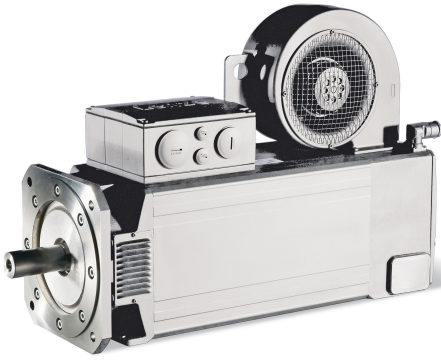




Servo motors

MQA asynchronous servo motor

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About this document

Document description

This document addresses to all persons who want to carry out any configurations with the products described.

The data and information compiled in this document serve to support you in the dimensioning and selection processes and in carrying out the electrical and mechanical installation. You will receive information regarding product extensions and accessories.

- The document includes safety instructions which must be observed.
- All persons working on and with the drives must have the documentation at hand during work and observe the information and notes relevant for it.
- The documentation must always be complete and in a perfectly readable state.

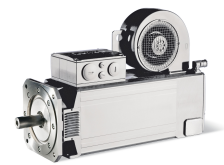
Further documents



Information and tools with regard to the Lenze products can be found on the Internet: www.Lenze.com → Downloads

About this document

Notations and conventions



Notations and conventions

Conventions are used in this document to distinguish between different types of information.

Numeric notation		
Decimal separator	Point	Generally shown as a decimal point. Example: 1 234.56
Warnings		
UL Warnings	UL	Are used in English and French.
UR warnings	UR	
Text		
Engineering Tools	" "	Software Example: "Engineer", "EASY Starter"
Icons		
Page reference		Reference to another page with additional information. Example:  16 = see page 16
Documentation reference		Reference to other documentation with additional information. Example:  EDKxxx = see documentation EDKxxx

Layout of the safety instructions

DANGER!

Indicates an extremely hazardous situation. Failure to comply with this instruction will result in severe irreparable injury and even death.

WARNING!

Indicates an extremely hazardous situation. Failure to comply with this instruction may result in severe irreparable injury and even death.

CAUTION!

Indicates a hazardous situation. Failure to comply with this instruction may result in slight to medium injury.

NOTICE

Indicates a material hazard. Failure to comply with this instruction may result in material damage.



Product information

Product description

The MQA asynchronous servo motor for precisely controlled motion.

The naturally ventilated MQA asynchronous servo motor is suitable for applications that require a high dynamic performance, high construction-related operational reliability and precisely controlled motion.

In connection with the i700 and i950 servo inverters, Servo Drives 9400, and Inverter Drives 8400 TopLine, high-performance drive solutions in the torque range from 66 to 1100 Nm can be obtained.

Customer benefit

- Optimum controllability and high dynamic performance thanks to low moments of inertia
- Optimal smooth running characteristics for exact work results
- Wide speed setting range
- Field weakening operation usable
- Robust resolvers are included as a standard, and incremental encoders or absolute value encoders ensure a high precision



Fig. 1: Asynchronous servo motor MQA22P08-

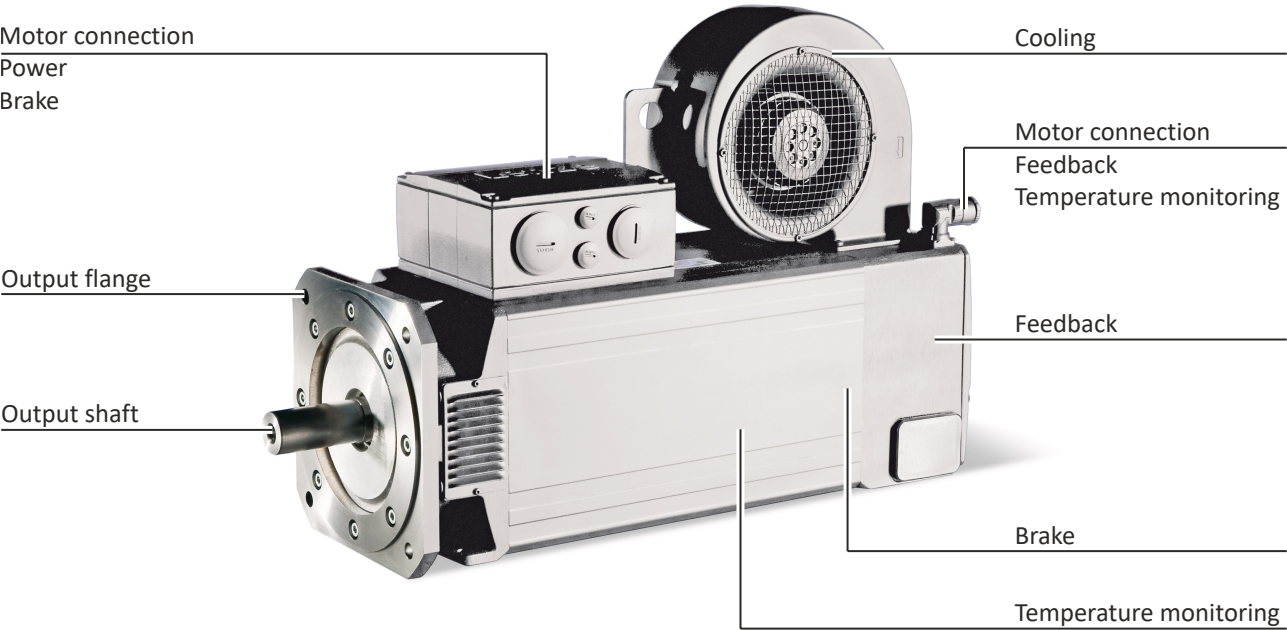
Identification of the products

Product name: MQA asynchronous servo motor

		Motor				
Example		MQA	20	L	14	H
Meaning	Variant					
Product family		MQA				
Size			20 22 26			
Overall length				L ... T		
Rated speed	rpm x 100				05 ... 29	
Inverter mains connection	3 x 400 V					H



Features



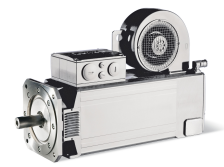


The modular system



Values printed in **bold** are standard designs. Values that are not printed in **bold** are potential extensions, some of them including a surcharge.

Motor		MQA20	MQA22	MQA26
Technical data				
Rated power	kW	10.6 ... 20.3	11.5 ... 38.4	17.0 ... 60.2
Rated torque	Nm	66.2 ... 71.3	125 ... 145	257 ... 296
Max. torque	Nm	250	500	1100
Rated speed	rpm	1420 ... 2930	760 ... 2935	550 ... 2235
Colour		Primed RAL9005 matt jet black RAL colours		
Surface and corrosion protection		OKS-G Different types of OKS		
Output shaft				
Solid shaft with featherkey	mm	38 x 80	38 x 80	55 x 110
Solid shaft without keyway	mm	38 x 80	38 x 80	55 x 110
Shaft material		Steel		
Shaft sealing ring material		FKM		
Drive-end shield		Not oil-tight Oil-proof		
Design		With flange (B3/B35)		
Output flange	mm	FF215 FF265	FF265	FF265 FF350
Cooling		Forced-ventilated IP23s		
Dust filter		Without With		
Motor connection				
Power + brake + separate fan		ICN connector Terminal box	Terminal box	
Sensor + temperature monitoring		ICN connector		
Spring-applied brake - holding brake		Without With		
Standard braking torque	Nm	80.0	130	260
Increased braking torque	Nm	130	260	-
DC brake voltage	V	24		
AC brake voltage	V	230 (not with cURus and ICN connector)		
Feedback		Resolver Absolute value encoder Incremental encoder		
Temperature monitoring		Thermal detectors PT1000 Thermal contact TCO (not with ICN connector and spring-applied brake)		



Information on project planning

Safety instructions

Disregarding the following basic safety measures and safety information may lead to severe personal injury and damage to property!

Observe all specifications of the corresponding documentation supplied. This is the precondition for safe and trouble-free operation and for obtaining the product features specified.

Please observe the specific safety information in the other sections!



Basic safety instructions

Product

- The product must only be used as directed.
- Never commission the product in the event of visible damage.
- The product must never be technically modified.
- Never commission the product before assembly has been completed.
- The product must never be operated without required covers.
- Connect/disconnect all pluggable terminals only in de-energized condition.
- Only remove the product from the installation in the de-energized state.

Personnel

Only qualified and skilled personnel are allowed to work with the product. IEC 60364 and/or CENELEC HD 384 define the qualifications of these persons as follows:

- They are familiar with the installation, mounting, commissioning, and operation of the product.
- They possess the appropriate qualifications for their tasks.
- They are familiar with all regulations for the prevention of accidents, directives, and laws applicable at the location and are able to apply them.

Electrical connection

When working on energized products, comply with the applicable national accident prevention regulations.

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

This documentation contains notes about installation according to EMC regulations. Also observe these notes for CE-marked products. The manufacturer of the system or machine is responsible for adherence to the limits required in connection with EMC legislation.

Operation

Where appropriate, you must equip the system with additional monitoring and protective devices. Comply with the safety regulations and other regulations applicable at the place of operation.

After disconnecting the product from the supply voltage, do not touch live device parts and power terminals immediately because capacitors may be charged. Observe the corresponding information labels on the product.

Dirt or dust deposits impede the heat dissipation and cooling. Remove any such deposits where appropriate at regular intervals.

Process engineering

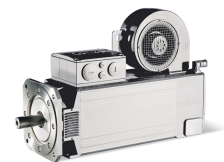
The procedural notes and circuit details described are only proposals. It is up to the user to check whether they can be adapted to the particular applications. Lenze does not take any responsibility for the suitability of the procedures and circuit proposals described.

Disposal

The products and accessories must be properly disposed of in accordance with the applicable regulations. The products contain raw materials that can be recycled such as metals, plastics and electronic components.

Information on project planning

Safety instructions
Application as directed



Application as directed

NOTICE

Please observe the notes in the following chapters!

- ▶ [Safety instructions](#) 10
- ▶ [Information on mechanical installation](#) 21
- ▶ [Information on electrical installation](#) 22

- The product must only be actuated under the operating conditions and power limits specified in this documentation.
- The product meets the protection requirements of 2014/35/EU: Low-Voltage Directive.
- The product is not classed as a machine under 2006/42/EU: Machinery Directive.
- No machine is to be commissioned or put into operation as intended in conjunction with the product until it has been determined that the machine meets the regulations of EC Directive 2006/42/EU: Machinery Directive; observe EN 60204-1.
- Commissioning or putting into operation as intended is only permitted in compliance with the EMC Directive 2014/30/EU.
- The product is not a household appliance. Instead, it is a component that is intended exclusively for further use in the context of commercial or professional use as defined by EN 61000-3-2.
- The product can be used according to the technical data if the drive systems have to comply with categories in accordance with EN 61800-3.
- In residential areas, the product may cause EMC interferences. The operator is responsible for taking interference suppression measures.
- Do not use the built-in brakes as fail-safe brakes. Disruptive factors that cannot be influenced may cause the braking torque to be reduced.
- The product is only to be operated together with an inverter.
- The harmonized standards of the series IEC/EN60034 are used.

Foreseeable misuse

- Actuate directly on the mains voltage
- Use in potentially explosive areas
- Use in aggressive environments
- Use under water
- Use under radiation
- Use in generator mode



Residual hazards

Even if notes given are taken into consideration and protective measures are implemented, the occurrence of residual risks cannot be fully prevented.

The user must take the residual hazards mentioned into consideration in the risk assessment for his/her machine/system.

If the above is disregarded, this can lead to severe injuries to persons and damage to property!

Product

Observe the warning labels on the product!



Dangerous electrical voltage:

Before working on the product, make sure there is no voltage applied to the power terminals!

After mains disconnection, the power terminals will still carry the hazardous electrical voltage for the time given next to the symbol!



Electrostatic sensitive devices:

Before working on the product, the staff must ensure to be free of electrostatic charge!



High leakage current:

Carry out fixed installation and PE connection in compliance with:
EN 61800-5-1 / EN 60204-1



Hot surface:

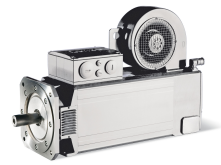
Use personal protective equipment or wait until the device has cooled down!

Protection of persons

- The product does not provide any safety-related functions.
 - A higher-level safety system must be implemented.
 - Provide additional monitoring and protective equipment complying with the safety regulations applicable in each case.
- The power terminals may carry voltage in the switched-off state or when the motor is stopped.
 - Before working, check whether all power terminals are deenergized.
- Voltages may occur on the drive components (e.g. capacitive, caused by inverter supply).
 - Careful earthing must be carried out at the marked positions of the components.
- There is a risk of burns from hot surfaces!
 - Provide protection against accidental contact.
 - Use personal protective equipment or wait until the device has cooled down!
 - Prevent contact with flammable substances.
- Risk of injury from rotating parts.
 - Before working on the drive system, ensure that the motor is at a standstill.
- There is a danger of unintentional start-up or electric shocks!
- Installed brakes are no fail-safe brakes.
 - torque may be reduced by disruptive factors that cannot be influenced such as ingressing oil.

Information on project planning

Safety instructions
Residual hazards



Motor protection

- Version with plug:
 - Never disconnect the plug when energized. The plug could be destroyed.
 - Switch off the voltage supply or disable the inverter prior to disconnecting the plug.
- Installed thermal detectors are no full protection for the machine.
 - Limit the maximum current if necessary. Parameterize the inverter so that it will be switched off after several seconds of operation with $I > I_{\text{rated}}$ especially if there is a danger of blocking.
 - The integrated overload protection does not prevent overloading under all conditions.
- The fuses are no motor protection.
 - Use a current-dependent motor protection switch.
 - Use the built-in thermal detectors.
- Excessively high torques cause a fracture of the motor shaft.
 - Do not exceed the maximum torques according to the technical data on the nameplate.
- Lateral forces on the motor shaft are possible.
 - Align the shafts of motor and driven machine exactly to each other.



Drive dimensioning

In order to carry out an accurate drive dimensioning process, you can use our configuring software, the »Drive Solution Designer«.

With the »Drive Solution Designer«, you can design the drive both quickly and to a high quality. The software contains profound and proven expertise with regard to drive applications and mechatronic drive components.

Please get in touch with your Lenze representative.

The dimensioning is suitable for:

- kinematic profiles
- operating modes S1, S2, S3, S6 [66](#)
- simple linear speed profiles, not for S-curves or similar

The following 3 elements are taken into consideration in the dimensioning process:

Drive function

On the basis of the values required for the process that are specified, a drive is selected, for which all operating points are within the speed-torque characteristic curve of the motor.

As a result, a motor with a suitable speed and an inverter with a sufficient maximum current are selected. Further limits (maximum speed, installation height...) are specified in tables.

Mechanical strength

On the basis of the occurring forces and torques, a drive is selected that has a sufficient mechanical strength (endurance strength for the periodically occurring torques and fatigue strength for the sporadically occurring torques).

Thermal dimensioning

For the inverter, the thermal dimensioning process is carried out on the basis of the continuous inverter current or on the basis of the continuous torque from the motor-inverter combination, which can be reached.

The motor is thermally dimensioned on the basis of the mean speed and the effective torque.

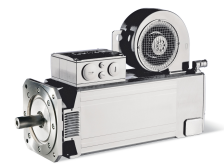
The mean speed of the drive should not exceed the values specified.



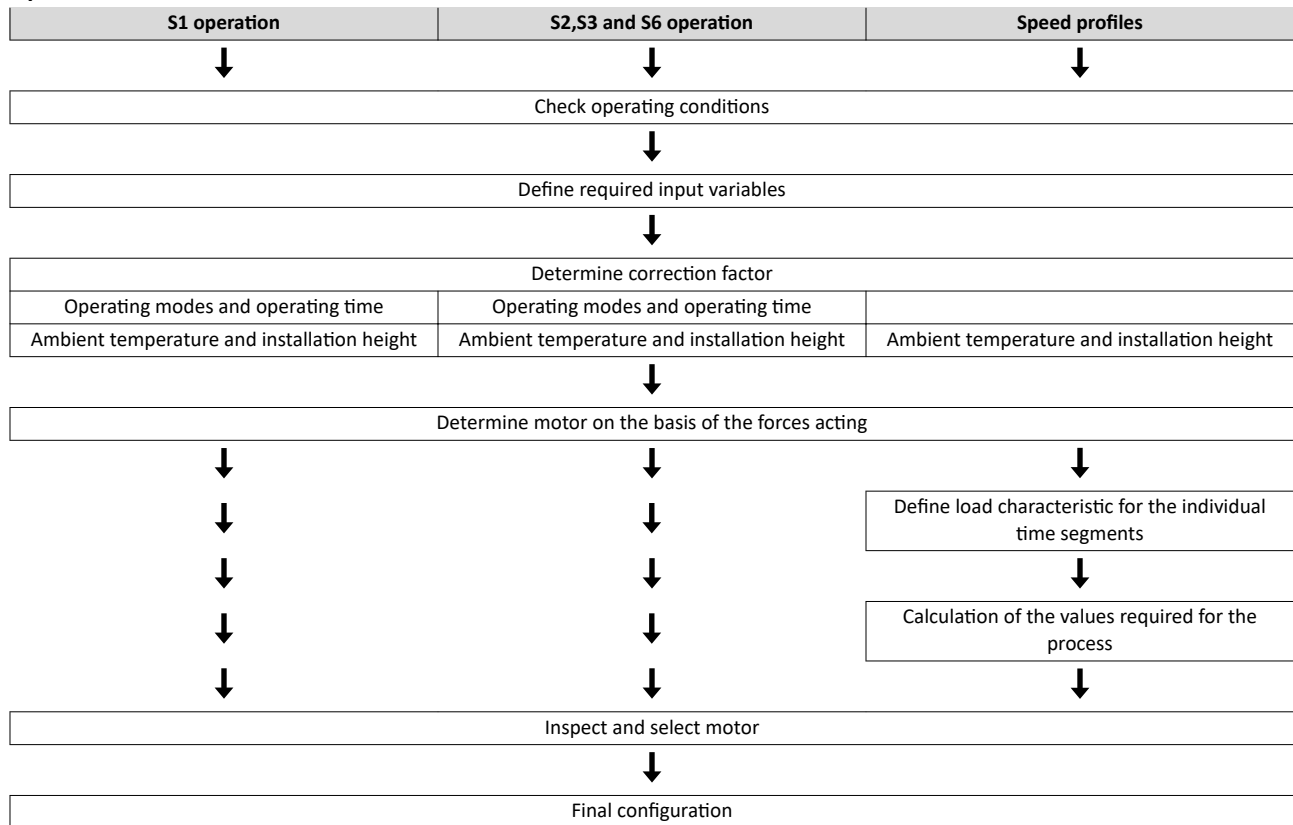
If dimensioning processes are complex or reach limit loads, please refer to your Lenze representative.

Information on project planning

Drive dimensioning



Operation chart



Check operating conditions

Check
Approvals Conformities Supply voltage Degree of protection Ambient temperature Surface protection

► [Standards and operating conditions](#) 24

► [Surface and corrosion protection](#) 20

Define required input variables

Necessary input variables	Note	Symbol	Unit
Mean speed utilisation	Relating to the load speed n_L		%
Ambient temperature		T_U	°C
Site altitude Amsl		H	m
Radial force		F_{rad}	N
Axial force		F_{ax}	N
Transmission element at the output	Gear wheels, sprockets ...		
Effective diameter of the transmission element		d_w	mm
Load torque	Only with S1, S2, S3, and S6 operating modes	M_L	Nm
Load speed	Only with S1, S2, S3, and S6 operating modes	n_L	rpm
Short-time maximum torque	Emergency off, quick stop, occasional high starting duty	$M_{L,max}$	Nm
Runtime with maximum torque		t_L	%



Determine correction factor

Operating modes S1, S2, S3, S6, and operating time							
Operating mode S1		Operating mode S2		Operating mode S3		Operating mode S6	
ED	k_L	ED	k_L	ED	k_L	ED	k_L
%		min		%		%	
100	1.0	10	1.4 - 1.5	15	1.4 - 1.5	15	1.5 - 1.6
		30	1.15 - 1.2	25	1.3 - 1.4	25	1.4 - 1.5
		60	1.07 - 1.1	40	1.15 - 1.2	40	1.3 - 1.4
		90	1.0 - 1.05	60	1.05 - 1.1	60	1.15 - 1.2

► Operating modes of the motor [66](#)

Ambient temperature and installation height				
Ambient temperature		Installation height amsl		
		≤ 1000 m	≤ 2000 m	≤ 3000 m
		Correction factor		
T_U		k_H	k_H	k_H
≤ 20 °C		1.15	1.06	0.97
30 °C		1.07	0.99	0.90
40 °C		1.00	0.92	0.83
50 °C		0.92	0.85	0.76
60 °C		0.83	0.77	0.70

Determine product on the basis of the forces

Transmission element			Gear wheels	Sprockets	Toothed belt pulleys (depending on the preloading)	Narrow V-belt (depending on the preloading)
Additional radial force factor	f_z		≥ 17 teeth = 1.0	≥ 20 teeth = 1.0	With belt tightener= 2.0 - 2.5	1.5 - 2.0
			< 17 teeth = 1.15	< 20 teeth = 1.25	Without belt tightener= 2.5 - 3.0	
			< 13 teeth = 1.4			
			Calculation		Check	
Radial force	F_{rad}	N	$F_{rad} = 2000 \times \frac{M_{L,max} \times f_z}{dw}$		$F_{rad} \leq F_{rad,max}$	
Axial force	F_{ax}	N			$F_{ax} \leq F_{ax,max}$	

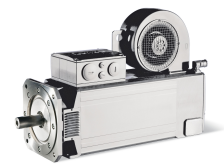
dw Effective diameter of transmission element

► Radial forces and axial forces [25](#)

Operating mode S1

Check and select servo motor/inverter combination			
	Check	Selection	Unit
Output torque	$M_{rated} \geq M_L / (k_L \times k_H)$	M_{rated}	Nm
Output speed	$n_{rated} \geq n_L$	n_{rated}	rpm

► Rated data [27](#)



Operating modes S2, S3, and S6

Check and select servo motor/inverter combination			
	Check	Selection	Unit
Output torque	$M_{rated} \geq M_L / (k_L \times k_H)$	M_{rated}	Nm
Output speed (recommendation)	$n_{rated} \geq n_L$	n_{rated}	rpm
Max. output torque.	$M_{max} \geq M_L$	M_{max}	Nm
Max. output speed	$n_{max} \geq n_L$	n_{max}	rpm
All operating points (●)		n_L	
below the maximum torque characteristic of the servo motor/inverter combination here, $M_{L,max}$ must be considered		M_L	
Thermally effective operating point (○)		n_L	
below the S1 torque characteristic of the servo motor		$M_L / (k_L \times k_H)$	

► [Rated data](#) 27

► [Torque characteristics](#) 34

Speed profiles

Temporal load characteristic for the individual time segments z							
Total time	Individual time segments	Load speed	Load speed variation	Steady-state load torque	Torque	Acceleration torque	Moment of inertia
t	Δt_z	$n_{L,z}$	$\Delta n_{L,z}$	$M_{L,z}$	M_z	$M_{s,z}$	J_L
s	s	rpm	rpm	Nm	Nm	Nm	kgcm ²

	Calculation	Symbol	Unit
Load cycle duration	$T = \sum \Delta t_z$	T	s

Calculation of the values required for the process			
	Calculation	Symbol	Unit
Torque per time segment	$M_z = M_{L,z} + J_L \frac{2\pi \times \Delta n_{L,z}}{60 \times \Delta t_z}$	M_z	Nm
Maximum torque of the profile	$M_{p,max} = \max(M_z)$	$M_{p,max}$	Nm
Effective torque	$M_{eff} = \sqrt{\frac{1}{T} \sum_z M_z^2 \times \Delta t_z}, T \leq 1 \text{ min}$	M_{eff}	Nm
Mean speed	$n_m = \overline{n_{L,z}} = \frac{1}{T} \sum_z n_{L,z} \times \Delta t_z$	n_m	rpm
Maximum load speed	$n_{L,max} = \max(n_{L,z})$	$n_{L,max}$	rpm



Check and select servo motor/inverter combination			
	Check	Preselection	Unit
Output torque	$M_{\text{rated}} > M_{\text{eff}} / k_H$	M_{rated}	Nm
Output speed	$n_{\text{rated}} \geq n_m$	n_{rated}	rpm
Load-matching factor			
for an optimum dynamic performance/ control properties	Requirement $k_j = 0.5 \dots 10$ Optimum $k_j = 1$	$k_j = J_L / (J_M + J_B)$	
Checking the motor torques			
Acceleration torque	$M_{S,z} = M_z + (J_M + J_B) \times \frac{2\pi \times \Delta n_{L,z}}{60 \times \Delta t_z}$	$M_{S,z}$	Nm
Effective torque	$M_{S,\text{eff}} = \sqrt{\frac{1}{T} \sum_z M_{S,z}^2 \times \Delta t_z}$	$M_{S,\text{eff}}$	
All operating points (●)		$n_{L,z}$	
below the maximum torque characteristic of the servo motor/ inverter combination here, $M_{L,\text{max}}$ must be considered		$M_{S,z}$	
Thermally effective operating point (○)		n_m	
below the S1 torque characteristic of the servo motor		$M_{S,\text{eff}} / k_H$	

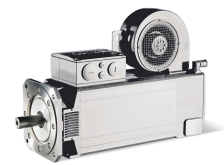
► [Rated data](#) 27

► [Torque characteristics](#) 34

Information on project planning

Final configuration

Surface and corrosion protection



Final configuration

	Check
Connection dimensions	Output shaft Output flange
Product extensions	Motor connection (connector/terminal box) Brake Feedback Blower

More information about the final configuration:

► [The modular system](#) 9

► [Product extensions](#) 50

Surface and corrosion protection

Depending on the ambient conditions, the surface and corrosion protection system (called OKS) offers solutions for optimum protection.

Various surface coatings ensure that the motors operate reliably at high air humidity, in outdoor installation or in the presence of atmospheric impurities. Any color from the "RAL Classic" collection can be chosen for the top coat.

Surface and corrosion protection	Applications	Type
OKS-G (primed)	Dependent on subsequent top coat applied	Standard
OKS-S (small)	- Standard applications - Internal installation in heated buildings - Air humidity up to 90 %	Optional
OKS-M (medium)	- Internal installation in non-heated buildings - Covered, protected external installation - Air humidity up to 95 %	
OKS-L (large)	- External installation - Air humidity above 95 % - Chemical industrial plants - Food industry	

Surface and corrosion protection	Corrosivity category	Surface coating	Colour	Coating thickness
	DIN EN ISO 12944-2	Design		
OKS-G (primed)		2K PUR priming coat	RAL 9005 matt jet black	60 ... 90 µm
OKS-S (small)	Comparable to C1	2K-PUR top coat	According to RAL Classic	80 ... 120 µm
OKS-M (medium)	Comparable to C2	2K PUR priming coat		110 ... 160 µm
OKS-L (large)	Comparable to C3	2K-PUR top coat		140 ... 200 µm



Information on mechanical installation

Important notes

- Install the product according to the information in the chapter "Standards and operating conditions".
 - ▶ [Standards and operating conditions](#)  24
- The technical data and the data regarding the supply conditions can be found on the nameplate and in this documentation.
- Ambient media – especially chemically aggressive ones – may damage shaft sealing rings, lacquers and plastics.
- Lenze offers special surface and corrosion protection in this case.

NOTICE

Bearing damage caused by unbalance!

Shafts with keyway are balanced with a half featherkey!

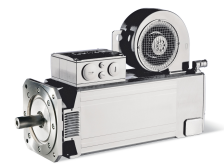
▶ Balance transmission elements with a half featherkey!

Transport

- Ensure appropriate handling.
- Make sure that all component parts are securely mounted. Secure or remove loose component parts.
- Only use safely fixed transport aids (e.g., eye bolts or support plates).
- Do not damage any components during transport.
- Avoid electrostatic discharges on electronic components and contacts.
- Avoid impacts.
- Check the carrying capacity of the hoists and load handling devices. The weights can be found in the shipping documents.
- Secure the load against tipping and falling down.
- Standing beneath suspended loads is prohibited.

Installation

- The mounting surfaces must be plane, torsionally rigid and free from vibrations.
- The mounting areas must be suited to absorb the forces and torques generated during operation.
- Ensure an unhindered ventilation.
- For versions with a fan, keep a minimum distance of 10 % from the outside diameter of the fan cover in intake direction.



Information on electrical installation

Important notes

DANGER!

Risk of injury and risk of burns from dangerous voltage

Power terminals may also carry voltage in the switched-off state or when the motor is stopped and may cause life-threatening cardiac arrhythmia and serious burns.

- ▶ Disconnect the product from the mains.
- ▶ Check that the power terminals are deenergized before starting work.

- When working on energized products, comply with the applicable national accident prevention regulations.
- The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection).
- The manufacturer of the system or machine is responsible for adherence to the limits required in connection with EMC legislation.

Preparation



The notes for the electrical connection can be found in the enclosed mounting instructions.

EMC-compliant wiring



The EMC-compliant wiring is described in detail in the documentation of the Lenze inverters.



Technical data

Notes regarding the given data

The power values, torques and speeds specified in the configuration are rounded values and apply to:

- ambient temperature $T_U = 40\text{ °C}$ for motors (in compliance with EN 60034)
- Site altitude $\leq 1000\text{ m}$ above mean sea level

The selection tables specify the inverter/ motor combination with the achievable torques.

The rated data applies to the S1 operating mode S1 (in accordance with EN 60034) and the operation on a servo inverter with a switching frequency of at least 4 kHz.

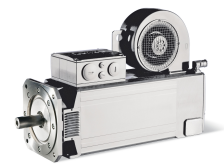
NOTICE

In case of other operating conditions, the achievable values can differ for those mentioned.

► In case of extreme operating conditions, please get in touch with your Lenze representative.

Technical data

Standards and operating conditions
Conformities and approvals



Standards and operating conditions

Conformities and approvals

Conformity		
CE	2014/35/EU	Low-Voltage Directive
	2014/30/EU	EMC Directive (reference: CE-typical drive system)
EAC	TR TC 004/2011	Eurasian conformity: safety of low voltage equipment
	TP TC 020/2011	Eurasian conformity: electromagnetic compatibility of technical means
Approval		
cURus	UL 1004-1 UL 1004-6	for USA and Canada (requirements of the CSA 22.2 No.100) Industrial Control Equipment, Lenze File No. E210321
UkrSepro		for Ukraine

Protection of persons and device protection

Degree of protection		
IP23S	EN 60034-5	Forced-ventilated
Temperature class		
F (155 °C)	EN 60034-1	
Max. voltage load		
Limit curve A	IEC/TS 60034-25:2007	
IVIC C/B/B@500V	IEC 60034-18-41	

EMC data

Noise emission	EN 60034-1	A final overall assessment of the drive system is indispensable
Noise immunity	EN 60034-1	A final overall assessment of the drive system is indispensable

Environmental conditions

Climate		
1K3 (-20 °C ... +60 °C)	EN 60721-3-1	Storage, < 3 months
1K3 (-20 °C ... +40 °C)	EN 60721-3-1	Storage, > 3 months
2K3 (-20 °C ... +70 °C)	EN 60721-3-2	Transport
3K3 (-15 °C ... +40 °C)	EN 60721-3-3	Operation, without brake
3K3 (-10 °C ... +40 °C)	EN 60721-3-3	Operation, with brake
Relative humidity ≤ 85 %		Without condensation
Site altitude		
0 ... 1000 m amsl		Without power reduction
1000 ... 4000 m amsl		Observe the power reductions of the inverter and the servo motor
Vibration resistance		
3M6	EN 60721-3-3	Operation
Vibration severity		
A	EN 60034-14	
Vibration velocity		
1.6 mm/s		Free suspension
Smooth running, axial runout, concentricity		
Normal class	IEC 60072	

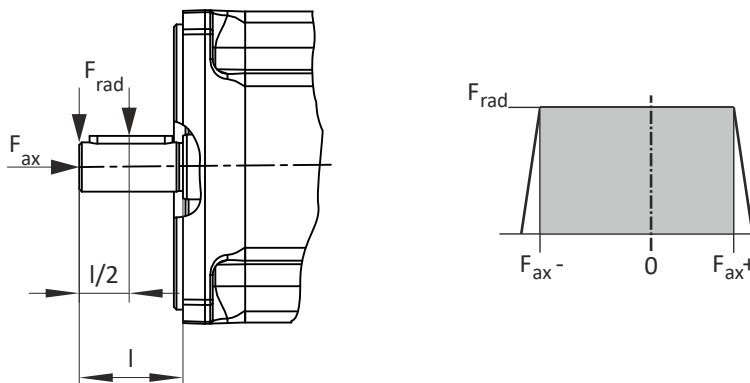


Radial forces and axial forces



The values of the bearing service life L_{10h} refer to an average motor speed of 3000 rpm. Depending on the ambient temperatures, they are also limited by the grease lifetime.

Application of forces

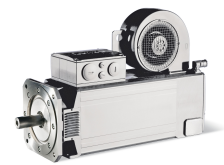


Application of force at $l/2$

Bearing service life L_{10h}			Motor		
			MQA20	MQA22	MQA26
5000 h					
Radial force	F_{rad}	N	3,400	3600	6950
Axial tensile force	$F_{ax, -}$	N	-1330	-2370	-2500
Axial compression force	$F_{ax, +}$	N	690	1700	1580
10000 h					
Radial force	F_{rad}	N	2500	2800	5400
Axial tensile force	$F_{ax, -}$	N	-1020	-1740	-1800
Axial compression force	$F_{ax, +}$	N	380	1090	880
20000 h					
Radial force	F_{rad}	N	1950	2200	4300
Axial tensile force	$F_{ax, -}$	N	-780	-1280	-1300
Axial compression force	$F_{ax, +}$	N	140	640	380
30000 h					
Radial force	F_{rad}	N	1700	1,900	3700
Axial tensile force	$F_{ax, -}$	N	-690	-1080	-1090
Axial compression force	$F_{ax, +}$	N	40	440	160
50000 h					
Radial force	F_{rad}	N		1600	
Axial tensile force	$F_{ax, -}$	N		-880	
Axial compression force	$F_{ax, +}$	N		240	

Technical data

Radial forces and axial forces



Application of force at I

Bearing service life L_{10h}			Motor		
			MQA20	MQA22	MQA26
5000 h					
Radial force	F_{rad}	N	3150	3500	6400
Axial tensile force	$F_{ax, -}$	N	-1170	-2240	-2080
Axial compression force	$F_{ax, +}$	N	530	1600	1150
10000 h					
Radial force	F_{rad}	N	2300	2600	5000
Axial tensile force	$F_{ax, -}$	N	-920	-1640	-1600
Axial compression force	$F_{ax, +}$	N	280	1100	680
20000 h					
Radial force	F_{rad}	N	1800	2050	4000
Axial tensile force	$F_{ax, -}$	N	-710	-1200	-1160
Axial compression force	$F_{ax, +}$	N	70	560	230
30000 h					
Radial force	F_{rad}	N	1400	1800	3,400
Axial tensile force	$F_{ax, -}$	N	-650	-1020	-1090
Axial compression force	$F_{ax, +}$	N	0	380	50
50000 h					
Radial force	F_{rad}	N		1450	
Axial tensile force	$F_{ax, -}$	N		-850	
Axial compression force	$F_{ax, +}$	N		200	



Technical data

Rated data

Inverter mains connection 400 V, Forced ventilated motors

Rated data

Inverter mains connection 400 V, Forced ventilated motors

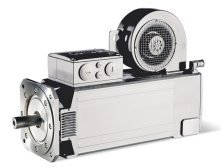
Product name			MQA20L14H	MQA20L29H	MQA22P08H
Standstill torque	M_0	Nm	76.0	76.0	156
Rated torque	M_{Rated}	Nm	71.3	66.2	145
Max. torque	$M_{max.}$	Nm	250	250	500
Rated speed	n_{Rated}	rpm	1420	2930	760
Max. speed	$n_{max.}$	rpm	6500	6500	6500
Rated power	P_{Rated}	kW	10.6	20.3	11.5
standstill current	I_0	A	27.0	54.0	29.5
Rated current	I_{Rated}	A	26.5	46.9	27.6
Max. current	$I_{max.}$	A	106	188	110
Rated voltage	$V_{N, AC}$	V	360	360	360
Rated frequency	f_{rated}	Hz	50	100	28
Moment of inertia	J	kgcm ²	171	171	487
Efficiency	$\eta_{100 \%}$		0.800	0.900	0.770
Stator terminal resistance	$R_{UV 20^{\circ}C}$	Ω	0.73	0.18	1.07
Stator terminal resistance	$R_{UV 150^{\circ}C}$	Ω	1.10	0.28	1.62
Mutual inductance	L_H	mH	57.0	13.7	92.8
Stator leakage inductance	$L_{1\sigma}$	mH	1.98	0.49	3.53
Rotor leakage inductance	$L_{2\sigma}$	mH	2.10	0.52	4.76
Mass	m	kg	63.0	63.0	102

Product name			MQA22P14H	MQA22P17H	MQA22P29H
Standstill torque	M_0	Nm	156	156	156
Rated torque	M_{Rated}	Nm	135	130	125
Max. torque	$M_{max.}$	Nm	500	500	500
Rated speed	n_{Rated}	rpm	1425	1670	2935
Max. speed	$n_{max.}$	rpm	6500	6500	6500
Rated power	P_{Rated}	kW	20.1	22.7	38.4
standstill current	I_0	A	51.0	59.0	102
Rated current	I_{Rated}	A	45.6	50.3	86.0
Max. current	$I_{max.}$	A	182	201	344
Rated voltage	$V_{N, AC}$	V	360	360	360
Rated frequency	f_{rated}	Hz	50	58	100
Moment of inertia	J	kgcm ²	487	487	487
Efficiency	$\eta_{100 \%}$		0.860	0.880	0.900
Stator terminal resistance	$R_{UV 20^{\circ}C}$	Ω	0.36	0.27	.09
Stator terminal resistance	$R_{UV 150^{\circ}C}$	Ω	0.54	0.40	0.13
Mutual inductance	L_H	mH	93.3	23.9	23.2
Stator leakage inductance	$L_{1\sigma}$	mH	3.57	0.90	0.89
Rotor leakage inductance	$L_{2\sigma}$	mH	4.81	1.21	1.20
Mass	m	kg	102	102	102

Technical data

Rated data

Inverter mains connection 400 V, Forced ventilated motors



Product name			MQA26T05H	MQA26T10H	MQA26T12H
Standstill torque	M_0	Nm	325	325	325
Rated torque	M_{Rated}	Nm	296	288	282
Max. torque	$M_{max.}$	Nm	1100	1100	1100
Rated speed	n_{Rated}	rpm	550	1030	1200
Max. speed	$n_{max.}$	rpm	5500	5500	5500
Rated power	P_{Rated}	kW	17.0	31.1	35.4
standstill current	I_0	A	48.5	85.5	109
Rated current	I_{Rated}	A	44.5	76.2	88.8
Max. current	$I_{max.}$	A	178	305	355
Rated voltage	$V_{N, AC}$	V	360	360	360
Rated frequency	f_{rated}	Hz	20	36	42
Moment of inertia	J	kgcm ²	1335	1335	1335
Efficiency	$\eta_{100\%}$		0.810	0.870	0.820
Stator terminal resistance	$R_{UV\ 20^\circ C}$	Ω	0.59	0.20	0.15
Stator terminal resistance	$R_{UV\ 150^\circ C}$	Ω	0.89	0.30	0.23
Mutual inductance	L_H	mH	70.0	69.2	16.8
Stator leakage inductance	$L_{1\sigma}$	mH	2.87	2.91	0.65
Rotor leakage inductance	$L_{2\sigma}$	mH	5.05	5.09	0.69
Mass	m	kg	193	193	193

Product name			MQA26T22H
Standstill torque	M_0	Nm	325
Rated torque	M_{Rated}	Nm	257
Max. torque	$M_{max.}$	Nm	1100
Rated speed	n_{Rated}	rpm	2235
Max. speed	$n_{max.}$	rpm	5500
Rated power	P_{Rated}	kW	60.2
standstill current	I_0	A	171
Rated current	I_{Rated}	A	138
Max. current	$I_{max.}$	A	552
Rated voltage	$V_{N, AC}$	V	340
Rated frequency	f_{rated}	Hz	76
Moment of inertia	J	kgcm ²	1335
Efficiency	$\eta_{100\%}$		0.920
Stator terminal resistance	$R_{UV\ 20^\circ C}$	Ω	0.05
Stator terminal resistance	$R_{UV\ 150^\circ C}$	Ω	0.08
Mutual inductance	L_H	mH	18.4
Stator leakage inductance	$L_{1\sigma}$	mH	0.78
Rotor leakage inductance	$L_{2\sigma}$	mH	1.30
Mass	m	kg	193



Selection tables

Notes on the selection tables

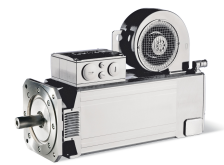
The selection tables represent the combinations of servo motors and servo inverters. The serve as a rough overview.

In the case of the servo inverters, the overload capacity depending on the switching frequency in the default setting is taken into consideration. For more information, please refer to the inverter documentation.

Graphical representation of the operating points		Explanation	Notes
	M_0	Standstill torque	
	$M_{0,max}$	Max. standstill torque	With an active load observe (e. g. vertical drive axes, hoists, test benches, unwinders).
	M_{rated}	Rated torque	
	n_{rated}	Rated speed	
	M_{max}	Max. torque	Can usually be used with a passive load (e. g. horizontal drive axes).
	n_{eto}	Transition speed	
	n_k	Derating speed	Due to a derating of the inverter output current to the derating speed, for some inverters the achievable max. standstill torque is smaller than the max. speed when the value of 5 Hz is not reached.

Derating speed

Motor	Derating speed
	n_k
	rpm
MQA20	150
MQA22	
MQA26	



9400 HighLine servo drives



The data apply to a mains voltage of 3x 400 V and a switching frequency of 8 kHz of the inverter.

If the motors are operated at a lower switching frequency, please get in touch with your Lenze representative!

When operating at 4 kHz, the motor generates just 95 % of its rated torque with increased noise emissions.

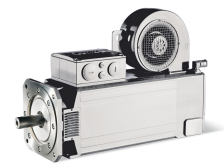
MQA20 ... 22, forced ventilated

Motor			Inverter								
			E94A□□								
			E0174	E0244	E0324	E0474	E0594	E0864	E1044	E1454	E1724
MQA20L14H											
Standstill torque	M ₀	Nm	32.5	66.0							
Rated torque	M _{rated}	Nm	32.5	66.0							
Max. standstill torque	M _{0,max}	Nm	154.2	190.0							
Max. torque	M _{max}	Nm	154.2	190.0							
MQA20L29H											
Standstill torque	M ₀	Nm			28.0	51.6	51.6				
Rated torque	M _{rated}	Nm			28.0	51.6	51.6				
Max. standstill torque	M _{0,max}	Nm			116.0	148.2	192.8				
Max. torque	M _{max}	Nm			116.0	148.2	192.8				
MQA22P08H											
Standstill torque	M ₀	Nm		116.0	156.0						
Rated torque	M _{rated}	Nm		116.0	145.0						
Max. standstill torque	M _{0,max}	Nm		313.0	402.0						
Max. torque	M _{max}	Nm		313.0	402.0						
MQA22P14H											
Standstill torque	M ₀	Nm					118.0				
Rated torque	M _{rated}	Nm					118.0				
Max. standstill torque	M _{0,max}	Nm					372.0				
Max. torque	M _{max}	Nm					372.0				
MQA22P17H											
Standstill torque	M ₀	Nm					99.0	156.0			
Rated torque	M _{rated}	Nm					99.0	130.0			
Max. standstill torque	M _{0,max}	Nm					325.0	463.0			
Max. torque	M _{max}	Nm					325.0	463.0			
MQA22P29H											
Standstill torque	M ₀	Nm							109.0	156.0	156.0
Rated torque	M _{rated}	Nm							109.0	125.0	125.0
Max. standstill torque	M _{0,max}	Nm							335.0	416.0	486.0
Max. torque	M _{max}	Nm							335.0	416.0	486.0



MQA26, forced ventilated

Motor			Inverter									
			E94A□□									
			E0474	E0594	E0864	E1044	E1454	E1724	E2024	E2454	E2924	E3664
MQA26T05H												
Standstill torque	M ₀	Nm	268.0	268.0	325.0							
Rated torque	M _{rated}	Nm	268.0	268.0	296.0							
Max. standstill torque	M _{0,max}	Nm	665.0	826.0	1100.0							
Max. torque	M _{max}	Nm	665.0	826.0	1100.0							
MQA26T10H												
Standstill torque	M ₀	Nm			270.0	298.0	325.0					
Rated torque	M _{rated}	Nm			270.0	288.0	288.0					
Max. standstill torque	M _{0,max}	Nm			713.0	855.0	1044.0					
Max. torque	M _{max}	Nm			713.0	855.0	1044.0					
MQA26T12H												
Standstill torque	M ₀	Nm				219.0	291.0	325.0	325.0			
Rated torque	M _{rated}	Nm				219.0	282.0	282.0	282.0			
Max. standstill torque	M _{0,max}	Nm				609.0	739.0	840.0	950.0			
Max. torque	M _{max}	Nm				609.0	739.0	840.0	950.0			
MQA26T22H												
Standstill torque	M ₀	Nm							242.0	290.0	325.0	325.0
Rated torque	M _{rated}	Nm							242.0	257.0	257.0	257.0
Max. standstill torque	M _{0,max}	Nm							711.0	843.0	1001.0	1100.0
Max. torque	M _{max}	Nm							711.0	843.0	1001.0	1100.0



8400 TopLine inverter drives



The data apply to a mains voltage of 3x 400 V and a switching frequency of 8 kHz of the inverter.

If the motors are operated at a lower switching frequency, please get in touch with your Lenze representative!

When operating at 4 kHz, the motor generates just 95 % of its rated torque with increased noise emissions.

MQA20 ... 22, forced ventilated

Motor			Inverter						
			E84AVTC□						
			1134	1534	1834	2234	3034	3734	4534
MQA20L14H									
Standstill torque	M ₀	Nm	-	76.0	76.0	76.0	76.0		
Rated torque	M _{rated}	Nm	-	71.3	71.3	71.3	71.3		
Max. standstill torque	M _{0,max}	Nm	146.0	202.0	249.2	250.0	250.0		
Max. torque	M _{max}	Nm	146.0	202.2	249.2	250.0	250.0		
MQA20L29H									
Standstill torque	M ₀	Nm			-	76.0	76.0	76.0	76.0
Rated torque	M _{rated}	Nm			-	66.2	66.2	66.2	66.2
Max. standstill torque	M _{0,max}	Nm			121.8	140.9	183.7	224.5	250.0
Max. torque	M _{max}	Nm			121.8	140.9	183.9	225.5	250.0
MQA22P08H									
Standstill torque	M ₀	Nm	-	156.0	156.0	156.0	156.0		
Rated torque	M _{rated}	Nm	-	144.5	144.5	144.5	144.5		
Max. standstill torque	M _{0,max}	Nm	222.8	310.5	377.0	372.9	374.6		
Max. torque	M _{max}	Nm	223.0	310.5	377.0	372.9	374.6		
MQA22P14H									
Standstill torque	M ₀	Nm		-	-	156.0	156.0	156.0	156.0
Rated torque	M _{rated}	Nm		-	-	134.7	134.7	134.7	134.7
Max. standstill torque	M _{0,max}	Nm		185.1	230.6	267.1	343.7	418.3	500.0
Max. torque	M _{max}	Nm		185.1	230.6	267.1	344.4	420.0	500.0
MQA22P17H									
Standstill torque	M ₀	Nm			-	-	156.0	156.0	156.0
Rated torque	M _{rated}	Nm			-	-	129.8	129.8	129.8
Max. standstill torque	M _{0,max}	Nm			198.6	230.2	300.0	365.3	447.0
Max. torque	M _{max}	Nm			198.6	230.4	300.0	367.5	449.9
MQA22P29H									
Standstill torque	M ₀	Nm					-	-	156.0
Rated torque	M _{rated}	Nm					-	-	124.9
Max. standstill torque	M _{0,max}	Nm					176.1	218.9	263.2
Max. torque	M _{max}	Nm					176.4	219.6	264.1

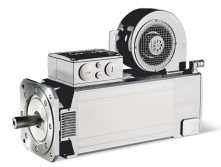


MQA26, forced ventilated

Motor			Inverter					
			E84AVTC□					
			1534	1834	2234	3034	3734	4534
MQA26T05H								
Standstill torque	M ₀	Nm	-	-	325.0	325.0	325.0	325.0
Rated torque	M _{rated}	Nm	-	-	295.2	295.2	295.2	295.2
Max. standstill torque	M _{0,max}	Nm	390.4	489.6	567.1	744.4	902.3	1080.2
Max. torque	M _{max}	Nm	390.4	490.2	568.0	744.8	904.7	1080.2
MQA26T10H								
Standstill torque	M ₀	Nm				-	-	325.0
Rated torque	M _{rated}	Nm				-	-	288.3
Max. standstill torque	M _{0,max}	Nm				429.7	532.5	638.2
Max. torque	M _{max}	Nm				431.4	534.1	641.5
MQA26T12H								
Standstill torque	M ₀	Nm					-	325.0
Rated torque	M _{rated}	Nm					-	281.7
Max. standstill torque	M _{0,max}	Nm					458.2	550.4
Max. torque	M _{max}	Nm					460.6	552.9

Technical data

Torque characteristics

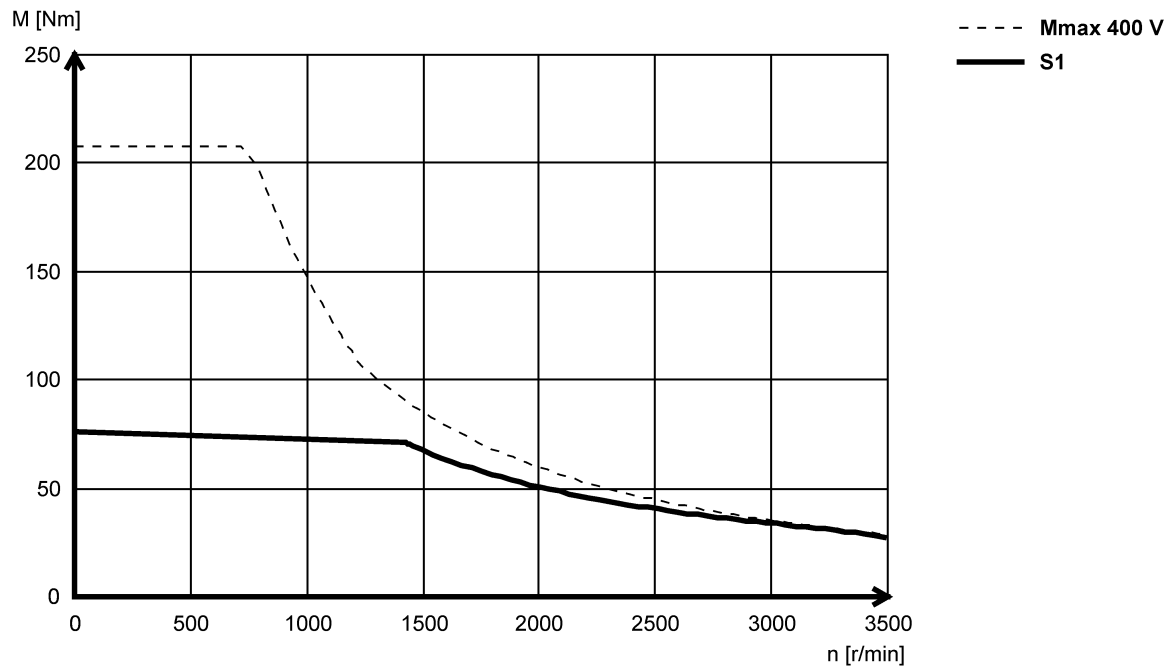


The torque/speed characteristic for your motor/inverter combination can be found on the Internet: <http://www.lenze.com> → Product Finder → M-n characteristics

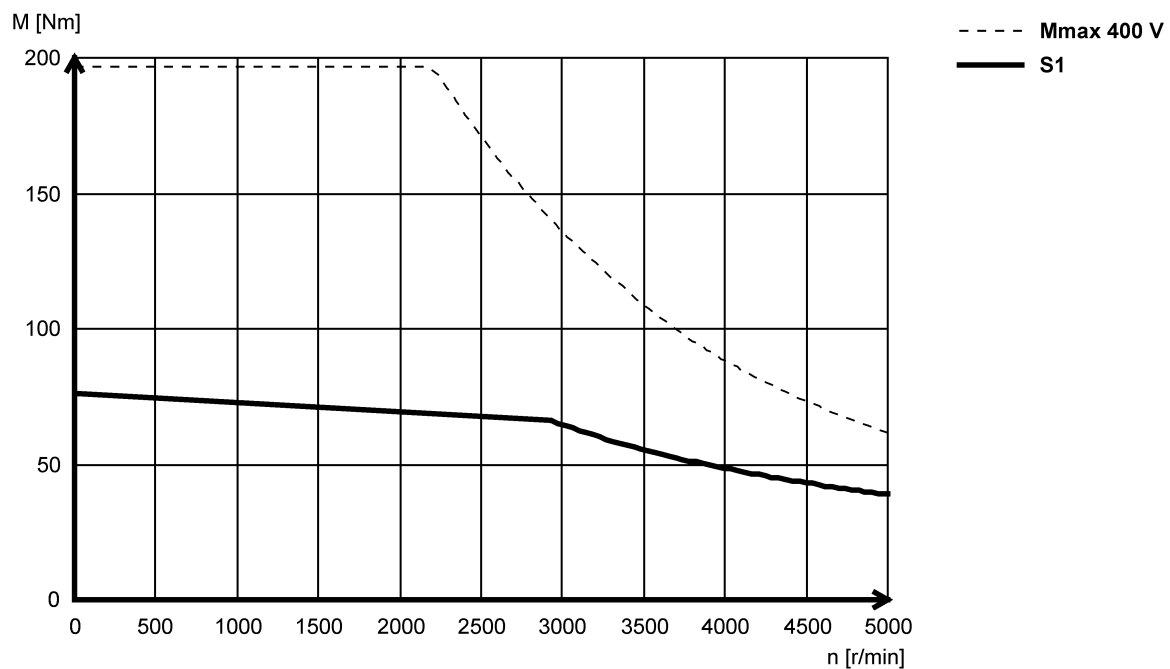


The following data apply to a mains voltage 3 x 400 V of the inverter.

MQA20L14H (forced ventilated)

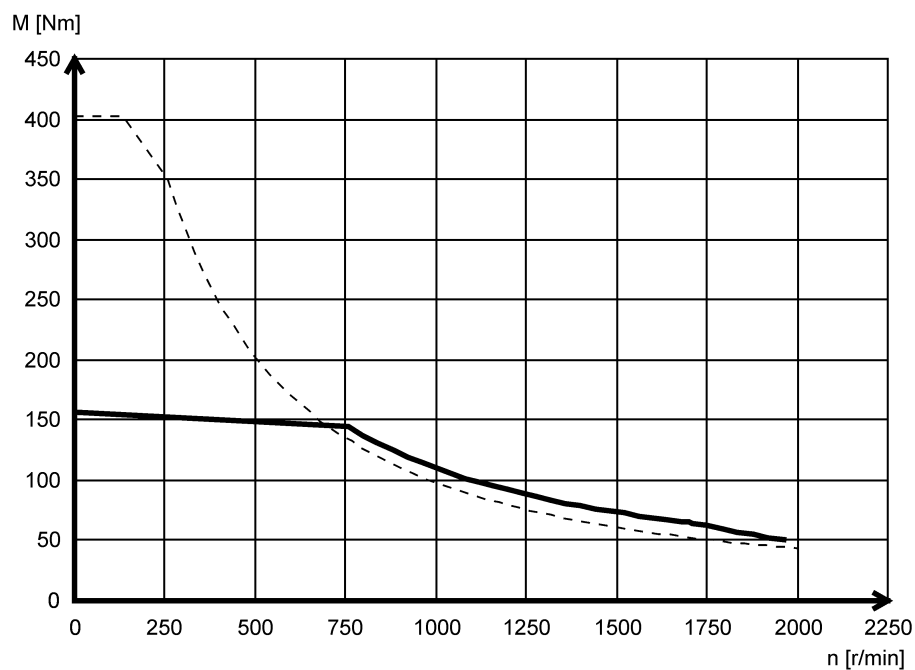


MQA20L29H (forced ventilated)

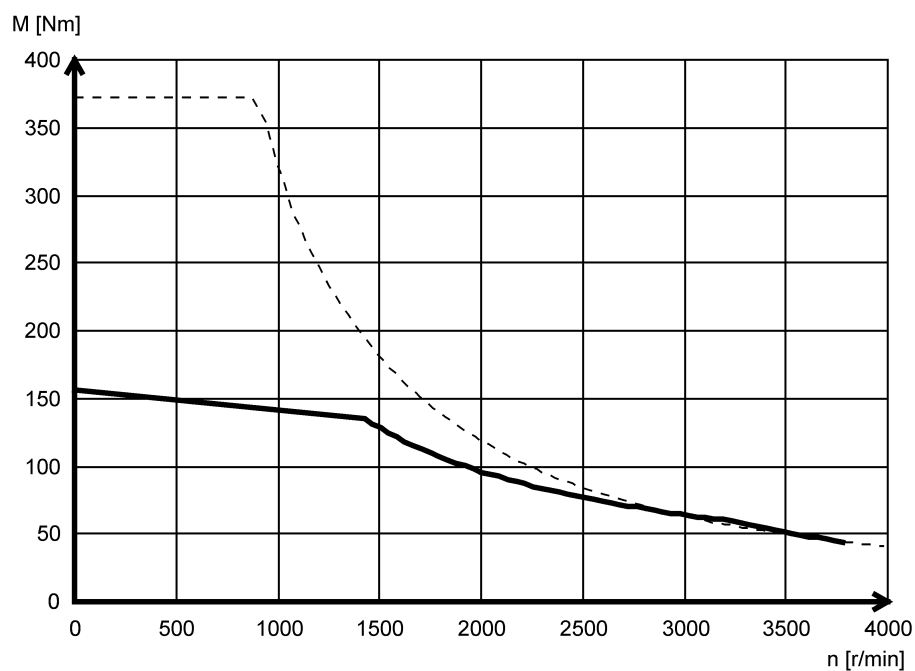




MQA22P08H (forced ventilated)

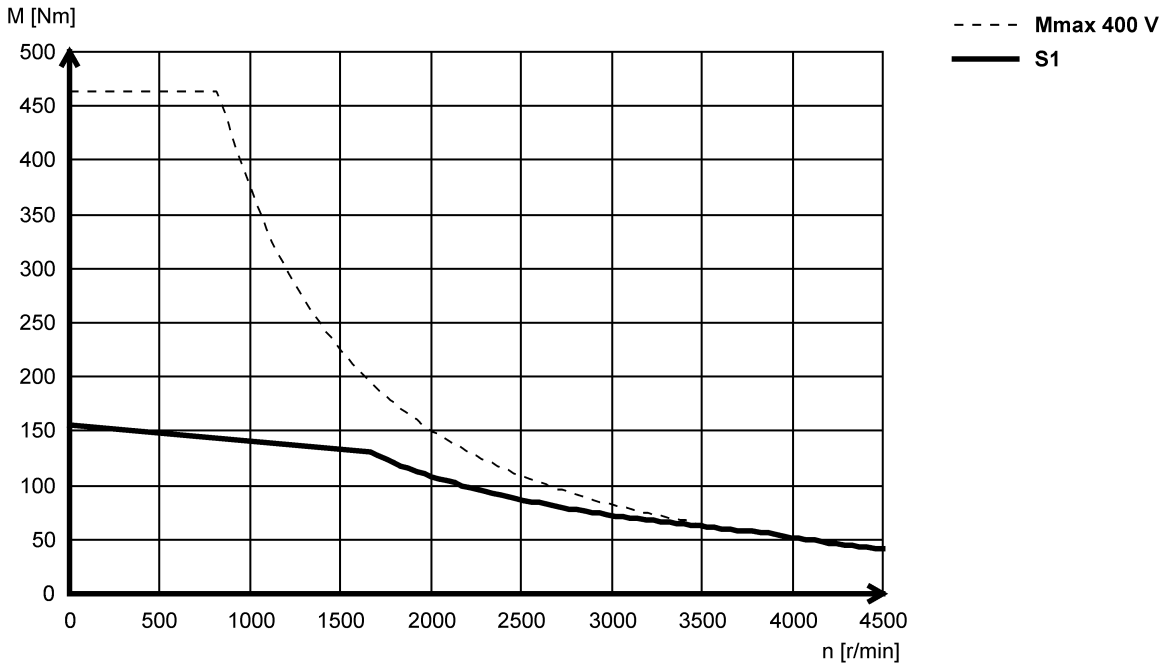


MQA22P14H (forced ventilated)

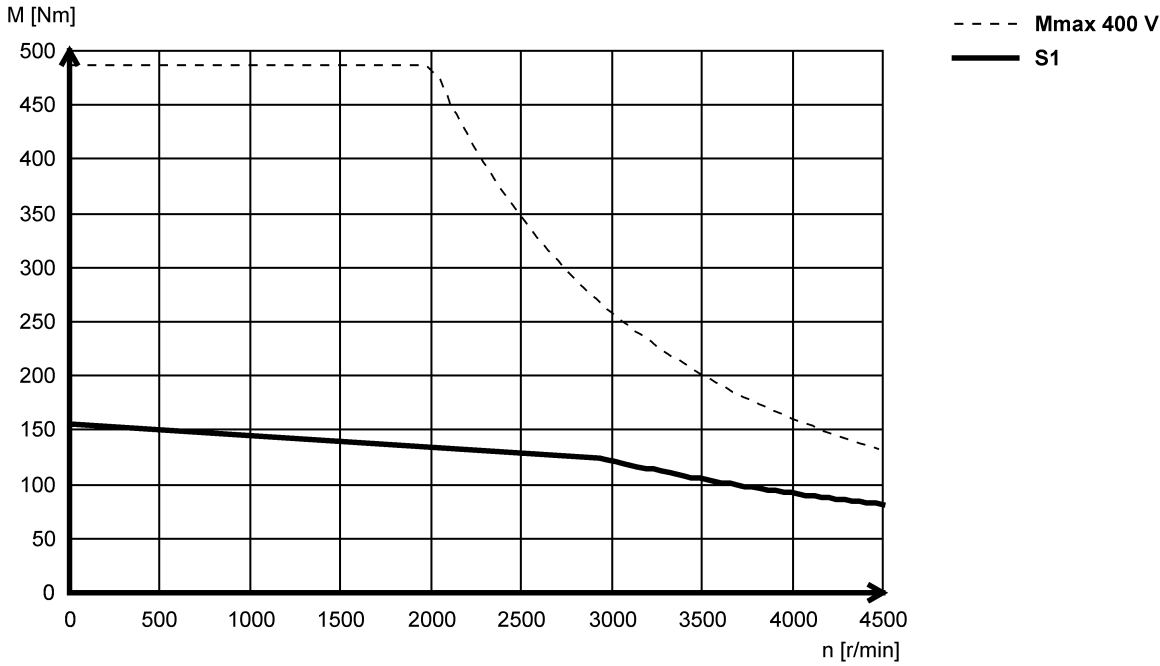




MQA22P17H (forced ventilated)

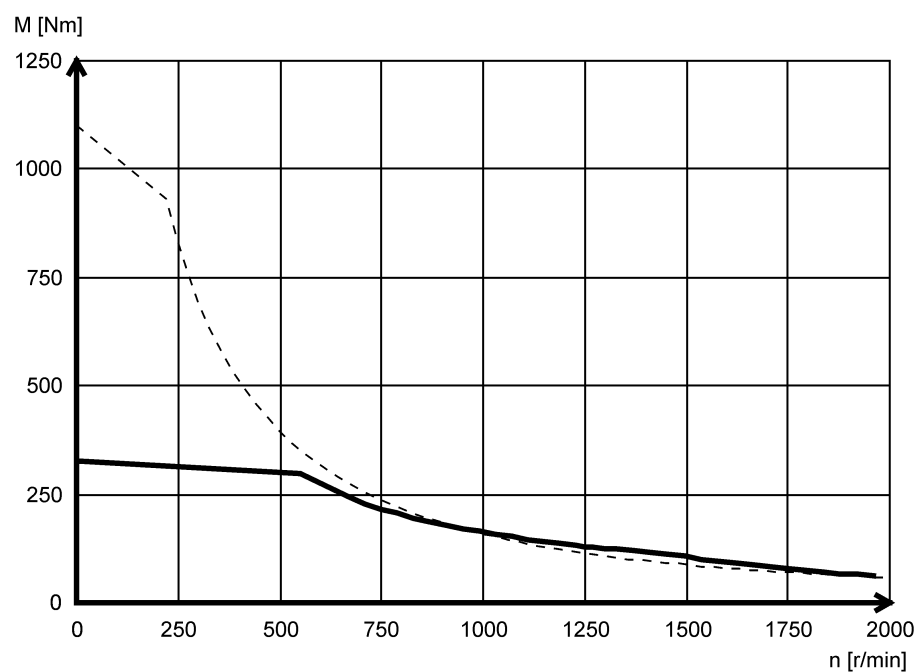


MQA22P29H (forced ventilated)

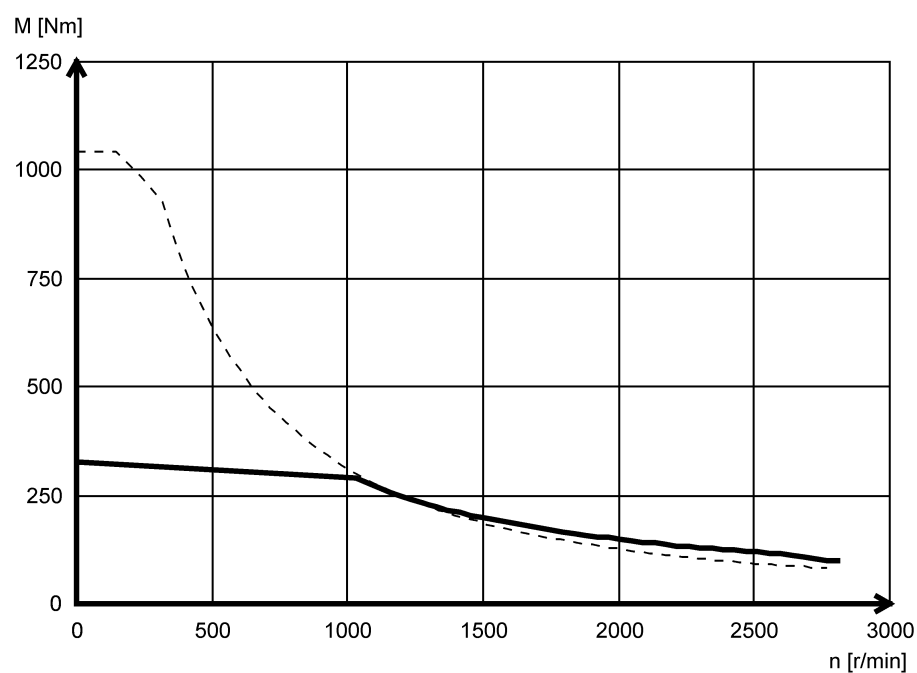




MQA26T05H (forced ventilated)

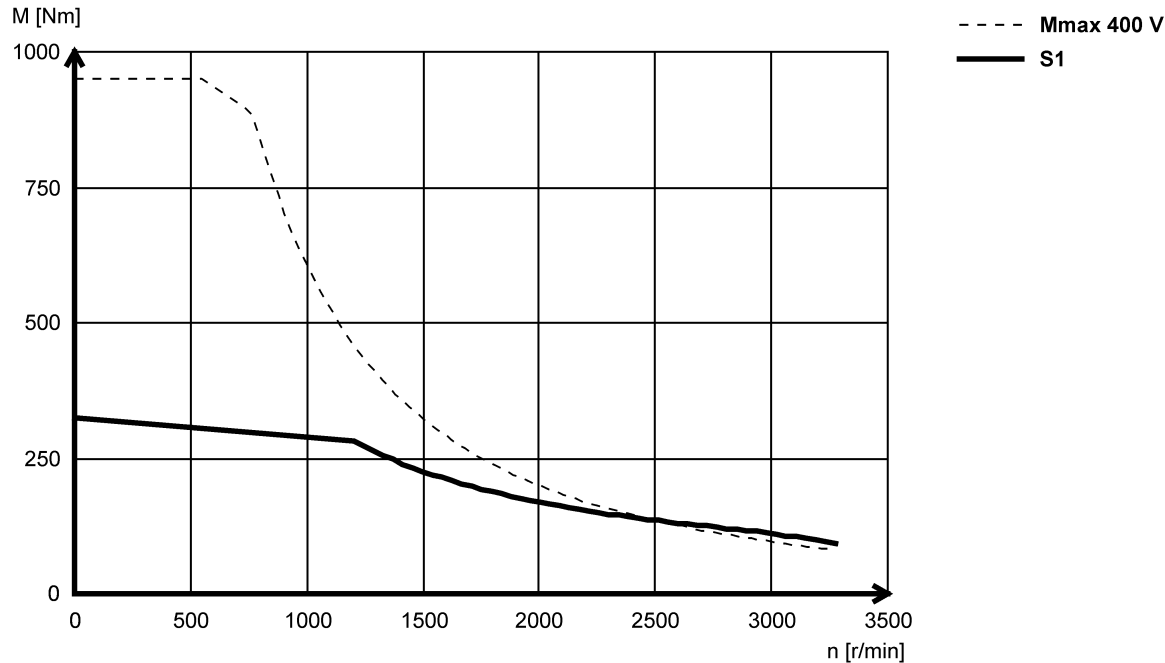


MQA26T10H (forced ventilated)

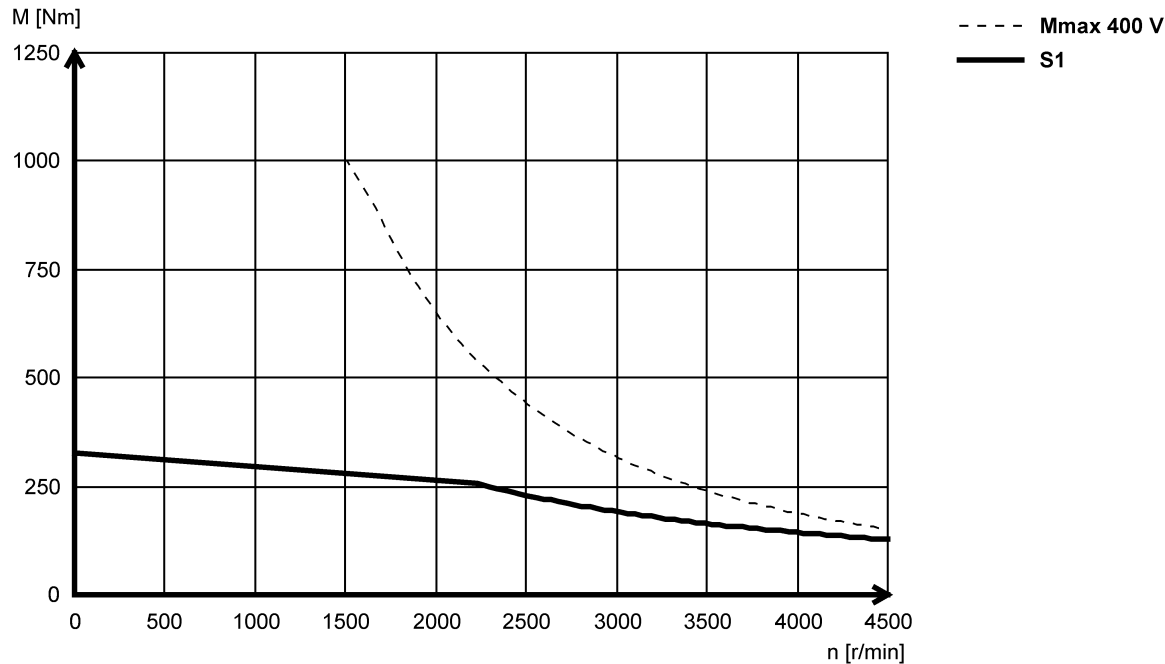




MQA26T12H (forced ventilated)



MQA26T22H (forced ventilated)





Technical data

Dimensions
Basic dimensions

Dimensions

Basic dimensions

Notes on the basic dimensions

Table content		Explanation
Total length without brake	L	Total length of the drive with resolver
Total length with brake	L	Total length of the drive with resolver
Length of motor options	ΔL	Additional length (longest design) In detail ► Additional lengths  48
Motor/connection distance	AD	Distance from motor centre to connector end / terminal box

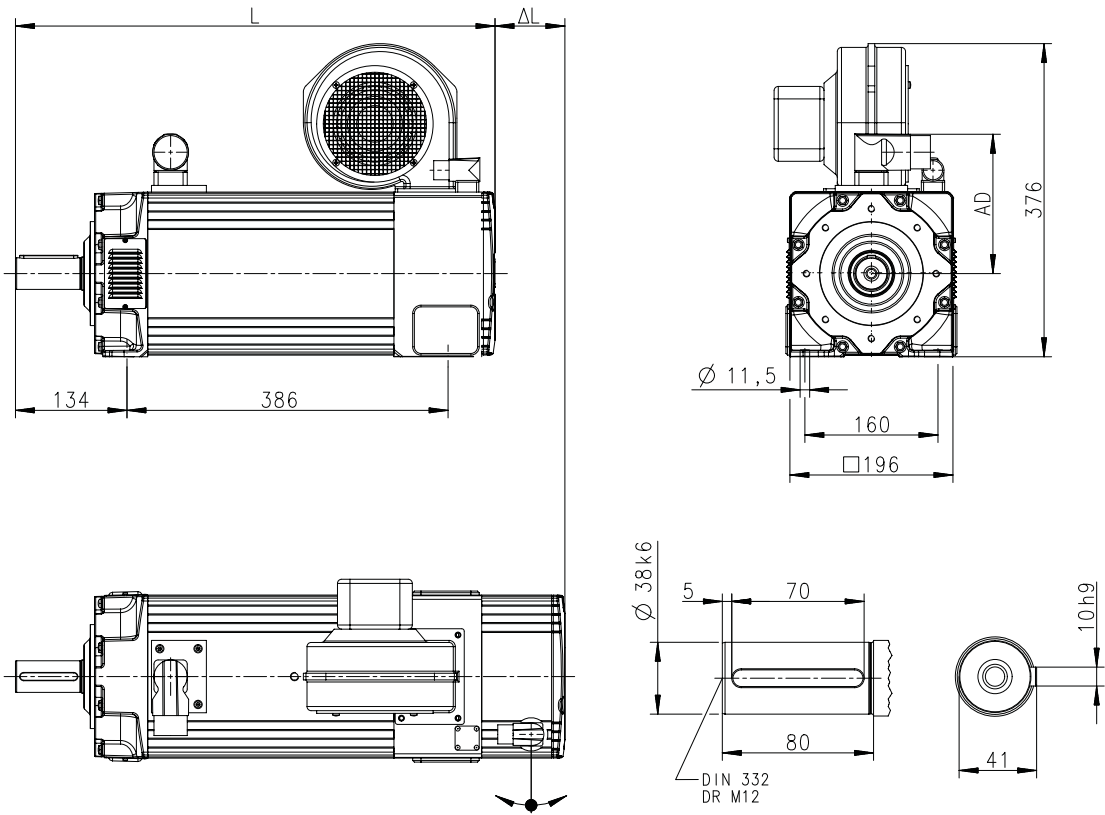
Technical data

Dimensions
Basic dimensions



MQA20, forced ventilated

Design B3



8800712-00

Motor			MQA20L14H	MQA20L29H
Total length without brake	L	mm	577	
Length of motor options	ΔL	mm	152	
Motor/connection distance	AD	mm	171	

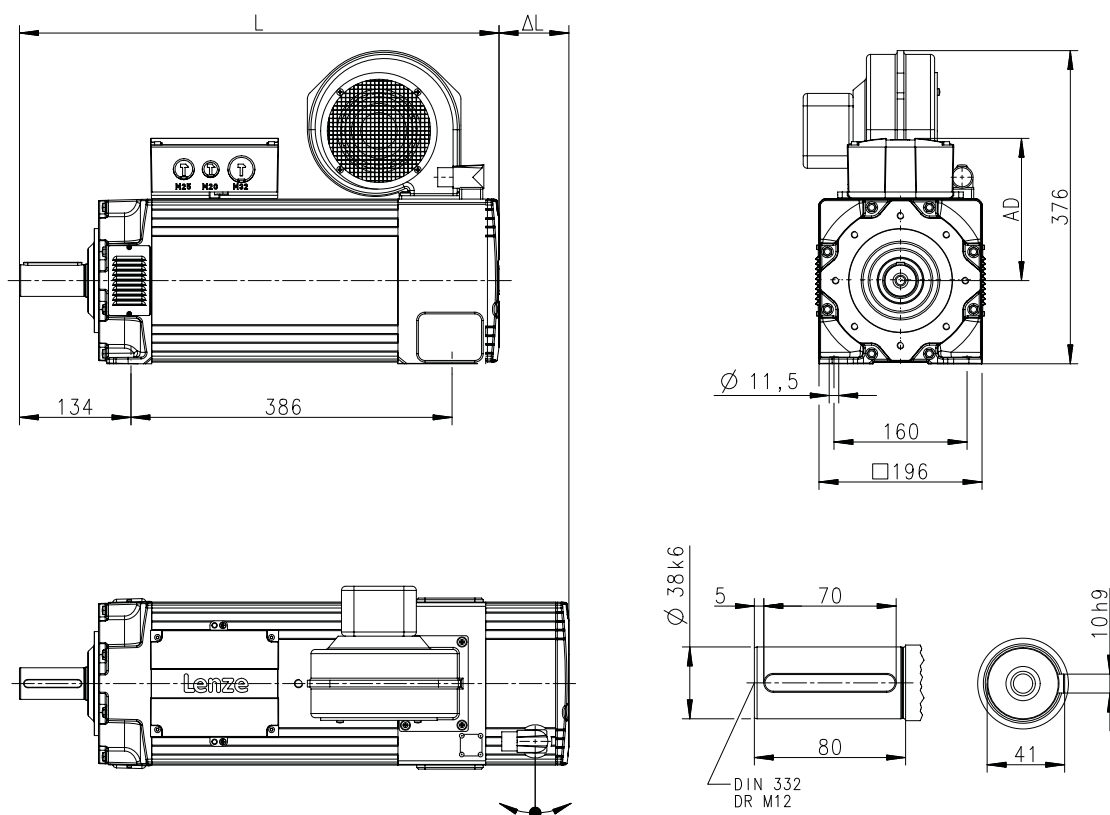


Technical data

Dimensions
Basic dimensions

MQA20, forced ventilated

Design B3



8800714-00

Motor			MQA20L14H	MQA20L29H
Total length without brake	L	mm	577	
Length of motor options	ΔL	mm	152	
Motor/connection distance	AD	mm	171	

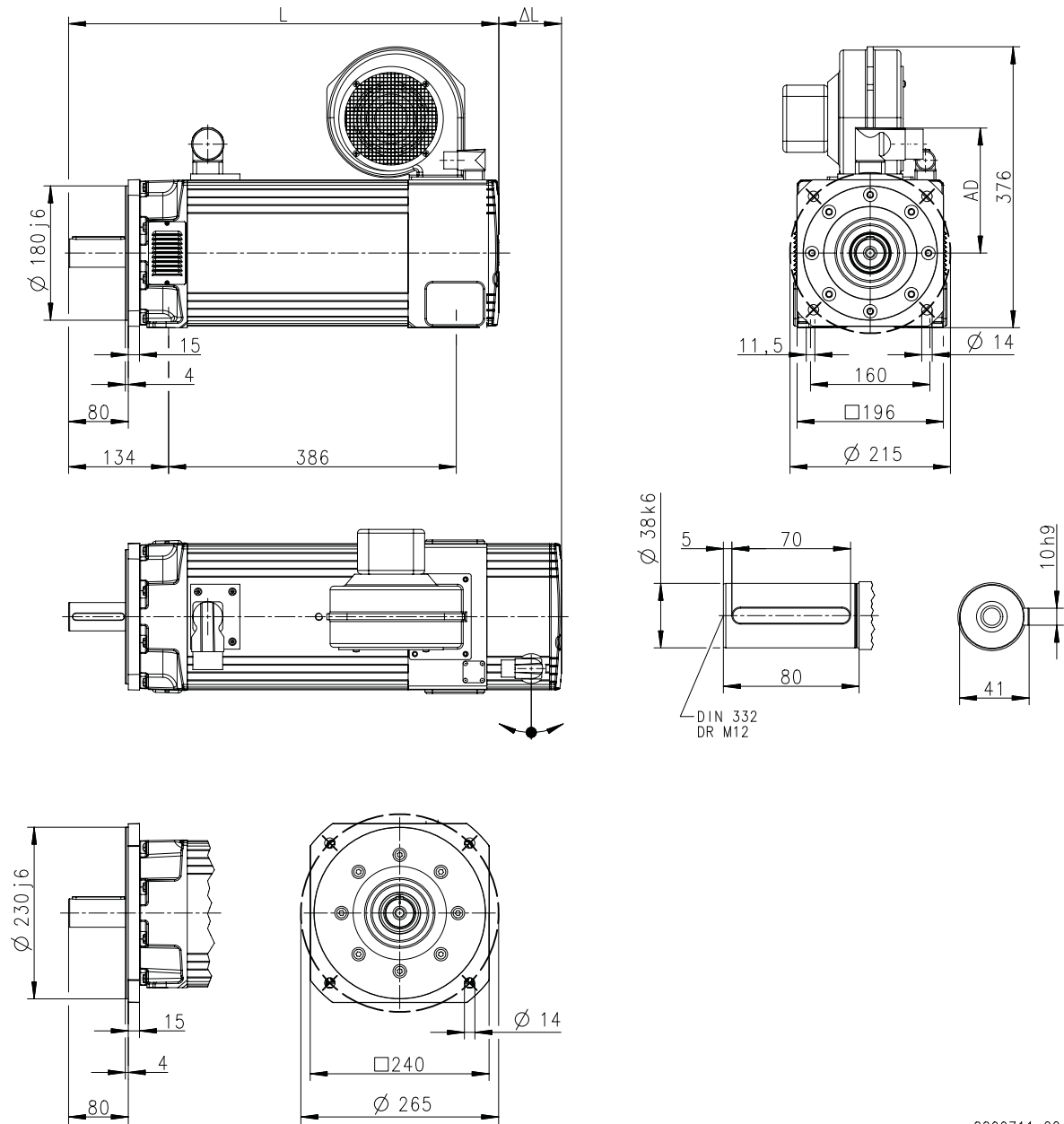
Technical data

Dimensions
Basic dimensions



MQA20, forced ventilated

Design B35-FF215/265



8800711-00

Motor			MQA20L14H	MQA20L29H
Total length without brake	L	mm	577	
Length of motor options	ΔL	mm	152	
Motor/connection distance	AD	mm	171	

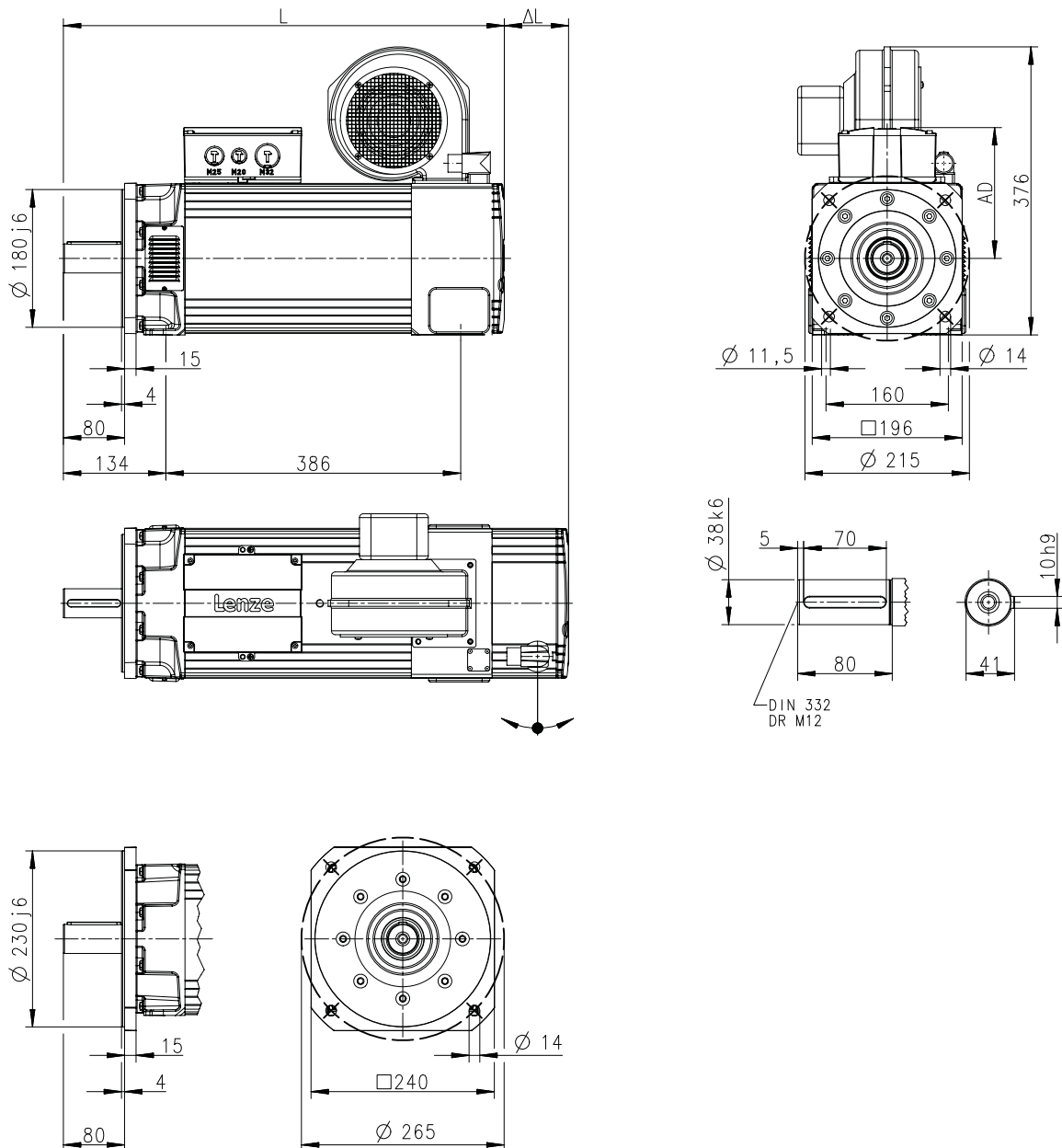


Technical data

Dimensions
Basic dimensions

MQA20, forced ventilated

Design B35-FF215/265



8800669-00

Motor			MQA20L14H	MQA20L29H
Total length without brake	L	mm	577	
Length of motor options	ΔL	mm	152	
Motor/connection distance	AD	mm	171	

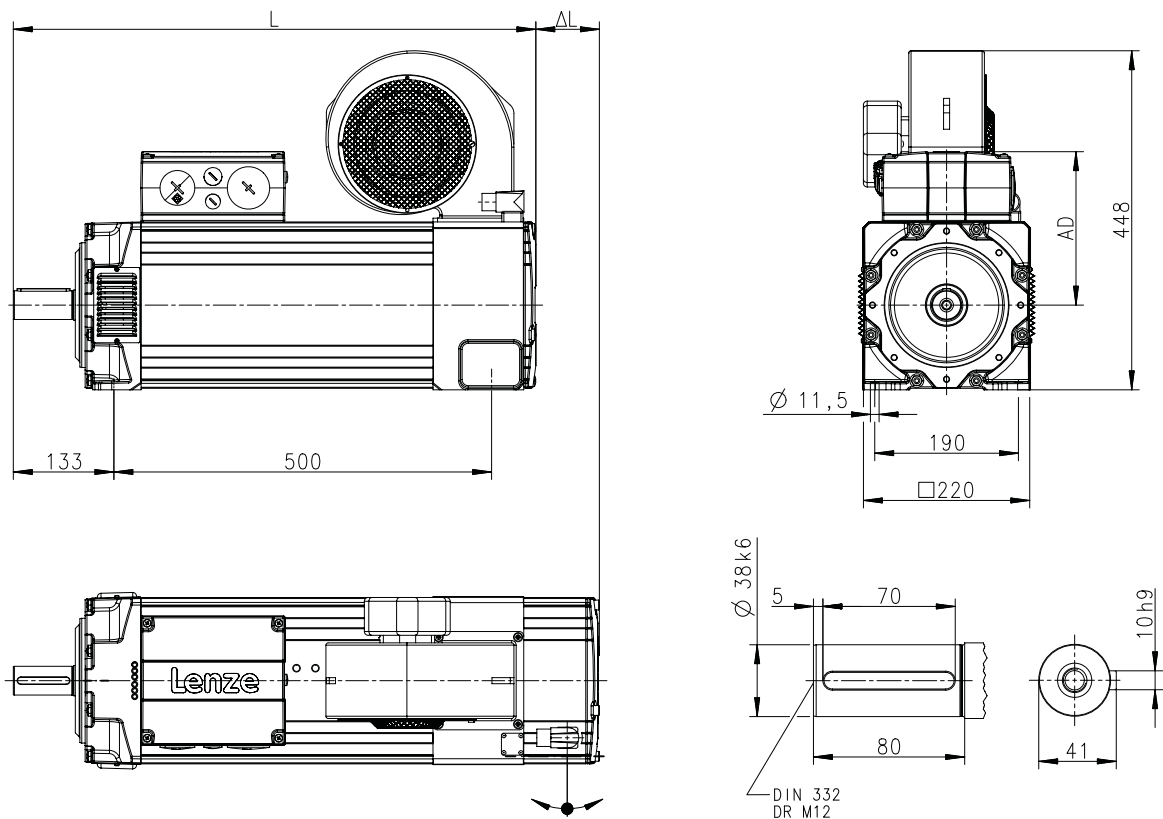
Technical data

Dimensions
Basic dimensions



MQA22, forced ventilated

Design B3



8800716-00

Motor			MQA22P08H	MQA22P14H	MQA22P17H	MQA22P29H
Total length without brake	L	mm	691			
Length of motor options	ΔL	mm	157			
Motor/connection distance	AD	mm	203			

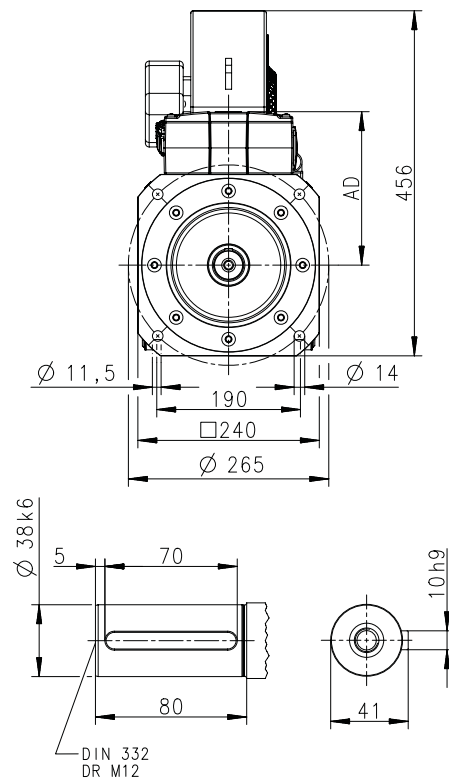
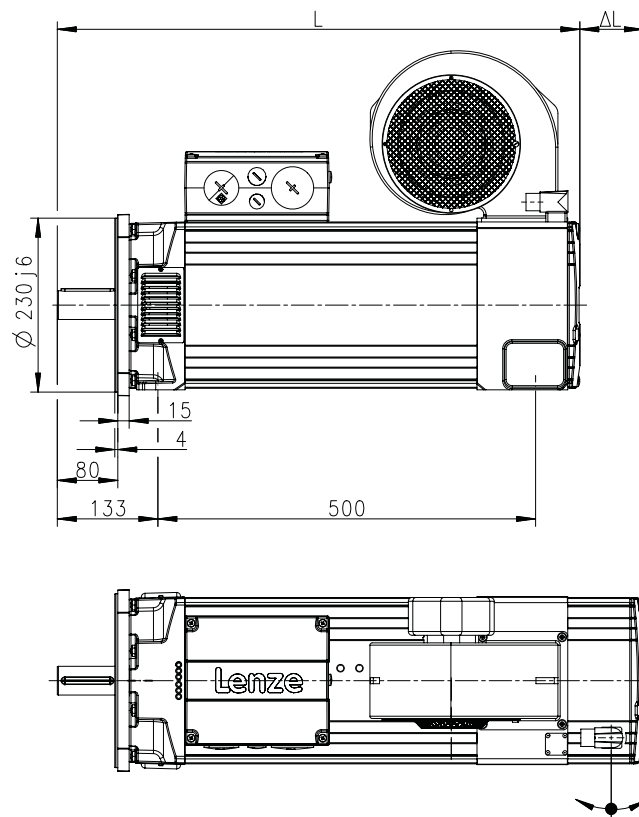


Technical data

Dimensions
Basic dimensions

MQA22, forced ventilated

Design B35-FF265



8800715-00

Motor			MQA22P08H	MQA22P14H	MQA22P17H	MQA22P29H
Total length without brake	L	mm	691			
Length of motor options	Δ L	mm	157			
Motor/connection distance	AD	mm	203			

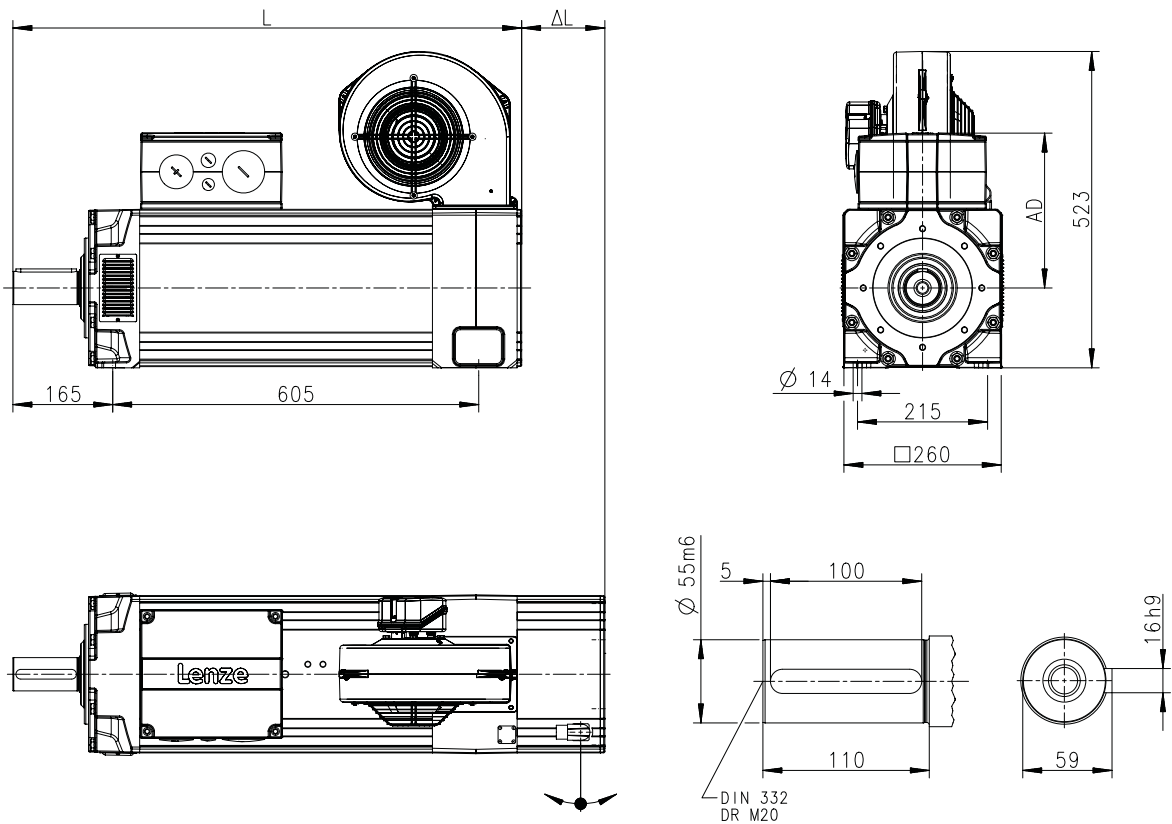
Technical data

Dimensions
Basic dimensions



MQA26, forced ventilated

Design B3



8800718-00

Motor			MQA26T05H	MQA26T10H	MQA26T12H	MQA26T22H
Total length without brake	L	mm	841			
Length of motor options	Δ L	mm	176			
Motor/connection distance	AD	mm	256			

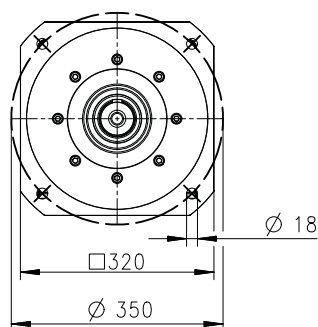
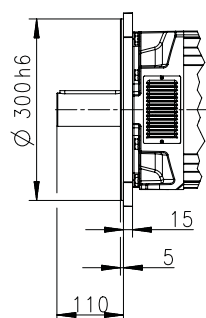
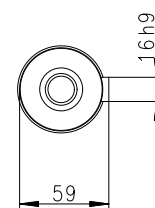
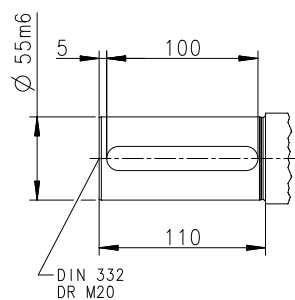
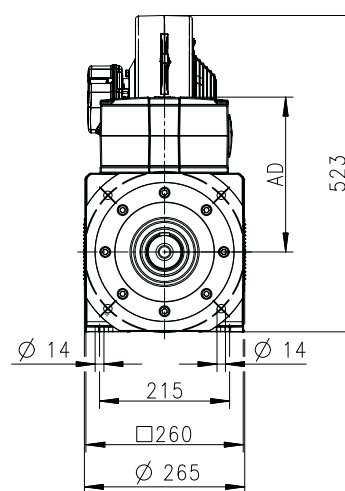
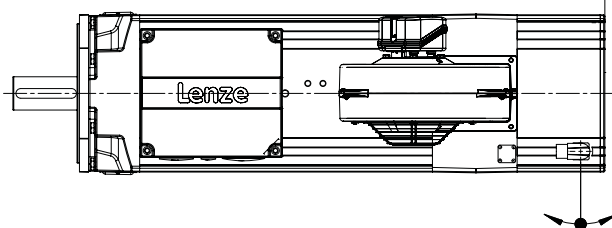
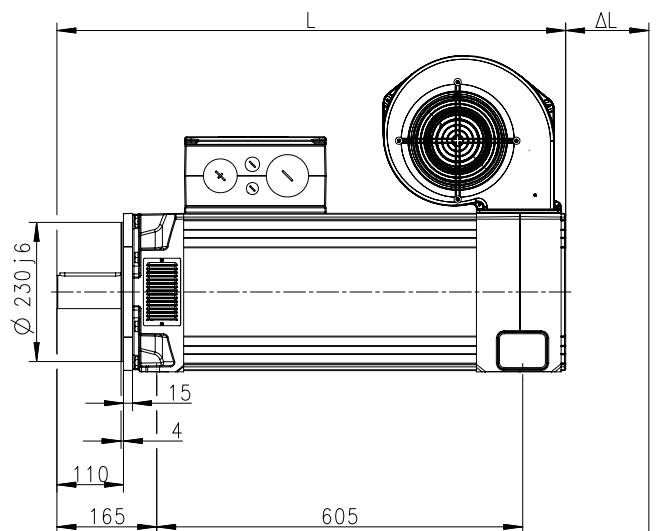


Technical data

Dimensions
Basic dimensions

MQA26, forced ventilated

Design B35-FF350



8800717-00

Motor			MQA26T05H	MQA26T10H	MQA26T12H	MQA26T22H
Total length without brake	L	mm	841			
Length of motor options	Δ L	mm	176			
Motor/connection distance	AD	mm	256			

Technical data

Dimensions
Additional lengths



Additional lengths



The motor code indicates the short designation of the brake and feedback.
Detailed information can be found for

► [Product codes](#) 63

► [Brakes](#) 54

► [Feedback](#) 58

MQA20

Motor			MQA20L14H	MQA20L29H
Cooling type			Forced	Forced
Feedback (without brake B0)				
R□0	Δ L	mm	0	
S□□ / T□□ / E□□	Δ L	mm	0	
Brake (F1/FG) and feedback				
R□0	Δ L	mm	84	
S□□ / T□□ / E□□	Δ L	mm	127	
Brake (F2/FH) and feedback				
R□0	Δ L	mm	152	
S□□ / T□□ / E□□	Δ L	mm	152	

MQA22

Motor			MQA22P08H	MQA22P14H	MQA22P17H	MQA22P29H
Cooling type			Forced	Forced	Forced	Forced
Feedback (without brake B0)						
R□0	Δ L	mm	0			
S□□ / T□□ / E□□	Δ L	mm	0			
Brake (F1/FG) and feedback						
R□0	Δ L	mm	82			
S□□ / T□□ / E□□	Δ L	mm	125			
Brake (F2/FH) and feedback						
R□0	Δ L	mm	157			
S□□ / T□□ / E□□	Δ L	mm	157			

MQA26

Motor			MQA26T05H	MQA26T10H	MQA26T12H	MQA26T22H
Cooling type			Forced	Forced	Forced	Forced
Feedback (without brake B0)						
R□0	Δ L	mm	0			
S□□ / T□□ / E□□	Δ L	mm	0			
Brake (F1/FG) and feedback						
R□0	Δ L	mm	138			
S□□ / T□□ / E□□	Δ L	mm	176			
Brake (F2/FH) and feedback						
R□0	Δ L	mm	176			
S□□ / T□□ / E□□	Δ L	mm	176			



Technical data

Weights
Additional weights

Weights

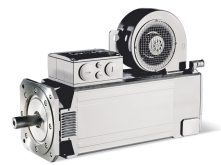
Additional weights

Motors

Motor			MQA20	MQA22	MQA26
Spring-applied holding brake					
Standard braking torque	m	kg	13.0	20.5	30.7
Increased braking torque	m	kg	15.4	26	-

Product extensions

Motor connection
Connection via terminal box



Product extensions

Motor connection

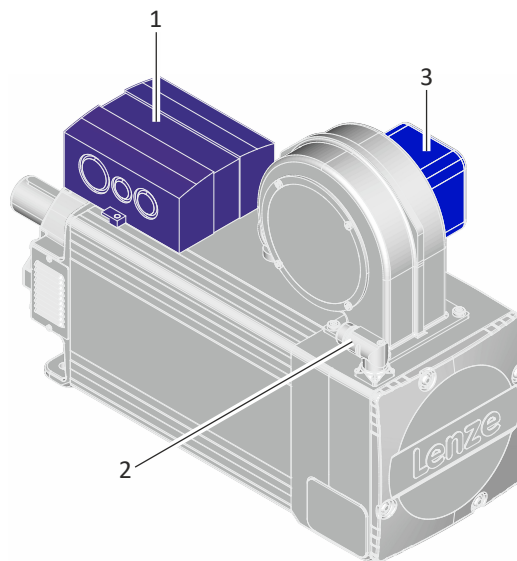
Connection via terminal box

If a motor is to be connected to an existing cable or plug connectors are not to be used for other reasons, the connection can also be made via a terminal box.

The connection for feedback and temperature monitoring is generally via the ICN connector and the electric fan is connected via a terminal box.

The terminals are designed as tension spring terminals to ensure here the long-term vibration resistance of the cable contacts with adequate contact pressure required.

Position of the connections



Position	Meaning
1	Power connection Brake connection PE connection
2	Feedback connection Connection of temperature monitoring
3	Blower connection



Product extensions

Motor connection
Connection via terminal box

Cable glands



The cut-outs for the cable glands are closed with sealing plugs.

The cable glands are arranged on both sides with MQA20.

The cable glands are arranged on one side with MQA22 and MQA26. If required, the terminal box can be rotated by 180 ° after loosening the screws in the terminal box.

Motor		MQA20	MQA22	MQA26
Screwed connections		2x M20 x 1.5 2x M25 x 1.5 2x M32 x 1.5	1x M40 x 1.5 1x M50 x 1.5 1x M20 x 1.5 1x M16 x 1.5	1x M50 x 1.5 1x M63 x 1.5 1x M20 x 1.5 1x M16 x 1.5
Cable cross-section	mm ²	2.5 ... 16	10 ... 35	-
Terminal design		Spring-loaded terminal	Screw terminal	Threaded bolt
Stripping length	mm	18 ... 20	18	-
Threaded bolt		-	-	M12
Tightening torque	Nm	-	3.2	15.5

Power connection

Contact	Name	Meaning
PE	PE	PE conductor
V	V	Motor winding phase U
V	V	Motor winding phase V
W	W	Motor winding phase W

Connection of brake AC

Connection via rectifiers			
Contact	Name	Meaning	
~	BA1	Mains L1	
~	BA2	Mains N	
+	BD1	Holding brake + (factory-wired)	
-	BD2	Holding brake - (factory-wired)	
		Switching contact - DC switching	

Blower connection

1-phase		
Contact	Name	Meaning
PE	PE	PE conductor
U1	L1	Mains connection
U2	N	

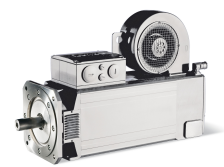
three-phase			
Contact	Name	Meaning	Note
PE	PE	PE conductor	Pay attention to the direction of rotation! Swap L1 and L2 if the direction of rotation is incorrect.
U1	L1	Mains connection	
V1	L2		
W1	L3		

Connection of temperature monitoring

Contact	Name	Meaning
R1	+	Thermal detector +
R2	-	Thermal detector -

Product extensions

Motor connection
Connection via ICN connector



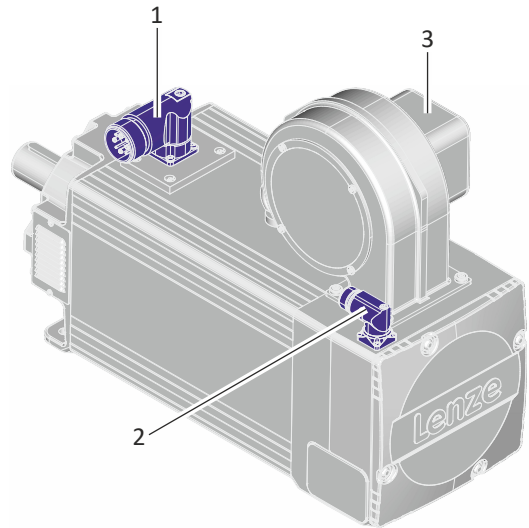
Connection via ICN connector

The connectors can be rotated by 270 ° and are provided with a bayonet catch. Since the catch of the connector is also compatible with conventional box nuts, existing mating connectors with a screw plug can continue to be used without any problems.



In order to provide for a quick and error-free connection of Lenze motors to Lenze inverters, we recommend using prefabricated Lenze system cables.

Position of the connections



Position	Meaning
1	Power connection Brake connection PE connection
2	Feedback connection Connection of temperature monitoring
3	Blower connection

Power and brake connection

Valid for MQA20

ICN-M40 connector assignment 8-pole			
Contact	Name	Meaning	
1		Not assigned	
2		Not assigned	
+	BD1	Holding brake +	
-	BD2	Holding brake -	
PE	PE	PE conductor	
V	V	Power phase U	
V	V	Power phase V	
W	W	Power phase W	



Product extensions

Motor connection
Connection via ICN connector

Feedback and temperature monitoring connection

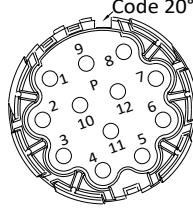
ICN-M23 connector assignment

Resolvers

Contact	Name	Meaning	
1	+ Ref	Transformer windings	
2	- Ref		
3	+VCC ENP	Supply: Electronic nameplate (Only for motors and inverters which support this function)	
4	+ Cos	Stator windings cosine	
5	- Cos		
6	+ Sin	Stator windings Sine	
7	- Sin		
8		Not assigned	
9			
10	Shield	Encoder housing shield	
11	+	Temperature monitoring: PT1000	
12	-		

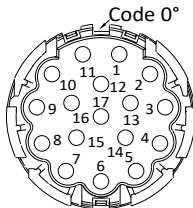
ICN-M23 connector assignment

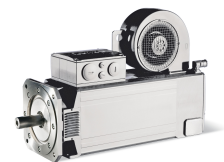
Incremental and SinCos absolute value encoder Hiperface®

Contact	Name	Meaning	
1	B	Track B / + SIN	
2	A ⁻	Track A inverse / - COS	
3	A	Track A / + COS	
4	+ UB	Supply +	
5	GND	Mass	
6	Z ⁻	Zero track inverse / - RS485	
7	Z	Zero track / + RS485	
8		Not assigned	
9	B ⁻	Track B inverse/-SIN	
10	Shield	Encoder housing shield	
11	+	Temperature monitoring: PT1000	
12	-		

ICN-M23 connector assignment

SinCos absolute value encoder with EnDat interface

Contact	Designation	Meaning	
1	U _p sensor	U _p sensor	
2		Not assigned	
3		Not assigned	
4	0 V sensor	0 V sensor	
5	+	Temperature monitoring: KTY/PT1000	
6	-		
7	+ UB	Supply +	
8	Cycle	EnDat interface cycle	
9	Cycle ⁻	Inverse EnDat interface cycle	
10	GND	Mass	
11	Shield	Encoder housing screen	
12	B	Track B	
13	B ⁻	Track B inverse/-SIN	
14	Data	EnDat interface data	
15	A	Track A	
16	A ⁻	Track A inverse	
17	Data ⁻	Data inverse EnDat interface	



Brakes

Optionally the motors can be ordered with a spring-applied brake as holding brake.

⚠ CAUTION!

They may not be used as safety elements (particularly with hoist axes) without additional measures being implemented.

The brakes used are not fail-safe brakes in the sense that prospective disruptive factors, e.g. oil ingress, can lead to a reduction in torque!

- ▶ The brakes must only be used as holding brakes for holding the axes at a standstill or in the deenergised state.
- ▶ The brake must not be used as a service brake.

⚠ CAUTION!

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.

Motor supply cables

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:

$U[V] = U_B[V] + 0.08 \frac{[V]}{[A] \times [m]} \times l_{Lg}[m] \times I_B[A]$	U	V	Resulting supply voltage
	U _B	V	Rated voltage of the brake
	l _{Lg}	m	Cable length
	I _B	A	Rated current of the brake

NOTICE

- ▶ The brakes become active when the supply voltage has been switched off (closed-circuit principle).
- ▶ When using the brakes purely as holding brakes, virtually no wear occurs on the friction surfaces.
- ▶ 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.

NOTICE

In case of travel axes, the compliance of the permissible ratio of mass inertia load/brake motor (J_L/J_{MB}) ensures that the permissible maximum switching energy of the brake will not be exceeded and at least the values given for the emergency stop functions from the given speed (see rated data) are applied.

For hoist axes, the load torque resulting from the weight acts additionally. In this case, the specifications for (J_L/J_{MB}) do not apply.



To simplify matters, the friction energy per switching cycle can be calculated using the formula below and must not exceed the limit value for emergency stops, which depends on the switching rate:

$Q = \frac{1}{2} \times J_{\text{ges}} \times \left(2\pi \times \frac{\Delta n}{60} \right)^2 \times \frac{M_N}{M_N - M_L}$	Q	J	Friction energy
	J_{total}	kgm ²	Total mass inertia (motor + load)
	Δn	rpm	Differential speed
	M_N	Nm	Rated torque of the brake
	M_L	nM	Load torque



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, is not integrated into the motor).



It is not possible to readjust the brake.

Product extensions

Brakes
Spring-applied brakes



Spring-applied brakes

Rated data



Engagement and disengagement times apply to rated voltage ($\pm 0\%$) and suppressor circuit of the brakes with a varistor with DC switching. Without a suppressor circuit, the times may be longer.

The currents are the maximum values when the brake is cold (value used for dimensioning the current supply). The values for a motor at operating temperature are considerably lower.

With 24 V DC brake: smoothed DC voltage, ripple $\leq 1\%$.

With 230 V AC brake: connection to an integrated rectifier (no cURus possible).

Maximum switching energy for each emergency stop with $n = 3000$ rpm for at least 300, and a maximum of 4 emergency stops per hour.

Rated data with standard braking torque

DC 24 V, motor code= F1

Motor			MQA20L	MQA22P	MQA26T
Supply voltage range	$U_{in,DC}$	V	21.6 ... 26.4		
Rated voltage	$U_{N,DC}$	V	24		
Rated torque					
At 20 °C	M_N	Nm	90.0	150	300
At 120 °C	M_N	Nm	80.0	130	260
Rated current	I_N	A	3.13	3.75	3.75
Engagement time	t_1	ms	70.0	50.0	175
Disengagement time	t_2	ms	220	260	320
Maximum switching energy	Q_E	J	18000	23000	51000
Mass	m	kg	13.0	20.5	30.7
Moment of inertia					
Brake	J	kgcm ²	6.88	18.1	70.4
Brake motor	J_{MB}	kgcm ²	177	505	1405
Load/brake motor ratio	J_L/J_{MB}		19.6	8.20	12.7

AC 230 V, motor code = FG

Motor			MQA20L	MQA22P	MQA26T
Supply voltage range	$U_{in,AC}$	V	207 ... 253		
Rated voltage	$U_{N,AC}$	V	230		
Rated torque					
At 20 °C	M_N	Nm	90.0	150	300
At 120 °C	M_N	Nm	80.0	130	260
Rated current	I_N	A	0.37	0.44	0.37
Engagement time	t_1	ms	70.0	130	175
Disengagement time	t_2	ms	220	260	360
Maximum switching energy	Q_E	J	18000	23000	51000
Mass	m	kg	13.0	20.5	30.7
Moment of inertia					
Brake	J	kgcm ²	6.88	18.1	70.4
Brake motor	J_{MB}	kgcm ²	177	505	1405
Load/brake motor ratio	J_L/J_{MB}		19.6	8.20	12.7



Product extensions

Brakes
Spring-applied brakes

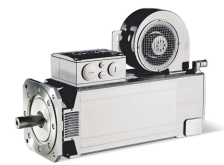
Rated data with increased braking torque

DC 24 V, motor code= F2

Motor			MQA20L	MQA22P
Supply voltage range	$U_{in,DC}$	V	21.6 ... 26.4	
Rated voltage	$U_{N,DC}$	V	24	
Rated torque				
At 20 °C	M_N	Nm	150	300
At 120 °C	M_N	Nm	130	260
Rated current	I_N	A	2.58	3.75
Engagement time	t_1	ms	70	175
Disengagement time	t_2	ms	240	320
Maximum switching energy	Q_E	J	31000	39000
Mass	m	kg	15.4	26.0
Moment of inertia				
Brake	J	kgcm ²	14.1	36.3
Brake motor	J_{MB}	kgcm ²	185	523
Load/brake motor ratio	J_L/J_{MB}		33.0	14.1

AC 230 V, motor code= FH

Motor			MQA20L	MQA22P
Supply voltage range	$U_{in,DC}$	V	207 ... 253	
Rated voltage	$U_{N, AC}$	V	230	
Rated torque				
At 20 °C	M_N	Nm	150	300
At 120 °C	M_N	Nm	130	260
Rated current	I_N	A	0.30	0.44
Engagement time	t_1	ms	70	130
Disengagement time	t_2	ms	240	310
Maximum switching energy	Q_E	J	31000	39000
Mass	m	kg	15.4	26.0
Moment of inertia				
Brake	J	kgcm ²	14.1	36.3
Brake motor	J_{MB}	kgcm ²	185	523
Load/brake motor ratio	J_L/J_{MB}		33.0	14.1



Feedback

For speed control with a servo inverter, the servo motor can be equipped with the following feedback systems:

Inverter	Feedback		
	Resolver	Absolute value encoder	Incremental encoder
i950 servo inverter	RS0	AM1024-8V-H AS1024-8V-H	-
Supports safety functions	RV03	-	-
i700 servo inverter	RS0 RV03	AM1024-8V-H AS1024-8V-H	-
8400 TopLine inverter drives	RS0 RV03	AM1024-8V-H AS1024-8V-H	IG1024-5V-V3 IG2048-5V-S IG2048-5V-T IG4096-5V-T
9400 HighLine servo drives	RS0	AM32-5V-E AM1024-8V-H AM2048-5V-E AS1024-8V-H AS2048-5V-E	IG2048-5V-S IG2048-5V-T IG4096-5V-T
Supports safety functions	RV03	-	IG1024-5V-V3

Feedbacks in the environment of functional safety

Motors can perform speed-dependent safety functions for safe speed and/or safe relative position monitoring in a drive system by Lenze inverters or Controllers. In case of inverters, these functions are implemented by integrable safety modules and in case of Controllers by the additionally required Safety Controller.

When planning systems/installations of this kind, always observe the following:

- When using just one single feedback system in the environment of these safety applications, the applicable safety engineering standard IEC 61800-5-2 (adjustable speed electrical power drive systems - Part: 5-2: Safety requirements - Functional) stipulates special requirements for the connection between feedback system and motor shaft.
- This is due to the fact that two-channel safety systems at this point in the mechanical system are actually designed as single-channel systems. If this mechanical connection is designed with considerable overdimensioning, the standard permits exclusion of the fault "encoder-shaft breakage" or "encoder-shaft slip". As such, the permissible angular acceleration limit values must not be exceeded for the individual drive solutions.

You can find the limit values in the corresponding feedback data of the individual motor ranges.

Speed-dependent safety functions

Examples of speed-dependent safety functions:

- Safe stop 1 (SS1)
- Safe operational stop (SOS)
- Safely limited speed (SLS)
- Safe maximum speed (SMS)
- Safe direction (SDI)
- Operation mode selector (OMS) with confirmation (ES)
- Safe speed monitor (SSM)
- Safely limited increment (SLI)



Resolver

The stator-supplied, 2-pole resolver with two stator windings shifted by 90 degrees and a rotor winding with a transformer winding can record both the speed and the rotor position, just like a single-turn absolute value encoder. The rotor position can be determined within one mechanical motor revolution after a voltage failure.

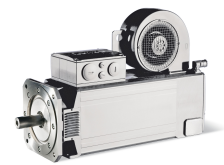
Feedback type			Resolver	
Feedback			RS0	RV03
Motor code			RS0	RV03
Speed-dependent safety functions			No	Yes
Resolution				
Angle		'	0.80	
Accuracy		'	-10 ... 10	
Absolute positioning			1 revolution	
Max. speed	$n_{\max}$	rpm	8000	
Max. input voltage				
DC	$U_{\text{in,max}}$	V	10.0	
Max. input frequency	$f_{\text{in,max}}$	kHz	4.00	
Ratio				
Stator / rotor			0.30 ± 5 %	
Rotor impedance	Z_{ro}	Ω	51 + j90	
Stator impedance	Z_{so}	Ω	102 + j150	
Impedance	Z_{rs}	Ω	44 + j76	
Min. insulation resistance				
With DC 500 V	R_{min}	M Ω	10.0	
Number of pole pairs			1	
Max. angle error		'	-10 ... 10	

Speed-dependent safety functions

Feedback			RV03
Motor code			RV03
Max. permissible angular acceleration	α	rad/s ²	22000
Functional safety			
IEC 61508			SIL3
EN 13849-1			Up to Performance Level e

Product extensions

Feedback
Incremental encoder



Incremental encoder

Incremental encoders can be used for speed measurement. Homing is required in order to enable positioning later.

Feedback type		TTL incremental		SinCos incremental	
Feedback		IG2048-5V-T	IG4096-5V-T	IG2048-5V-S	IG1024-5V-V3
Motor code		T20	T40	S20	S1S
Speed-dependent safety functions		No	No	No	Yes
Encoder type		-	-	Single-turn	Single-turn
Pulses		2048	4096	2048	1024
Output signals		TTL	TTL	1 Vss	1 Vss
Interfaces		A, B, N track and inverted	-	-	-
Absolute revolution		0	0	0	-
Resolution (angle)	'	2.60	1.30	0.40	0.40
Accuracy	'	-2 ... 2	-2 ... 2	-0.8 ... 0.8	-0.8 ... 0.8
Min. DC input voltage	V	4.75	4.75	4.50	4.75
Max. DC input voltage	V	5.25	5.25	5.50	5.25
Max. speed	rpm	8789	8789	5273	8000
Max. current consumption	A	0.15	0.15	0.10	0.070
Limit frequency	kHz	300	300	180	200

Speed-dependent safety functions

Feedback			SinCos incremental
Motor code			S1S
Max. permissible angular acceleration	α	rad/s ²	73000
Functional safety			
IEC 61508			SIL3
EN 13849-1			Up to Performance Level e

Absolute value encoder

Absolute value encoders can detect the speed, the rotor position, and the machine position with a very high resolution. They are used for the positioning of dynamic applications and do not require homing.

Feedback type		SinCos absolute value			
Feedback		AM1024-8V-H	AM2048-5V-E	AS1024-8V-H	AS2048-5V-E
Motor code		SRM	EQN	SRS	ECN
Speed-dependent safety functions		No	No	No	No
Encoder type		Multi-turn	Multi-turn	Single-turn	Single-turn
Pulses		1024	2048	1024	2048
Output signals		1 Vss	1 Vss	1 Vss	1 Vss
Interfaces		Hiperface	EnDat	Hiperface	EnDat
Absolute revolution		4096	4096	1	1
Resolution (angle)	'	0.40	0.40	0.40	0.40
Accuracy	'	-0.8 ... 0.8	-0.6 ... 0.6	-0.8 ... 0.8	-0.6 ... 0.6
Min. DC input voltage	V	7.00	4.75	7.00	4.75
Max. DC input voltage	V	12.0	5.25	12.0	5.25
Max. speed	rpm	6000	12000	6000	12000
Max. current consumption	A	0.080	0.25	0.080	0.15
Limit frequency	kHz	200	200	200	200



Blower

The motors are cooled as a standard by means of a separate radial fan.

The separate fans are optionally available with a dust filter.

Rated data 50 Hz

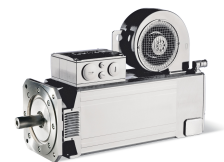
Motor		MQA20L14H		MQA22P08H		MQA26T05H
		MQA20L29H		MQA22P14H		MQA26T10H
				MQA22P17H		MQA26T12H
				MQA22P29H		MQA26T22H
Degree of protection		IP23s				
Number of phases		1	3	1	3	3
Rated voltage AC	V	230	400	230	400	400
Min. AC mains voltage	V	210	360	210	360	360
Max. AC mains voltage	V	250	440	250	440	440
Rated power	kW	0.090	0.067	0.26	0.23	0.43
Rated current	A	0.39	0.13	1.10	0.37	0.68

Rated data 60 Hz

Motor		MQA20L14H MQA20L29H		MQA22P08H MQA22P14H MQA22P17H MQA22P29H		MQA26T05H
						MQA26T10H
						MQA26T12H
						MQA26T22H
Degree of protection		IP23s				
Number of phases		1	3	1	3	3
Rated voltage AC	V	230	400	230	400	400
Min. AC mains voltage	V	210	360	210	360	360
Max. AC mains voltage	V	250	440	250	440	440
Rated power	kW	0.12	0.10	0.30	0.37	0.60
Rated current	A	0.49	0.16	1.28	0.48	0.79

Product extensions

Temperature monitoring
Thermal detectors PT1000



Temperature monitoring

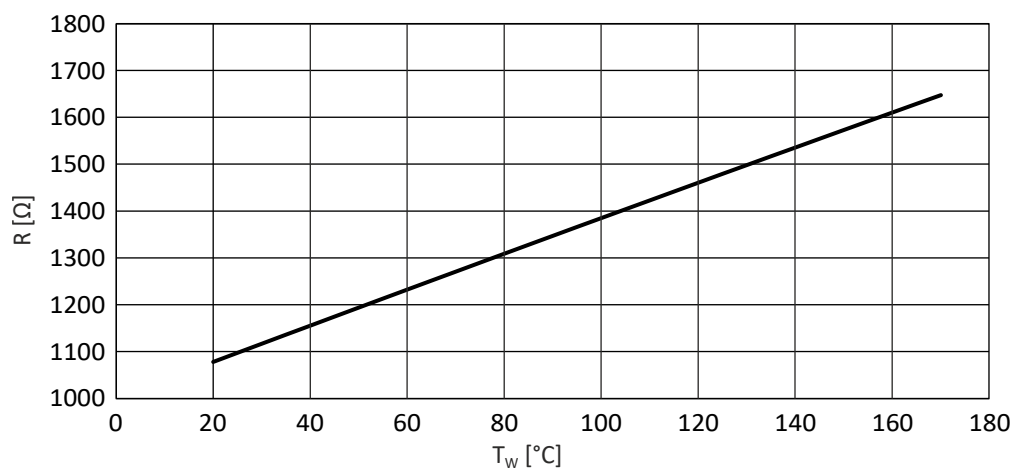
Thermal detectors PT1000

The thermal detector used continuously monitors the motor temperature. The temperature information is transferred to the inverter using the system cable of the feedback system. **This is not a full motor protection!**

This makes it possible to determine the motor temperature in the permissible operating range with great accuracy.



When supplying the thermal sensors with a measurement current of 1 mA, the connection between the temperature and the resistance measured applies.



R Resistance
 T_w Winding temperature



Product codes

Product code of MQA asynchronous servo motor

Example		M	Q	A	20	L	14	-	RS0	B0
Meaning	Variant	Product code								
Product family	Motor	M								
Type	Compact servo motors		Q							
Variant	Asynchronous			A						
Motor frame size	Square dimension 200 mm				20					
	Square dimension 220 mm				22					
	Square dimension 260 mm				26					
Overall length						L P T				
Rated speed	rpm x 100						05 ... 29			
Inverter mains connection	3 x 400 V							H		
Feedback	SinCos absolute value encoder, single-turn, EnDat AS2048-5V-E									ECN
	SinCos absolute value encoder, multi-turn, EnDat AM32-5V-E									EQI
	SinCos absolute value encoder, multi-turn, EnDat AM2048-5V-E									EQN
	Resolver									RS0
	Safety resolver RV03									RV0
	SinCos safety incremental encoder, single-turn IG1024-5V-V3									S1S
	SinCos incremental encoder, single-turn IG2048-5V-S									S20
	SinCos absolute value encoder, multi-turn, Hiperface® AM1024-8V-H									SRM
	SinCos absolute value encoder, single-turn, Hiperface® AS1024-8V-H									SRS
	TTL incremental encoder IG2048-5V-T									T20
	TTL incremental encoder IG4096-5V-T									T40
Brake	Without brake									B0
	Spring-applied brake DC 24 V									F1
	Spring-applied brake DC 24 V, reinforced									F2
	Spring-applied brake AC 230 V									FG
	Spring-applied brake AC 230 V, reinforced									FH



Environmental notes and recycling

Lenze has been certified according to the global environmental management standard (DIN EN) ISO 14001 for many years. As part of our environmental policy and the associated climate responsibility, please observe the following information on hazardous substances and the recycling of Lenze products and their packaging:



Lenze products are subject in part to EU Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS). This is documented accordingly in the EU Declaration of Conformity and with the CE mark.



Lenze products are not subject to EU Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), but do sometimes contain batteries/rechargeable batteries in accordance with EU Directive 2006/66/EC (Battery Directive). The separate from domestic waste disposal route is shown by the corresponding labeling with the "crossed-out garbage can".

Any batteries/rechargeable batteries included are designed for the service life of the product and do not have to be replaced or otherwise removed by the end user.



Lenze products are usually sold with cardboard or plastic packaging. This packaging corresponds to EU Directive 94/62/EC on packaging and packaging waste (Packaging Directive). The required waste disposal route is shown by material-specific labeling with the "recycling triangle". Example: "21 - Miscellaneous cardboard"

REACH

Lenze products are subject to the European Regulation EC No. 1907/2006 (REACH chemical regulation). When used as intended, exposure of substances to humans, animals and the environment is excluded.

Lenze products are industrial electrical and electronic products and are to be disposed of professionally. Both the mechanical and electrical components, such as electric motors, gearboxes, or inverters, contain valuable raw materials that can be recycled and reused. Proper recycling and thus maintaining the highest possible reusable materials cycle is therefore important and sensible from an economic and ecological point of view.

- Always coordinate professional waste disposal with your local waste disposal company.
- Separate mechanical and electrical components, packaging, hazardous waste (e.g. gearbox oils), and batteries/rechargeable batteries wherever possible.
- Dispose of the separated waste in an environmentally friendly and proper way (not with household waste or municipal bulky waste).



More information on Lenze's environmental and climate responsibility, as well as on the topic of energy efficiency, can be found on the Internet:

www.Lenze.com → search word: "Sustainability"

What?	Material	Where?
Pallets	Wood	Return to manufacturer, freight forwarder or reusable materials collection system
Packaging material	Paper, cardboard, pasteboard	Reusable materials collection system
	Plastics	
Products		
Electronic devices	Metals and plastics	Material/recycling center
Gearboxes and motors		
Substances hazardous to water		
Lubricants	Oil	Observe disposal in accordance with the law!
	Bold	Dispose of via a company authorized to receive!
Dry-cell batteries/rechargeable batteries		Return system



Appendix

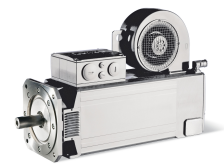
Good to know

Approvals and directives

CCC	China Compulsory Certification documents the compliance with the legal product safety requirements of the PR of China - in accordance with Guobiao standards.
cCSA _{US}	CSA certificate, tested according to US and Canada standards
UE	Union Européenne documents the declaration of the manufacturer that EU Directives are complied with.
CEL	China Energy Label documents the compliance with the legal energy efficiency requirements for motors, tested according to the PR of China and Guobiao standards
CSA	CSA Group (Canadian Standards Association) CSA certificate, tested according to Canada standards
UL ^{Energy} _{US CA}	Energy Verified Certificate Determining the energy efficiency according to CSA C390 for products within the scope of energy efficiency requirements in the USA and Canada
cUL _{US}	UL certificate for products, tested according to US and Canada standards
cUR _{US}	UL certificate for components, tested according to US and Canada standards
EAC	Customs union Russia / Belarus / Kazakhstan certificate documents the declaration of the manufacturer that the specifications for the Eurasian conformity (EAC) required for placing electronic and electromechanical products on the market of the entire territory of the Customs Union (Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan) are complied with.
UL	Underwriters Laboratory Listed Product
UL _{LISTED}	UL Listing approval mark as proof that the product has been tested and the applicable safety requirements have been confirmed by UL (Underwriters Laboratory).
UR	UL Recognized Component approval mark as proof that the UL approved component can be used in a product or system bearing the UL Listing approval mark.

Appendix

Good to know
Operating modes of the motor



Operating modes of the motor

Operating modes S1 ... S10 as specified by EN 60034-1 describe the basic stress of an electrical machine.

In continuous operation a motor reaches its permissible temperature limit if it outputs the rated power dimensioned for continuous operation. However, if the motor is only subjected to load for a short time, the power output by the motor may be greater without the motor reaching its permissible temperature limit. This behaviour is referred to as overload capacity.

Depending on the duration of the load and the resulting temperature rise, the required motor can be selected reduced by the overload capacity.

The most important operating modes

Continuous operation S1	Short-time operation S2
Operation with a constant load until the motor reaches the thermal steady state. The motor may be actuated continuously with its rated power.	Operation with constant load; however, the motor does not reach the thermal steady state. During the following standstill, the motor winding cools down to the ambient temperature again. The increase in power depends on the load duration.
Intermittent operation S3	Non-intermittent periodic operation S6
Sequence of identical duty cycles comprising operation with a constant load and subsequent standstill. Start-up and braking processes do not have an impact on the winding temperature. The steady-state is not reached. The guide values apply to a cycle duration of 10 minutes. The power increase depends on the cycle duration and on the load period/downtime ratio.	Sequence of identical duty cycles comprising operation with a constant load and subsequent no-load operation. The motor cools down during the no-load phase. Start-up and braking processes do not have an impact on the winding temperature. The steady-state is not reached. The guide values apply to a cycle duration of 10 minutes. The power increase depends on the cycle duration and on the load period/idle time ratio.

P Power
t Time
 t_L Idle time
 θ Temperature

P_V Power loss
 t_B Load period
 t_S Cycle duration



Enclosures

The degree of protection indicates the suitability of a motor for specific ambient conditions with regard to humidity as well as the protection against contact and the ingress of foreign particles. The degrees of protection are classified by EN 60529.

The first code number after the code letters IP indicates the protection against the ingress of foreign particles and dust. The second code number refers to the protection against the ingress of humidity.

Code number 1	Degree of protection	Code number 2	Degree of protection
0	No protection	0	No protection
1	Protection against the ingress of foreign particles $d > 50$ mm. No protection in case of deliberate access.	1	Protection against vertically dripping water (dripping water).
2	Protection against medium-sized foreign particles, $d > 12$ mm, keeping away fingers or the like.	2	Protection against diagonally falling water (dripping water), 15° compared to normal service position.
3	Protection against small foreign particles $d > 2.5$ mm. Keeping away tools, wires or the like.	3	Protection against spraying water, up to 60° from vertical.
4	Protection against granular foreign particles, $d > 1$ mm, keeping away tools, wire or the like.	4	Protection against spraying water from all directions.
5	Protection against dust deposits (dust-protected), complete protection against contact.	5	Protection against water jets from all directions.
6	Protection against the ingress of dust (dust-proof), complete protection against contact.	6	Protection against choppy seas or heavy water jets (flood protection).

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