Temperature class	F (155 °C) IEC/EN 60034-1	Exceedance of the temperature limit weakens or destroys the insulation	

Operating conditions

Ambient conditions			
Climatic			
Transport	IEC/EN 60721-3-2	2K3 (-20 °C ... +70 °C)	
Storage	IEC/EN 60721-3-1	1K3 (-20 °C ... +60 °C)	< 3 months
		1K3 (-20 °C ... +40 °C)	> 3 months
Operation	IEC/EN 60721-3-3	3K3 (-20 °C ... +40 °C)	Without brake
		3K3 (-10 °C ... +40 °C)	With brake
		> +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		Relative humidity ≤ 85 %, without condensation	
Mechanical			
	IEC/EN60721-3-3	3M6	

5.1 Important notes

Danger!

Some of the motors mounted to the gearboxes are equipped with transport aids. They are **only** intended for the mounting/dismounting of the motor to the gearbox and must **not** be used for the entire geared motor!

- Only move the drive with means of transport or hoists that have sufficient load-bearing capacity.
- Ensure safe fixing.
- Avoid shocks!

5.2 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 $\leq$1kΩper volt of rated voltage, dry the winding.

5.3 Installation

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

Blows to shafts can cause damage to the bearings.

- Do not exceed the permissible range of ambient operating temperature (📖 18).
- Securely fasten the motor.
- Ensure unobstructed ventilation. The exhaust air, also that of adjacent aggregates, must not be inlet again immediately.
- During operation, surface temperatures of up to 140 °C are possible! Protect against contact!

Note!

From the air inlet to other component parts, a minimum distance of 10% of the outer diameter of the fan cover must be complied with!

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

Only mount or remove transmission elements using appropriate means. In order to facilitate handling, heat them beforehand. Cover belt pulleys and clutches with a touch guard.

Stop!

Ensure a correct belt tension!

The machines are halfkey balanced. The clutch must be halfkey balanced, too. The visible jutting out part of the key must be removed.

Designs with shaft end at the bottom must be protected with a cover at the N-end, preventing the ingress of foreign particles into the fan.

5.4 Assembly of built-on accessories

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.

- Mount the transmission elements:
  - Shocks and impacts must be avoided! They could destroy the motor.
  - For mounting always use the centre bore in the motor shaft as specified by DIN 332-DR-M...
  - 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.

5.5 Spring-applied brakes

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) may 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, (📖 35).

The spring-applied brakes work on the basis of 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. The permissible voltage tolerance is ±10 %.

In case of long motor cables the voltage drop must be checked due to increasing conductor resistance and compensated for by higher input voltage if necessary.

The following applies to Lenze system cables:

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

U^* [V]	Resulting supply voltage
U_B [V]	Rated voltage of the brake
I [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 an external 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 for increasing the service life of the relay contacts (external, not integrated into the motor).

For permissible operating speeds and characteristics, please see the motor catalogue applicable in each case. 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).

$$Q = \frac{1}{2} \times J_{ges} \times \Delta\omega^2 \times \frac{M_K}{M_K - M_L}$$

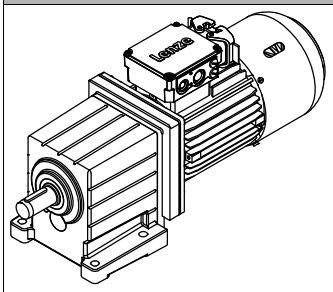
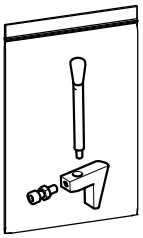
Q [J]	Friction energy
J_{tot} [kgm²]	Total mass inertia (motor + load)
$\Delta\omega$ [$^1/_s$]	Angular velocity $\omega = 2\pi\, ^n/_{60}$, n= speed [rpm]
M_K [Nm]	Characteristic torque
M_L [Nm]	Load torque

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

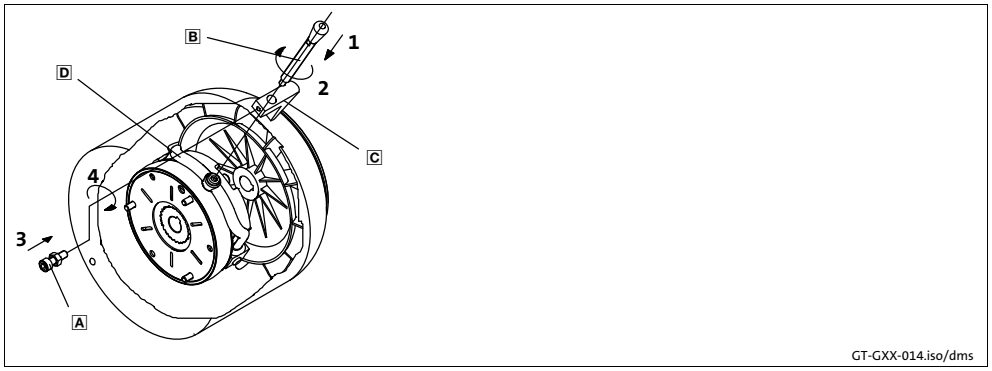
More detailed information on the used brakes is provided in the corresponding catalogues.

5.6 Locking of the manual release

Scope of supply

Geared motor	Shipping bag
 GT-GNG-GST-010.iso/dms	 GT-GXX-012.iso/dms GT-GXX-013.iso/dms • 1 Manual release lever with knob • 1 Terminal block • 1 Cheese head screw with nut

Mounting

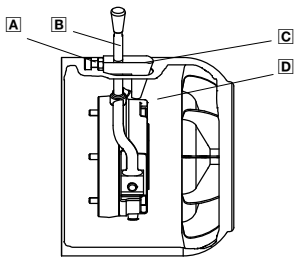
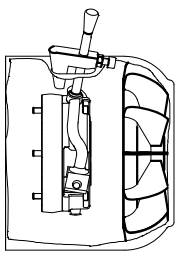


A	Cheese head screw with nut	C	Terminal block
B	Manual release lever with knob	D	Manual release shackle (brake)

Handling

Stop!

- Lock the manual release only for service work!
- The manual release must not be locked during operation, otherwise the brake could be damaged!
- Always secure the terminal block against loosening in every position with cheese head screw and nut!

Brake not released / operating position	Brake released / service position
	

A	Cheese head screw with nut	C	Terminal block
B	Manual release lever with knob	D	Fan cover

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!

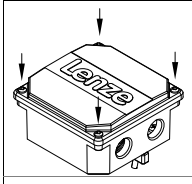
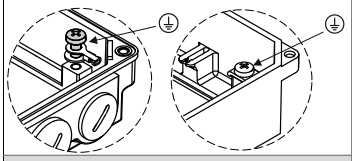
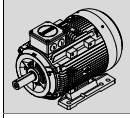
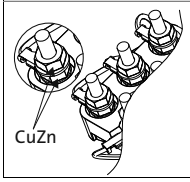
Stop!

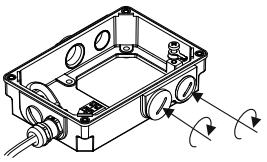
Electrical connections must be carried out in accordance with the national and regional regulations!

- Observe tolerances according to IEC/EN 60034-1:
  - Voltage ±10 %
  - Frequency ±2 %
  - Wave form, symmetry (increases heating and affects electromagnetic compatibility)
- Observe notes on wiring, information on the nameplate, and the connection scheme in the terminal box.
- The terminal box has to be free of foreign bodies, dirt, and humidity.
- All unused cable entries and the box itself must be sealed against dust and water.
- The connection must ensure a continuous and safe electrical supply, i.e.
  - no loose wire ends,
  - use assigned cable end fittings,
  - ensure good electrical conductivity of the contact (remove residual lacquer) if an (additional) PE connection on the motor housing is used,
  - establish a safe PE conductor connection,
  - tighten the plugin connector to the limit stop,
  - all connections at the terminal board are tightened.
- The smallest air gaps between uncoated, live parts and against earth must not fall below the following values.

Motor diameter	Minimum requirements for basic insulation according to IEC/EN 60664-1 (CE)	Higher requirements for UL design
< 178 mm	3.87 mm	6.4 mm
> 178 mm		9.5 mm

Tightening torques

[Nm] +/- 10%	M4	M5	M6	M8	M10
	2.2	3.5	4.5	-----	-----
	2.5	3.5	-----	-----	-----
	063...080	090...112	132...160	180...200	225
 CuZn	1.5	2.0	3.5	6.0	8.0



m540-P

[Nm] Material	M12x1.5	M16x1.5	M20x1.5	M25x1.5	M32x1.5	M40x1.5	M50x1.5
Plastics	4	4	4	4	6	6	6
Metal	8	10	12	12	18	18	20

Tab. 1 Locking screws and cable glands

6.2 Three-phase AC motor operation on a frequency inverter

Drehstrommotoren m540-P sind für den Einsatz an Lenze Frequenzumrichtern optimiert und qualifiziert und **können** ohne Einschränkungen kombiniert werden.

Bei Betrieb an einem Fremdumrichter dürfen die im Diagramm dargestellten Spannungsspitzen (U_{pk}) bei gegebener Anstiegszeit (t_R) nicht überschritten werden.

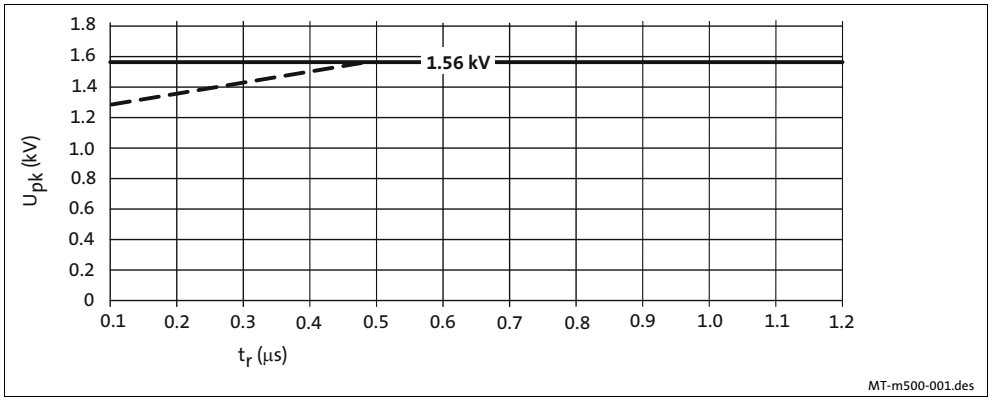


Fig. 1 Zulässige Spannungsspitzen bei Betrieb am Frequenzumrichter

– – – – IEC/TS 60034-25:2007 (entspricht IVIC C/B/B @500 V): m540-P

——— Lenze Standard A+: m500-P, m550-P

Mögliche Gegenmaßnahmen

Ist nicht auszuschließen, dass die zulässigen Spannungsspitzen überschritten werden, sind geeignete Gegenmaßnahmen zu ergreifen:

- Reduzierung der Zwischenkreisspannung (Einsatzschwelle der Brems-Chopper-Spannung);
- Einsatz von Filtern, Drosseln;
- Einsatz von speziellen Motorleitungen.

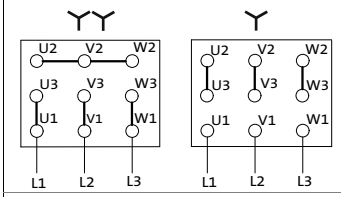
6.3 EMC-compliant wiring

The EMC-compliant wiring of the motors is described in detail in the operating instructions for the Lenze inverters.

- Using metal EMC cable glands with shield connection.
- Shield connection at the motor and the device.
- Shield connection at the terminal strip encoder.

6.3.1 Power connections on the terminal board

Motor

Multivoltage motors M54AP

MT_MXXXX_001.iso/dms

Legend for the circuit diagrams	
L1/L2/L3	Power connection
YY	Low voltage
Y	High voltage

Temperature monitoring

Terminal strip / terminal board		
Contact	**Meaning**	**Note**
(1)TB1	Thermal contact - TCO	Max. 250 V~ Max. 1.6 A ~
(1)TB2		
(1)TP1	PTC thermistor	
(1)TP2		
(1)R1	Thermal sensor +KTY	Observe polarity
(1)R2	Thermal sensor -KTY	

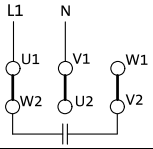
Terminal board or terminal possible for all thermal sensors.

Blowers via blower terminal box / motor terminal box

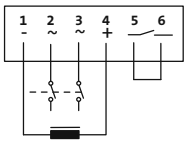
Blower 3~

Terminal board		
Contact	**Meaning**	**Note**
U1	Connection to L1 - mains	Observe direction of rotation! In case of wrong direction of rotation, L1 - L2 must be interchanged
V1	Connection to L2 - mains	
W1	Connection to L3 - mains	

Separate fan 1~

Terminal board		
Contact	**Meaning**	**Note**
U1		Connection to L1 - mains
V1 / U2		Connection to N - mains

6.3.2 Brake connection to terminal

Contact	Meaning	Additional specifications
~	AC-excited brake (rectifier)	Connection to L1 - mains
~		Connection to N - mains
+		Brake connection
-		Brake connection
⊶		Switching contact, DC switching
BD1 / 1BD1 / 5	Brake, DC operated	DC connection
BD2 / 1BD2 / 6		
MS1 / 2S1 / 32	Brake microswitch, release control	Two-way switch
MS2 / 2S2 / 33		NC contact
MS4 / 2S3 / 34		NO contact
MS1 / 3S1 / 35	Brake microswitch, wear control	Two-way switch
MS2 / 3S2 / 36		NC contact
MS4 / 3S3 / 37		NO contact
MS1	Brake microswitch, manual release	Two-way switch
MS2		NC contact
MS4		NO contact

6.3.3 Feedback system

Resolver		
Contact	**Name**	**Meaning**
B1 B2	+ Ref - Ref	Transformer windings (reference windings)
B3	Not assigned	
B4 B5	+COS -COS	Stator winding cosine
B6 B7	+SIN -SIN	Stator winding sine
B8	Not assigned	

Incremental encoder / sin/cos absolute value encoder with Hiperface		
Terminal	**Designation**	**Meaning**
B1 B2	+ U_B GND	Supply + Mass
B3 B4	A / + COS $\overline{A}$ / Ref cos	Track A / process data channel Track A inverse / process data channel
B5 B6	B / + SIN $\overline{B}$ / Ref sin	Track B / process data channel Track B inverse / process data channel
B7 B8	Z / data + $\overline{Z}$ / data -	Zero track / parameter channel + RS485 Zero track inverse / parameter channel - RS485
B10 [1)]	Shield - housing	Shield - incremental encoder

1) The terminal is not assigned if insulation at N-end shield of the motor has been selected!

7.1 Important notes

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

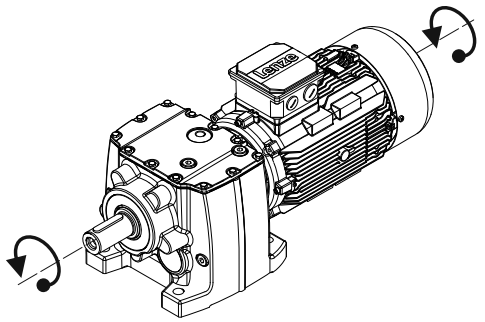
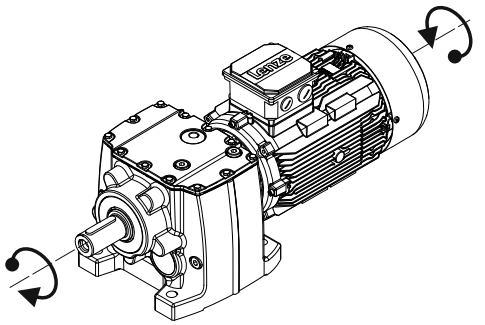
Note!

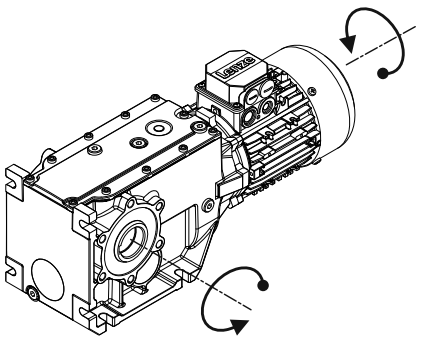
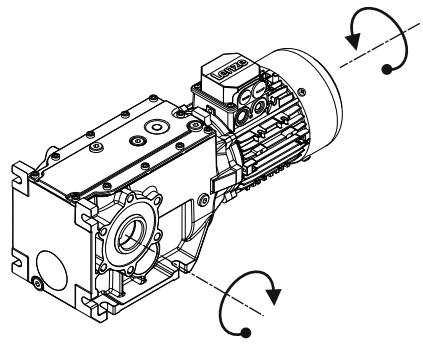
Before switch-on, you must ensure that the motor starts with the intended direction of rotation.

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

Please check the following:

- Drive function - machine function assignment
- The direction of rotation of the drive shaft

g500-H 2-stage	g500-H 3-stage
	

All sizes except for: g500-B240/G50BB124 3-stage	Only: g500-B240/G50BB124 3-stage
	

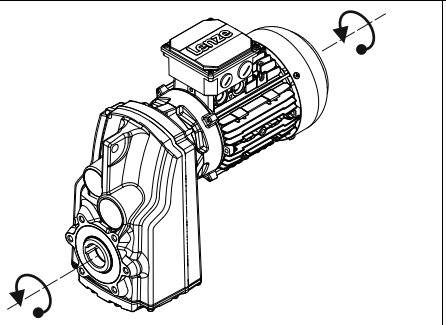
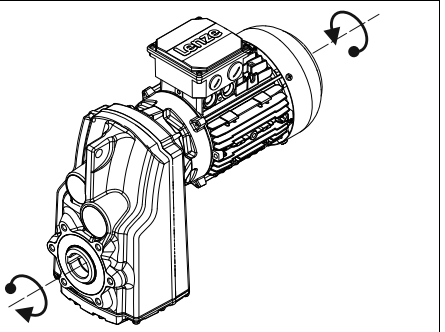
g500-S 2-stage	g500-S 3-stage
	

Fig. 2 Rotating direction of drive shaft (here with three-phase motor)

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

- The oil level of the gear unit after previous long-term storage!
- Check the drive for external damage!
- Measure the insulation resistance, in case of values ≤1 kΩ per 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 inverter correctly parameterised for the motor? (Inverter 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?

7.3 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

7.4 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 must not be touched. According to the operating status, the surface temperature for motors can be up to 140°C. For the protection against burn injuries, provide protection against contact, if necessary. Observe cooling-off times!

During operation, carry out inspections on a regular basis. Pay special 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
  - Deposits on the drive system and in the cooling channels
  - Pollution of the air filter

In case of irregularities or faults: (📖 44).

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 roller bearings have a limited service life.

Regrease bearings with relubricating devices while the low-voltage machine is running. Only use the grease recommended by the manufacturer.

If the grease drain holes are sealed with a plug, (IP54 drive end; IP23 drive and nondrive end), remove plug before commissioning. Seal bore holes with grease.

8.2 Maintenance intervals

Inspections

- If the machine is exposed to dirt, clean the air channels regularly.

8.2.1 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.

8.2.2 Encoder

Stop!

Repair work or replacement of defective safety encoders must only be carried out by Lenze service personnel!

After a service life of 10 years, an inspection of the metal elastomer torque plate is required for the AS1024-8V-K, AS1024-8V-K2; AM1024-8V-K, and AM1024-8V-K2 encoders. If no replacement is required, an inspection interval of max. 5 years has to be observed.

8.2.3 Spring-operated brakes

To ensure safe and trouble-free operation, spring-applied brakes must be checked and maintained at regular intervals. Servicing can be made easier if good accessibility of the brakes is provided in the plant. This must be considered when installing the drives in the plant.

Primarily, the necessary maintenance intervals for industrial brakes result from the load during operation. When calculating the maintenance interval, all causes for wear must be taken into account, ((📖 36). For brakes with low loads such as holding brakes with emergency stop, we recommend a regular inspection at a fixed time interval. To reduce the cost, the inspection can be carried out along with other regular maintenance work in the plant if necessary.

If the brakes are not maintained, failures, production losses or damage to the system may occur. Therefore, a maintenance concept adapted to the particular operating conditions and brake loads must be defined for every application. For the spring-applied brakes, the maintenance intervals and maintenance operations listed in the below table must be provided. The maintenance operations must be carried out as described in the detailed descriptions.

Type	Service brake	Holding brake with emergency stop
Spring-applied brake	• according to service life calculation • otherwise every six months • after 4,000 operating hours at the latest	• at least every two years • after 1 million cycles at the latest • provide shorter intervals in the case of frequent emergency stops

8.3 Maintenance operations

8.3.1 Motor

Stop!

- Make sure that no foreign bodies can enter the inside of the motor!
- Do not remove plugs when voltage is being applied!

Danger!

- Only work on the motor when it is deenergised!
- Hot motor surfaces of up to 140 °C. Observe cooling times!
- Remove loads acting on motors or secure loads acting on the drive!

8.3.2 Spring-operated brakes

The brake is mounted to the N-end shield of the motor. Remove the fan cover or blower unit or the encoder, if available, to check, maintain, or set the brake.

Note!

Brakes with defective armature plates, cheese head screws, springs or counter friction faces must always be replaced completely.

Generally observe the following for inspections and maintenance works:

- Remove oil and grease linked impurities using brake cleaning agents, if necessary, replace brake after identifying the cause of the contamination. Dirt deposits in the air gap between stator and armature plate impair the function of the brake and must be removed.
- After replacing the rotor, the original braking torque will not be reached until the run-in operation of the friction surfaces has been completed. After replacing the rotor, run-in armature plates and counter friction faces have an increased initial rate of wear.

Wear on spring-applied brakes

The used spring-applied brakes have a low rate of wear and are 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 function-related wear which depends on the application case (see table). In order to ensure safe and problem-free operation, the brake must therefore be checked and maintained regularly and, if necessary, replaced (see brake maintenance and inspection).

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 useful life of the rotor and brake and determine the maintenance intervals to be prescribed, 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	Effect	Influencing factors	Cause
Friction lining	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)
		Number of start-stop cycles	Starting wear if motor is mounted in a position with the shaft vertical, even if the brake is open
Armature plate and flange	Running-in of armature plate and flange	Applied friction energy	Friction between the brake lining and the armature plate or flange e.g. during emergency braking or service brake operation
Teeth of the brake rotor	Teeth wear (primarily at the rotor end)	Number of start-stop cycles, Level of the braking torque, Dynamics of the application, Speed fins in operation	Relative movement and impacts between brake rotor and brake hub
Armature plate bracket	Armature plate, cap screws and bolts are deflected	Number of start-stop cycles, Level of braking torque	Load changes and impacts due to reversal error during interaction between armature plate, cap screws and guide bolts
Springs	Fatigue failure of the springs	Number of switching operations of the brake	Axial load cycle and shearing stress on the springs due to radial reversing error of the armature plate

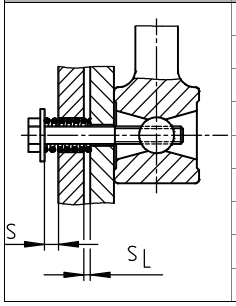
Tab. 2 Causes for wear

8.3.3 Checking the component parts

With a mounted brake	• Check ventilation function and activation/deactivation • Check air gap (if required, re-adjust it) • Measure rotor thickness (if required, replace rotor) • Thermal damage of the armature plate or flange (tarnished in dark blue)	🕮 38 🕮 38 🕮 37
With a dismounted brake	• Check clearance of the rotor gear teeth (replace rotors that are damaged by vibration) • Damage by vibration of the torque support at the sleeve bolts, cylindrical pins, and armature plate • Check springs for damage • Check armature plate and flange or end shield – Evenness for size 06...12 < 0.06 mm – Evenness from size 14 < 0.1 mm – Max. run-in depth = rated air gap of the design size	🕮 39

Check the mounting dimension of the manual release

Stop!
Dimension "s" must be maintained! Check air gap "s_L"!
(📖 operating instructions)

	Size	s_L (mm)	$s^{+0.1}$ (mm)	$s + s_L$ (mm)
	06	0.2	1	1.2
	08			
	10			
	12	0.3	1.5	1.8
	14			
	16			
	18	0.4	2	2.4
	20			
	25	0.5	2.5	3

8.3.4 Checking the rotor thickness

Danger!
When the rotor thickness is checked, the motor must not run.

1. Remove fan cover and cover ring if attached.
2. Measure rotor thickness with calliper gauge. If a friction plate is attached, ensure a flanged edge at the outer diameter of the friction plate.
3. Compare measured rotor thickness with minimally permissible rotor thickness (values 📖 39).
4. If required, exchange the entire rotor. Description 📖 39.

8.3.5 Checking the air gap

1. Check the air gap "s_L" near the fixing screws between the armature plate and stator using a feeler gauge (📖 39).
2. Compare air gap measured to maximally permissible air gap "$s_{L\,max.}$" (📖 39).
3. If required, set air gap to "s_{LN}" (📖 38).

8.3.6 Release / voltage

Danger!
The rotating rotor must not be touched.

Danger!
Live connections must not be touched.

1. Observe the brake's function while the drive is being operated. The armature plate must be tightened and the rotor must move free of residual torque.
2. Measure the DC voltage on the brake.
   – The DC voltage measured after the overexcitation time (operating instructions, forced voltage rectifier) must equal the voltage for the holding. A deviation of up to ±10 % is permissible.

8.3.7 Adjusting the air gap

Danger!
The brake must be free of residual torque.

Stop!
For the flange design, please observe the following if the flange is mounted with additional screws:
Clearing holes in the end shield must be provided behind the threaded holes in the flange that are designed for the screws. Without clearing holes, the minimum rotor thickness cannot be utilised fully. In no case must the screws press against the end shield.

1. Loosen screws (10).
2. Screw the sleeve bolts further into the stator using an open-jawed spanner. $^1/_6$ revolution reduces the air gap by approx. 0.15 mm.
3. Tighten screws, torques (📖 39).
4. Check air gap "s_L" near the screws using a feeler gauge, "s_{Lrated}" (📖 39).
5. If the deviation of "s_{Lrated}" is too great, repeat the adjustment process.

8.3.8 Rotor replacement

Danger!
The brake must be free of residual torque.

1. Loosen the connecting cable.
2. Evenly release the screws and remove them completely.
3. Completely remove the stator from the end shield. Observe the connecting cables.
4. Completely remove the rotor from the hub.
5. Check the toothed part of the hub.
6. In case of wear, replace the hub, too.
7. Check the friction surface of the end shield. If the flange / friction plate is severely gouged, it must be replaced. If the end shield is severely gouged, the friction surface must be reprocessed.
8. Measure the rotor thickness (new rotor) and the height of head of the sleeve bolts using a caliper gauge.
9. The distance between the stator and the armature plate is calculated as follows:

Distance = rotor thickness + s_{Lrated} - height of head

"s_{Lrated}" (📖 39)

10. Evenly remove the sleeve bolts until the calculated distance is reached between the stator and the armature plate.
11. Mount and set new complete rotor and stator, (📖 40).
12. Connect the connecting cable again.

8.4 Installation of a spring-applied brake

8.4.1 Brake characteristics

Brake size	s_{LN} +0.1 mm -0.05 mm [mm]	$s_{Lmax.}$ service brake [mm]	$s_{Lmax.}$ holding brake [mm]	Max. adjustment, permissible wear path [mm]	Rotor thickness min. [1] [mm]	Rotor thickness max. [mm]	Tightening torque of the fixing screws [Nm]
06	0.2	0.5	0.3	1.5	4.5	6.0	3.0
08					5.5	7.0	5.9
10					7.5	9.0	10.1
12	0.3	0.75	0.45	2.0	8.0	10.0	10.1
14				2.5	7.5	10.0	24.6
16				3.5	8.0	11.5	24.6
18	0.4	1.0	0.6	3.0	10.0	13.0	24.6
20				4.0	12.0	16.0	48.0
25	0.5	1.25	0.75	4.5	15.5	20.0	48.0

Tab. 3 Characteristics of the spring-applied brake

1) The dimension of the friction lining allows for adjustment of the brake for at least five times.

8.4.2 Installation of the brake

Stop!

- Check the state of the end shield (15). It must be free from oil and grease.

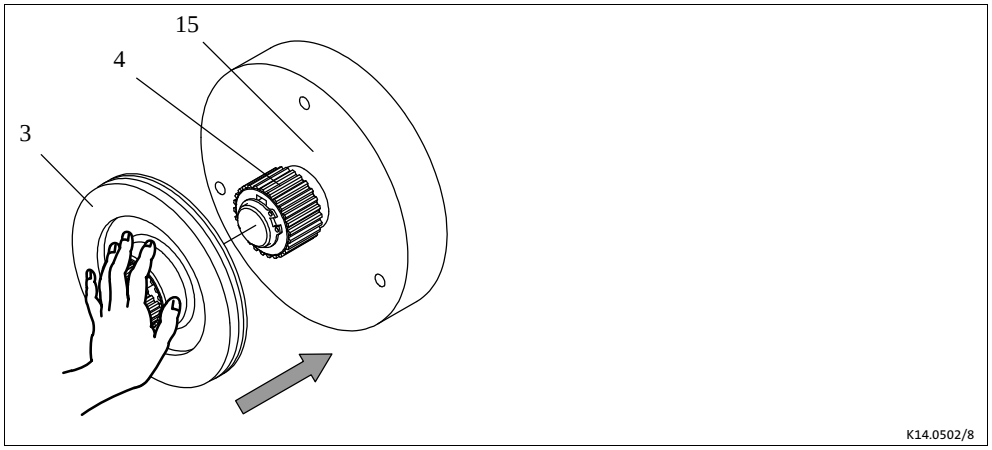


Fig. 3 Rotor mounting

3 Rotor 4 Hub 15 End shield

1. Push the rotor (3) onto the hub (4) and check whether it can be moved by hand (Fig. 3).

Stop!

Please note the following for the version ”brake with shaft sealing ring in torque adjustment ring”:

2. Lightly lubricate the lip of the shaft seal with grease.
3. When assembling the stator (1), push the shaft sealing ring carefully over the shaft.
   – The shaft should be located concentrically to the shaft seal.
4. Use the screws (10) to mount the stator (7) completely to the end shield (15) (Fig. 4).
   – Tighten the screws evenly, tightening torque (📖 39).

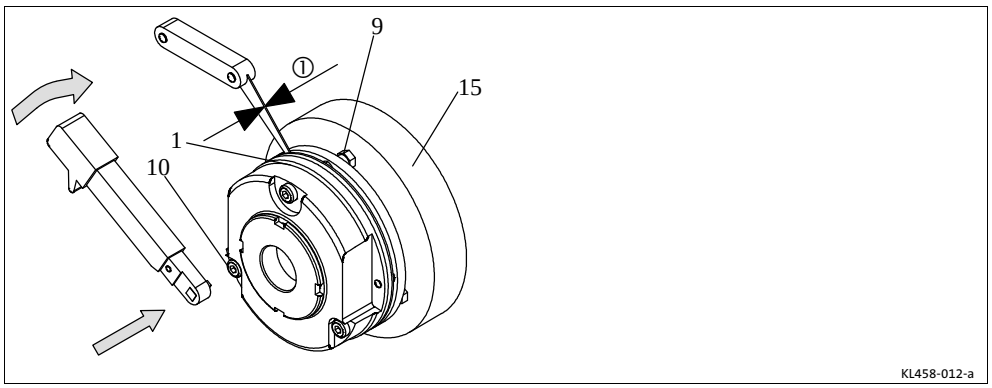


Fig. 4 Stator mounting

1 Stator 9 Sleeve bolt ① s_{Lrated}
10 Cheese head screw 15 End shield

1. Check air gap near the screws (10) using a feeler gauge and compare the values to the data for "s_{Lrated}" in the table, 📖 39.

Note!
Do not insert feeler gauge further than 10 mm between the armature plate (2) and stator (1)!

If "s_L" (📖 39) is not within the tolerance, readjust the air gap.

8.4.3 Adjusting the air gap

Danger!
Disconnect voltage. The brake must be free of residual torque.

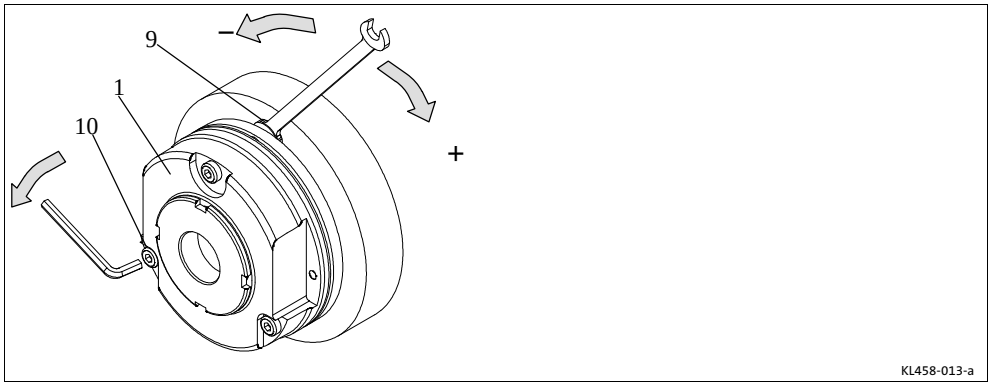


Fig. 5 Re-adjust air gap

1 Complete stator
9 Sleeve bolt
10 Cheese head screw

If the measured value "s_L" is outside the tolerance of "s_{Lrated}", set the dimension:

8.4.4 Assembly of the friction plate, sizes 06 to 16

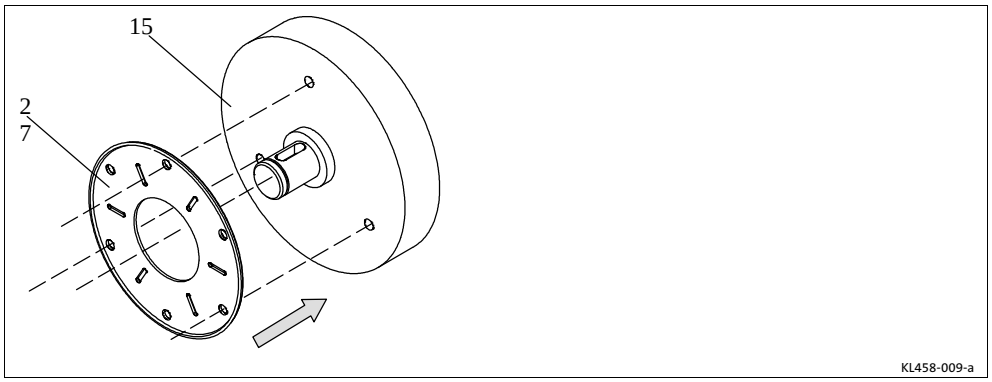


Fig. 6 Friction plate mounting

15 End shield
27 Friction plate

1. Put a friction plate (27) **or** flange (6) against the end shield (15).

Note!
The flanged edge of the friction plate must remain visible!

2. Align pitch circle and fastening bore hole thread.

8.4.5 Assembly of the flange

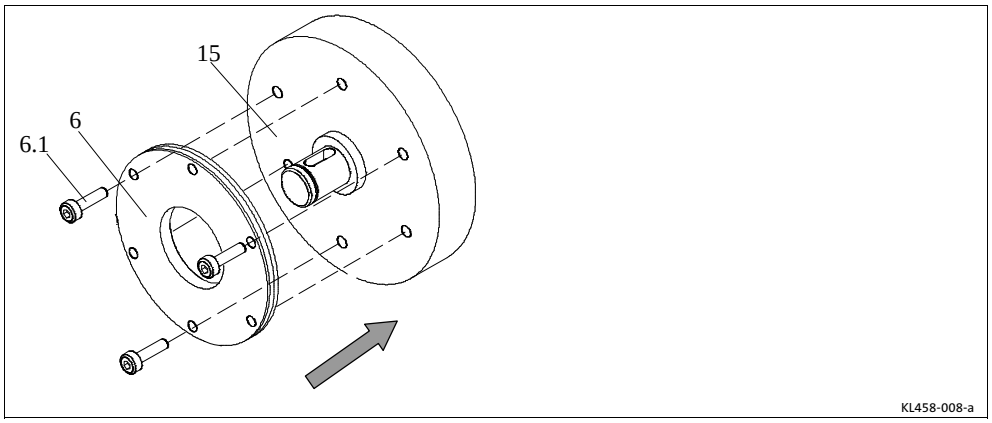


Fig. 7 Flange mounting

6 Flange
6.1 Set of screws
15 End shield

1. Hold the flange (6) against the end shield (15) and check the pitch circle and retaining screw drill hole threading.
2. Fasten the flange (6) on the end shield (15) with the screws (6.1).
3. Tighten the cheese head screws (6.1) evenly, (tightening torques (📖 39).
4. Check the height of the screw heads. The screw heads may not be higher than the minimum rotor thickness. We recommend using screws according to DIN 6912, dimensions (📖 39.

Mounting the flange without additional screws

1. Apply the flange (6) to the end shield (15). Check pitch circle and thread of the screw-on bore holes.
2. Mount the brake.

8.4.6 Assembly of the cover seal

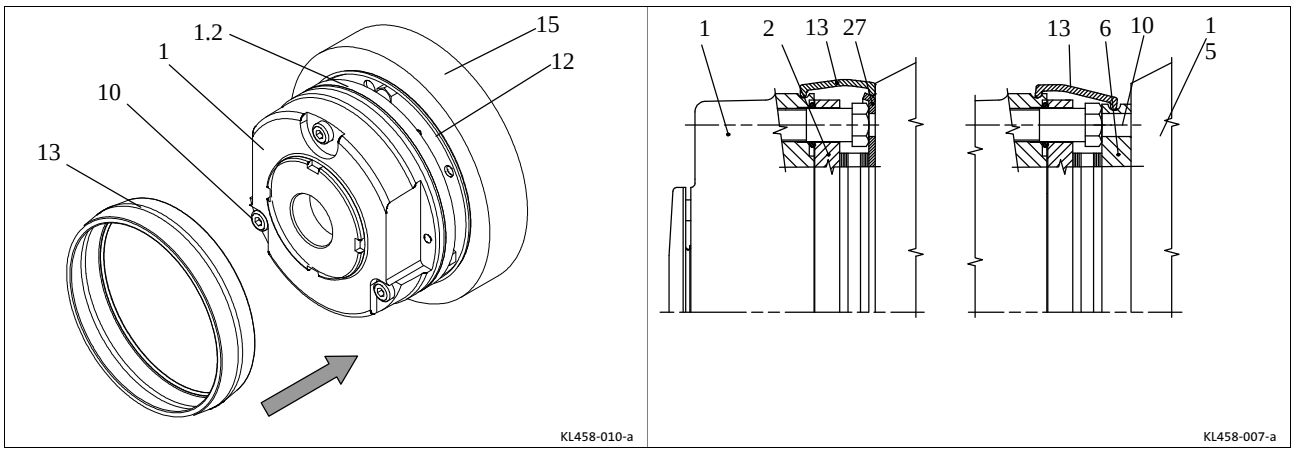


Fig. 8 Cover ring mounting

1	Complete stator	10	Cheese head screw	15	End shield
2	Armature plate	27	Friction plate		
6	Flange	13	Cover ring		

1. Insert the cable through the cover ring.
2. Push the cover ring over the stator.
3. Press the lips of the cover ring into the groove of rotor and flange.
   – If a friction plate is used, the lip must be pulled over the flanged edge.

8.5 Repair

- We recommend having all repairs carried out by the Lenze customer 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 for the other components of the drive system.

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

Fault	Cause	Remedy
Motor too hot Can only be evaluated by measuring the surface temperature: • Non-ventilated motors > 140 °C • Externally ventilated or self-ventilated motors > 110 °C	Insufficient cooling air, blocked air ducts.	Ensure unimpeded circulation of cooling air
	Preheated cooling air	Ensure a sufficient supply of fresh cooling air
	Overload, with normal mains voltage the current is too high and the speed too low	Use larger drive (determined by power measurement)
	Rated operating mode exceeded (S1 to S8 IEC/EN 60034-1)	Adjust rated operating mode to the specified operating conditions. Determination of correct drive by expert or Lenze customer service
	Loose contact in supply cable (temporary two-phase operation!)	Tighten loose contact
	Fuse has blown (two-phasing!)	Replace fuse
	Overload of the drive	Check load and, if necessary, reduce by means of longer ramp-up times
		Check winding temperature
	Heat dissipation impeded by deposits	Clean surface and cooling fins of the drives
Motor does not start	Voltage supply interrupted	Check error message on the inverter
		Check electrical connection, 📖 25
	Inverter inhibited	Check display on the inverter
		Check inverter enable
	Fuse has blown	Replace fuse
	Interrupted encoder cable	Check error message on the inverter
		Check encoder cable
	Brake does not release	Check electrical connection, 📖 25
		Check air gap, 🛞 brake documentation
		Check continuity of magnetic coil
	Drive blocks	Check components for easy movement, remove foreign particles if necessary
	Motor cable with reverse polarity	Check electrical connection, 📖 25
Motor suddenly stops and does not restart	Overload monitoring of the inverter is activated	Check inverter settings
		Reduce load caused by longer acceleration times
Incorrect rotating direction of the motor	Motor cable with reverse polarity	Check and correct polarity
Motor rotates normally but does not reach the expected torque	Motor cable interchanged cyclically Not all motor phases connected	Connect the phases at the motor cable connection correctly
Motor turns in one direction at maximum speed in an uncontrolled manner	Motor cable interchanged cyclically	Check motor connector and correct it if necessary
	Polarity of encoder cable reversed	Check encoder connection and correct it if necessary
Motor rotates slowly in one direction and cannot be influenced by the inverter	Polarity of motor cable and encoder cable reversed	Check and correct polarity
Irregular running	Insufficient shielding of motor or resolver cable	Checking shielding and earth connection
	Drive inverter gain too large	Adjust the gains of the inverters (see operating instructions for drive inverter)
Vibrations	Insufficiently balanced coupling elements or machine	Rebalance
	Inadequate alignment of 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	
Surface temperature > 140°C	Overload of the drive	Check load
		Check winding temperature
	Heat dissipation impeded by deposits	Clean surface and cooling fins of the drives

10 REGULATION (EU) 2019/1781

IE3 three-phase AC motors m540-P

Product information acc. to REGULATION (EU) 2019/1781 (ANNEX I, Section 2)

Rated efficiency at full load	η_N	%	84.1	86.5	85.3	86.5	86.7	89.5	87.7	89.5	89.5	88.6
Efficiency at 75 % rated load	η	%	84.7	86.4	85.9	86.4	87	89.2	88.5	89.5	89.4	89.2
Efficiency at 50 % rated load	η	%	83.4	84.2	84.9	84.6	85.9	87.2	87.9	88.3	87.7	88.6
Efficiency level			IE3									
Manufacturer's name			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY									
Commercial registration number			Hannover HRB 204803									
Product's model identifier			M54AP090M04		M54AP090L04		M54AP100M04		M54AP100L04		M54AP112M04	
Number of poles of the motor			4									
Rated power output	P_N	kW	1.1		1.5		2.2		3		3.7	4
Rated input frequency	f_N	Hz	50	60	50	60	50	60	50	60	60	50
Rated voltage	U_N	V	400	460	400	460	400	460	400	460	460	400
Rated speed	n_N	rpm	1440	1750	1445	1755	1465	1770	1460	1760	1770	1460
Number of phases of the motor			Three-phase motor									
Altitudes above sea-level		m	0 ... 1000									
Ambient air temperature		°C	-20 ... +40									
Maximum operating temperature		°C	155									
Potentially explosive atmospheres			No operation in explosive atmospheres									

Rated efficiency at full load	η_N	%	89.6	91.7	90.4	91.7	91.4	92.4	92.1	93	92.6	93.6
Efficiency at 75 % rated load	η	%	90	91.6	91.1	91.8	91.8	92.3	92.3	92.8	93.1	93.7
Efficiency at 50 % rated load	η	%	89.4	90.5	90.8	91	91.2	91.1	91.5	91.4	93	93.1
Efficiency level			IE3									
Manufacturer's name			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY									
Commercial registration number			Hannover HRB 204803									
Product's model identifier			M54AP132M04		M54AP132L04		M54AP160M04		M54AP160L04		M54AP180M04	
Number of poles of the motor			4									
Rated power output	P_N	kW	5.5		7.5		11		15		18.5	
Rated input frequency	f_N	Hz	50	60	50	60	50	60	50	60	50	60
Rated voltage	U_N	V	400	460	400	460	400	460	400	460	400	460
Rated speed	n_N	rpm	1470	1775	1465	1770	1475	1775	1475	1780	1470	1775
Number of phases of the motor			Three-phase motor									
Altitudes above sea-level		m	0 ... 1000									
Ambient air temperature		°C	-20 ... +40									
Maximum operating temperature		°C	155									
Potentially explosive atmospheres			No operation in explosive atmospheres									

Rated efficiency at full load	η_N	%	93	93.6	93.6	94.1	93.9	94.5	94.2	95	94.6	95.4
Efficiency at 75 % rated load	η	%	93.6	93.8	94.2	94.3	94.5	94.7	94.9	95.3	95.1	95.6
Efficiency at 50 % rated load	η	%	93.6	93.3	94.2	93.8	94.4	94.2	95.1	94.9	95	95.1
Efficiency level			IE3									
Manufacturer's name			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY									
Commercial registration number			Hannover HRB 204803									
Product's model identifier			M54AP180L04		M54AP200M04		M54AP225M04		M54AP225L04		M54AP250M04	
Number of poles of the motor			4									
Rated power output	P_N	kW	22		30		37		45		55	
Rated input frequency	f_N	Hz	50	60	50	60	50	60	50	60	50	60
Rated voltage	U_N	V	400	460	400	460	400	460	400	460	400	460
Rated speed	n_N	rpm	1470	1775	1470	1778	1478	1782	1478	1782	1482	1786
Number of phases of the motor			Three-phase motor									
Altitudes above sea-level		m	0 ... 1000									
Ambient air temperature		°C	-20 ... +40									
Maximum operating temperature		°C	155									
Potentially explosive atmospheres			No operation in explosive atmospheres									

Efficiency (η_N, η) The efficiency refers to the nominal voltage and an ambient reference temperature of 25 °C.

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