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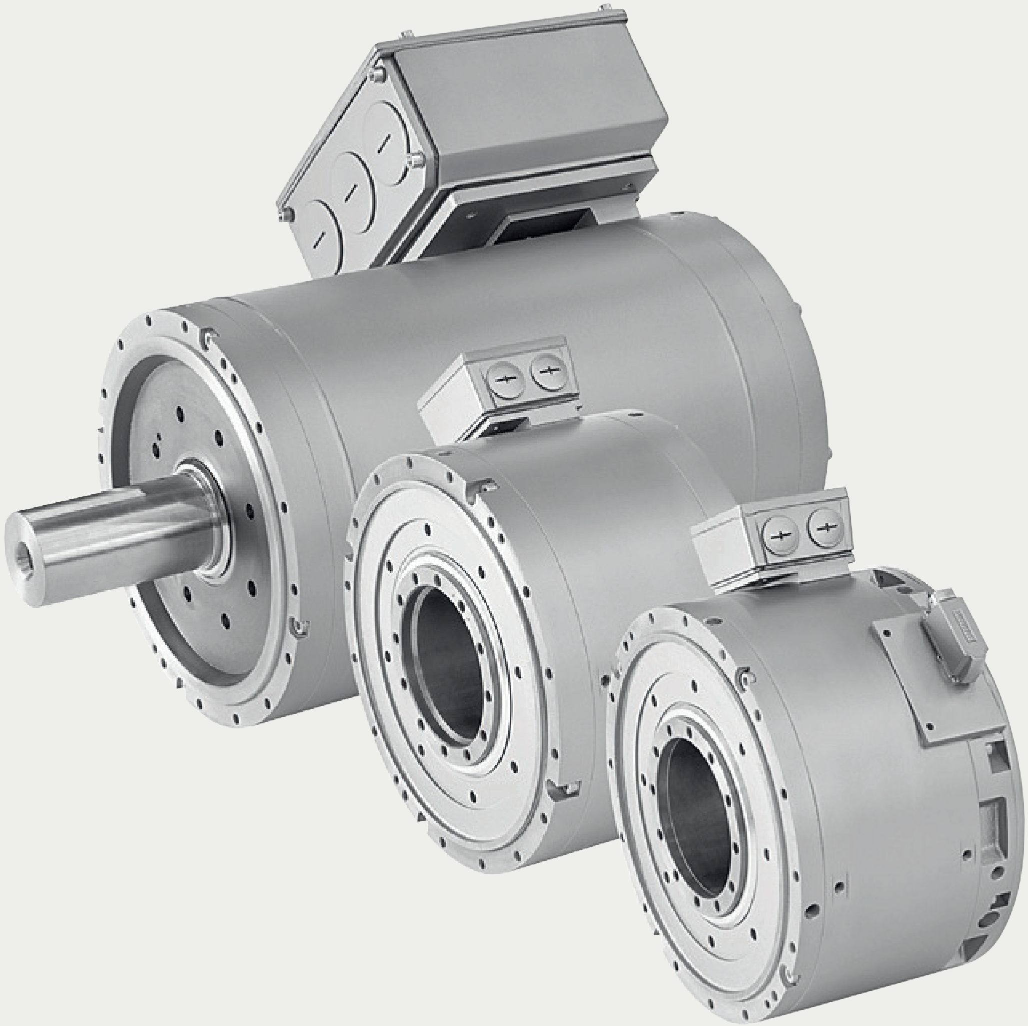

Edition 08/2022

CONFIGURATION MANUAL

SIMOTICS

Complete torque motors SIMOTICS T-1FW3

For SINAMICS S120

www.siemens.com/drives

SIEMENS

SIMOTICS

Drive technology
1FW3 complete torque motors

Configuration Manual

08/2022
A5E46027705B AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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A5E46027705B AB
Ⓟ 07/2022 Subject to change

Introduction

Standard scope

This documentation describes the functionality of the standard scope. The machine manufacturer documents the supplements and changes made by the machine manufacturer.

For reasons of clarity, this documentation cannot include all of the detailed information on all of the product types. Further, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

Target group

This documentation addresses project planners and project engineers as well as machine manufacturers and commissioning engineers.

Benefits

The Configuration Manual enables the target group to apply the rules and guidelines to be observed when configuring products and systems.

The Configuration Manual supports you with selecting motors, calculating the drive components, and selecting the required accessories. The Configuration Manual helps the target group to create a system or plant configuration.

Utilization phase

Planning and configuration phase

Text features

In addition to the notes that you must observe for your own personal safety as well as to avoid material damage, in this document you will find the following text features:

Operating instructions

Handling instructions with a specified sequence start with the word "Procedure":

The individual handling steps are numbered.

1. Execute the operating instructions in the specified sequence.

❒

The square indicates the end of the operating instruction.

Operating instructions without a specified sequence are identified using a bullet point:

- Execute the operating instructions.

Enumerations

- Enumerations are identified by a bullet point without any additional symbols.
  - Enumerations at the second level are hyphenated.

Notes

Notes are shown as follows:

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

More information

Information on the following topics is available at:

- Additional links to download documents
- Using documentation online (find and search in manuals / information)

More information (https://support.industry.siemens.com/cs/ww/en/view/108998034)

If you have any questions regarding the technical documentation (e.g. suggestions, corrections), send an e-mail to the following address: Email (mailto:docu.motioncontrol@siemens.com)

Internet address for products

Products (http://www.siemens.com/motioncontrol)

My support

Extensive assistance and more information can be found under the following link:

My Support Links and Tools (https://support.industry.siemens.com/cs/de/en/my)

You can individually compile your personal library, e.g. for your documentation based on Siemens content, and adapt it for your own machine documentation.

To do so, click "My Documentation".

Note

If you want to use this function, you must register once.

Later, you can log on with your login data.

You can create your own personal library under "mySupport" using the following procedure.

Precondition

You have registered for and logged on to "Siemens Industry Online Support", hereinafter referred to as "SIOS".

SIOS (https://support.industry.siemens.com/cs/de/en/)

Procedure for creating a personal library

1. Open SIOS and log on.
2. Enter the product you are looking for under "Search for product info" and press "Enter".
3. Select the doc. class you want, e.g. "Manual", under "Entry type".
4. Click on your desired manual under the entries.
5. Click on "Add to mySupport documentation".
6. Enter a title.
7. Press "OK".

❒

The selected manual can be found under "mySupport". To find further functions, click on the icon located to the right of the document.

In this way, you can create your own library and quickly access your documentation.

Training

The following link provides information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:

SITRAIN (http://siemens.com/sitrain)

Technical Support

If you have any technical questions, contact Technical support (https://support.industry.siemens.com/cs/de/en/).

To make a support request, proceed as follows:

Precondition

You have registered for and logged on to "Siemens Industry Online Support", abbreviated "SIOS".

SIOS (https://support.industry.siemens.com/cs/de/en/)

Procedure

1. Click on "Your direct way to the Support Request" or follow the link Support Request (https://support.industry.siemens.com/cs/de/en/my)

2. Follow the instructions in the online form.

❒

Websites of third parties

This publication contains hyperlinks to websites of third parties. Siemens does not take any responsibility for the contents of these websites or adopt any of these websites or their contents as their own, because Siemens does not control the information on these websites and is also not responsible for the contents and information provided there. Use of these websites is at the risk of the person doing so.

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

Table of contents

1 Fundamental safety instructions

1.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

WARNING

Electric shock due to damaged motors or devices

Improper handling of motors or devices can damage them.

Hazardous voltages can be present at the enclosure or at exposed components on damaged motors or devices.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors or devices.

WARNING

Electric shock due to unconnected cable shield

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

WARNING

Electric shock if there is no ground connection

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

WARNING

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

NOTICE

Property damage due to loose power connections

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

WARNING

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

WARNING

Active implant malfunctions due to electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

- If you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage" from such motors.

WARNING

Active implant malfunctions due to permanent-magnet fields

Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage".
- When transporting or storing permanent-magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

⚠ WARNING

Injury caused by moving or ejected parts

Contact with moving motor parts or drive output elements and the ejection of loose motor parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

⚠ WARNING

Fire due to inadequate cooling

Inadequate cooling can cause the motor to overheat, resulting in smoke and fire. Possible consequences can be serious injury or death. This can also result in increased failures and reduced service lives of motors.

- Comply with the specified cooling requirements for the motor.

⚠ WARNING

Fire due to incorrect operation of the motor

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

⚠ CAUTION

Burn injuries caused by hot surfaces

In operation, the motor can reach high temperatures, which can cause burns if touched.

- Mount the motor so that it is not accessible in operation.

Measures when maintenance is required:

- Allow the motor to cool down before starting any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

1.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

1.3 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity (https://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/cert (https://www.siemens.com/cert).

Further information is provided on the Internet:

Industrial Security Configuration Manual (https://support.industry.siemens.com/cs/ww/en/view/108862708)

WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.

1.4 Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage

3. Hazardous shock voltages caused by, for example:
   – Component failure
   – Influence during electrostatic charging
   – Induction of voltages in moving motors
   – Operation and/or environmental conditions outside the specification
   – Condensation/conductive contamination
   – External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

Description of the motor

2

2.1 Overview

Standardized complete torque motors SIMOTICS T-1FW3

The SIMOTICS T-1FW3 complete torque motors are synchronous motors and designed as compact direct drives for operation on the SINAMICS S120 drive system.

These motors are

- water-cooled
- high-pole
- permanent-magnet-excited

The type spectrum includes the three shaft heights 150, 200 and 280 in different shaft lengths.

Motors of shaft heights 150 and 200 you can install in the machine design. The stators and rotors of these motors have a flange with centering edges and tapped holes at the DE.

The SIMOTICS T-1FW3 complete torque motors are available with the following shaft versions:

- Hollow shaft
- Plug-on shaft with integrated shaft centering / stub shaft
- Solid shaft

Table 2-1 Shaft versions

Hollow shaft	Plug-on shaft	Stub shaft	Solid shaft
			
• Completely hollow shaft, e.g. for feeding coolant/ heat, measuring cables etc. • Motors with various lengths can be mounted on the machine shaft.	• Simple and quick installation as a result of the integrated shaft adapter with centering • Simple clamping element • Simple encoder replacement	• Simple encoder replacement • Rotor installation via flange, no integrated shaft centering as with plug-on shaft available	• "Classic" motor installation • Simple replacement of a geared motor with a SIMOTICS T-1FW3 complete torque motor without having to change the connection to the machine • Simple encoder replacement

General properties of the motors

- Compact design and low envelope dimensions
- High degree of stiffness
- High dynamic response (short acceleration times) and rotational accuracy
- Power range from 3 to 380 kW
- Rated torques from 100 to 7000 Nm
- Rated speeds from 150 to 1200 r/min
- Maximum speeds of up to 1800 r/min
- Hollow shaft, plug-on shaft / stub shaft or solid shaft
- Different encoder types for speed control and precision positioning
- Simple encoder replacement without requiring any readjustment for plug-on shafts / stub shafts and solid shafts

Special heavy duty version; Z-option L03

The SIMOTICS T-1FW3 complete torque motors in the special heavy duty version are particularly robust direct drives with the following properties:

- Compact design
- Stub shaft version
- High dynamic and precision
- Shock load permanently possible up to 10 g
- 200 % overload capability
- Rated speed up to 800 r/min
- Maximum speed up to 1380 r/min
- Rated torque up to 7000 Nm
- Maximum torque up to 11400 Nm
- Easy to integrate in the mechanical system and in the SINAMICS S120 drive system (DRIVE-CLiQ interface)

Figure 2-1 SIMOTICS T-1FW3 complete torque motors Heavy Duty with stub shaft

The type spectrum includes the shaft heights 200 and 280.

2.2 Use for the intended purpose

WARNING

Risk of death and material damage as a result of incorrect use

There is a risk of death, serious injury and/or material damage when direct drives or their components are used for a purpose for which they were not intended.

- Only use the motors for industrial or commercial plants and systems.
- Do not install the motors in hazardous zones if the motors have not been expressly and explicitly designed and authorized for this purpose. Carefully observe any special additional notes provided.
- Only use direct drives and their components for applications that Siemens has explicitly specified.
- Protect the motors against dirt and contact with aggressive substances.
- Ensure that the installation conditions comply with the rating plate specifications and the condition specifications contained in this documentation. Where relevant, take into account deviations regarding approvals or country-specific regulations.
- Contact your local Siemens office if you have any questions relating to correct use.
- If you wish to use special versions and design versions whose technical details vary from the motors described in this document, then you must contact your local Siemens office.

WARNING

Danger to life for wearers of active implants due to magnetic and electrical fields

Electric motors pose a danger to people with active medical implants, e.g. cardiac stimulators, who come close to the motors.

- If you are affected, stay a minimum distance of 300 mm from the motors (tripping threshold for static magnetic fields of 0.5 mT according to the Directive 2013/35/EU).

SIMOTICS T-1FW3 complete torque motors can be used for the following machine applications, for example:

- Main extruder drives
- Worm drives for injection molding machines
- Roll drive
- Winder
- Cross lapper
- Pull-roll drives for foil drawing machines
- Stretch, calender, casting and cooling rolls
- Dynamic positioning tasks, e.g. rotary tables, clocked conveyor belts
- Replacing hydraulic motors

- Roll drives in paper machines
- Cross-cutter drives for continuous material webs, e.g. paper, textiles, metal sheet
- Wire-drawing machines
- Chippers

WARNING

Injury and material damage by not observing machinery directive 2006/42/EC

There is a risk of death, serious injury and/or material damage if machinery directive 2006/42/EC is not carefully observed.

- The products included in the scope of delivery are exclusively designed for installation in a machine. Commissioning is prohibited until it has been fully established that the end product conforms with machinery directive 2006/42/EC.
- Observe all safety instructions and provide these safety instructions to the end user.

2.3 Technical features and environmental conditions

2.3.1 Directives and standards

Standards that are complied with

Note

The standards listed in this manual are not dated.

You can take the currently relevant and valid dates from the Declaration of Conformity.

The motors of the type series SIMOTICS S, SIMOTICS M, SIMOTICS L, SIMOTICS T, SIMOTICS A, called "SIMOTICS motor series" below, fulfill the requirements of the following directives and standards:

- EN 60034-1 - Rotating electrical machines – Dimensioning and operating behavior
- EN 60204-1 - Safety of machinery – Electrical equipment of machines; general requirements

Where applicable, the SIMOTICS motor series are in conformance with the following parts of EN 60034:

Feature	Standard
Degree of protection	EN 60034-5
Cooling [1)]	EN 60034-6
Type of construction	EN 60034-7
Connection designations	EN 60034-8

Feature	Standard
Noise levels [1)]	EN 60034-9
Temperature monitoring	EN 60034-11
Vibration severity grades [1)]	EN 60034-14

[1)] Standard component, e.g. cannot be applied to built-in motors

Relevant directives

The following directives are relevant for the SIMOTICS motor series.

European Low-Voltage Directive

The SIMOTICS motor series complies with the Low-Voltage Directive 2014/35/EU.

European Machinery Directive

The SIMOTICS motor series does not fall within the scope covered by the Machinery Directive.

However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

European EMC Directive

The SIMOTICS motor series does not fall within the scope covered by the EMC Directive. The products are not considered as devices in the sense of the directive. Installed and operated with a converter, the motor - together with the Power Drive System - must comply with the requirements laid down in the applicable EMC Directive.

European RoHS Directive

The SIMOTICS motor series complies with the Directive 2011/65/EU regarding limiting the use of certain hazardous substances.

European Directive on Waste Electrical and Electronic Equipment (WEEE)

The SIMOTICS motor series complies with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

European Directive 2005/32/EC defining requirements for environmentally friendly design of electric motors

The SIMOTICS motor series is not subject to Regulation (EC) No. 640/2009 for implementation of this directive.

European Directive 2009/125/EC defining ecodesign requirements of electric motors and speed controls

The SIMOTICS motor series is not subject to Regulation (EU) 2019/1781 for implementation of this directive.

Eurasian conformity

The SIMOTICS motor series complies with the requirements of the Russia/Belarus/Kazakhstan (EAC) customs union.

China Compulsory Certification

The SIMOTICS motor series does not fall within the scope covered by the China Compulsory Certification (CCC).

CCC negative certification (https://support.industry.siemens.com/cs/document/93013317/general-product-approval-ccc?dti=0&pnid=13308&lc=en-DE)

Underwriters Laboratories

The SIMOTICS motor series is generally in compliance with UL and cUL as components of motor applications, and are appropriately listed.

Specifically developed motors and functions are the exceptions in this case. Here, it is important that you carefully observe the contents of the quotation and that there is a cUL mark on the rating plate!

Quality systems

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Certificates for SIMOTICS motors can be downloaded from the Internet at the following link:

Certificates for SIMOTICS motors (https://support.industry.siemens.com/cs/ww/en/ps/13347/cert)

You can obtain the UL-certificate for 1FW3 complete torque motors at the Internet address: UL certificate 1FW3 (https://support.industry.siemens.com/cs/ww/en/view/109767471)

China RoHS

The SIMOTICS motor series complies with the China RoHS.

You can find additional information at:

China RoHS (https://support.industry.siemens.com/cs/de/de/view/109738670/en)

UKCA - United Kingdom Conformity Assessed

The SIMOTICS motor series complies with the conformity requirements of England, Wales and Scotland.

2.3.2 Torque overview

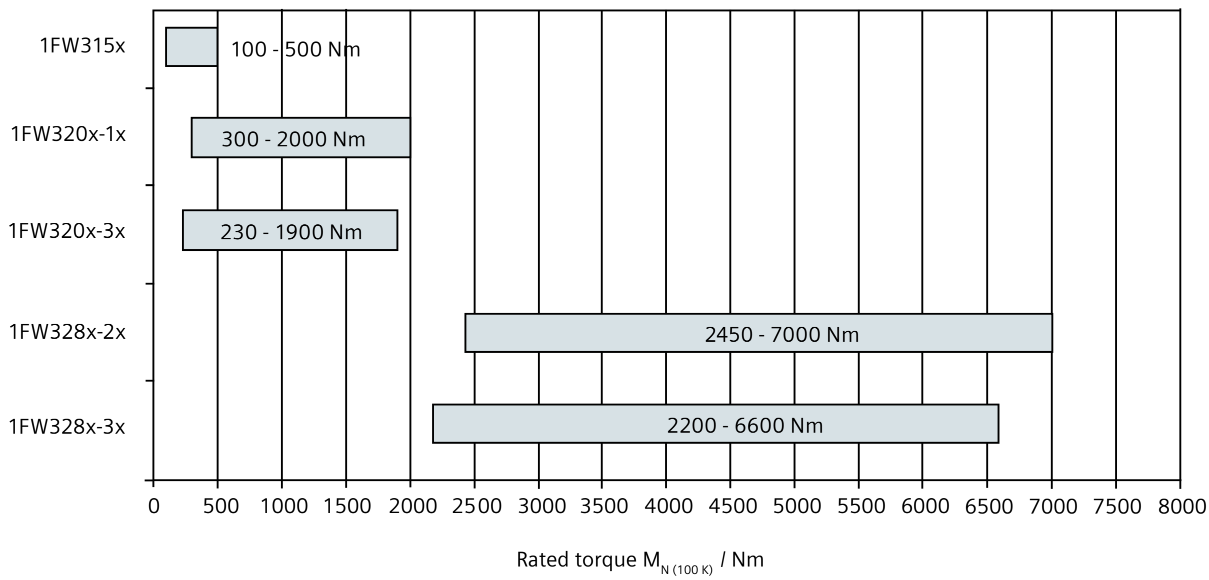


Figure 2-2 Torque overview, 1FW3

2.3.3 Technical features

Table 2-2 Technical features

Feature	Permanent-magnet synchronous motor
Magnet material	Rare-earth magnetic material
Stator winding insulation (acc. to EN 60034-1)	Temperature class 155 (F) for a winding temperature rise of ΔT = 100 K for a cooling water intake temperature of +30 °C.
Installation altitude (to EN 60034-1)	For an installation altitude > 1000 m above sea level, the relevant data in the drive converter documentation must be carefully observed (secondary conditions/limitations).
Type of construction (acc. to EN 60034-7)	• Shaft height 150: IM B14, IM V18, IM V19 • Shaft height 200: IM B14, IM V18, IM V19 • Shaft height 280: IM B35, IM B34, IM B3, IM B5, IM V1, IM V3, IM V15, IM V35
Degree of protection (acc. to EN 60034-5)	• Hollow shaft: IP54 • Plug-on shaft / stub shaft: IP55, SH 280 IP54 • Solid shaft: IP55, SH 280 IP54
Cooling (acc. to EN 60034-6)	Water cooling
Thermal motor protection (acc. to EN 60034–11)	KTY 84 or Pt1000 temperature sensor in the stator winding

Feature	Permanent-magnet synchronous motor
Paint finish	Anthracite grey similar to RAL 7016
2nd rating plate	Enclosed separately
Shaft version (acc. to DIN 748-3; IEC 60072-1)	Hollow shaft, plug-on shaft / stub shaft, solid shaft Details see Chapter "Shaft end and shaft versions (Page 52)" and "Dimension drawings"
Shaft and flange accuracy (acc. to DIN 42955; IEC 60072-1)	Tolerance class N (at normal running temperature)
Vibration severity (acc. to EN 60034-14)	Grade A is observed up to rated speed.
Sound pressure level (acc. to DIN EN ISO 1680)	Max. 73 dB(A) at 4 kHz rated pulse frequency at the nominal operating point
Bearing version	• Roller bearings with permanent grease lubrication (bearing change interval = 20000h) • Standard DE fixed bearing; NDE floating bearing: Roller bearings with permanent grease lubrication (bearing change interval = 20000h) • DE no bearing can be selected
Mounting set	• Siemens torque arm • Clamping elements
Built-in encoder systems for motors without DRIVE-CLiQ interface	• Incremental encoder, sin/cos 1 V_{pp}, 2048 S/R[1)] with C and D tracks, encoder IC2048S/R[1)], belt-mounted • Absolute encoder 2048 S/R[1)] singleturn, 4096 revolutions multiturn, with EnDat interface, encoder AM2048S/R[1)]), belt-mounted or coaxially mounted at NDE • Multi-pole resolver, belt mounted
Built-in encoder systems for motors with DRIVE-CLiQ interface Belt-mounted	• Incremental encoder, 22-bit (resolution 4194304, internal encoder 2048 S/R[1)]) + commutation position, 11-bit, encoder IC22DQ • Absolute encoder 22 bit singleturn (resolution 4194304, in the encoder 2048 S/R[1)]) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM22DQ • Resolver 15 bit (resolution 32768, internal, multi-pole), encoder R15DQ
Built-in encoder systems for motors with DRIVE-CLiQ interface Coaxially mounted at NDE	• Absolute encoder 24 bit singleturn (resolution 16777216), encoder AS24DQI • Absolute encoder 24 bit singleturn (resolution 16777216), + 12 bit multiturn (traversing range 4096 revolutions), encoder AM24DQI

Feature	Permanent-magnet synchronous motor
Connection	• Terminal box for power cable • Connector for encoder signals and temperature sensors
Options	• Motor protection with PTC thermistor with 3 embedded temperature sensors for tripping • Version with/without encoder • Shaft cover at NDE for the hollow shaft version • Regreasing system • Special paint finish • Non-standard rated speeds (an inquiry is required) • Natural cooling on request • Special grease lubrication for low speeds • Heavy-duty version in shaft heights 200 and 280 • Cable entry plate with 3 × M63 × 1.5 for 1XB7-700 terminal box • Cable entry plate with 4 x M63 x 1.5 for 1XB7-712 terminal box • Sensor hole M8; DE and NDE • Manufacturer's test certificate • Clamping element • Siemens torque arm

1) S/R = Signals/Revolution

Dimension drawings

You can find the dimension drawings for the motors in Chapter "Dimension drawings (Page 318)".

2.3.4 Environmental conditions

Classify the ambient conditions for stationary use at weather-protected locations according to standard DIN IEC 60721-3-3. The environmental effects and their limit values are defined in various classes in this standard.

With the exception of "Condensation" and "Low air pressure" environmental parameters, SIMOTICS T-1FW3 complete torque motors comply with the climatic class 3K4. Condensation and expansion of the temperature range are not permissible.

Table 2-3 **Environmental conditions are based on climate class 3K4**

Environmental parameter		Unit	Value
a)	Low air temperature	°C	- 15
b)	High air temperature	°C	+ 40
c)	Low relative humidity	%	5
d)	High relative humidity	%	95
e)	Low absolute humidity	g/m^3	1

Environmental parameter		Unit	Value
f)	High absolute humidity	g/m³	29
g)	Rate of temperature change[1)]	°C/min	0.5
h)	Low air pressure[5)]	kPa	89
i)	High air pressure[2)]	kPa	106
j)	Solar radiation	W/m²	700
k)	Thermal radiation	-	-
l)	Air movement[4)]	m/s	1.0
m)	Condensation	-	Not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See protection class
p)	Formation of ice	-	-

1) Averaged over a period of 5 min

2) Conditions in mines are not considered.

3) Climate-controlled locations with a tolerance of ±2 °C, referred to defined limit values.

4) A cooling system based on natural convection can be disturbed by unforeseen air movements.

5) The limit value of 89 KPa covers altitudes up to1000 m.

Note

Additional data on the ambient conditions

You will find additional data on the ambient conditions, such as ambient temperatures or conditions for transport and storage of the motors, in the relevant chapters of this documentation.

Note

Unsuitable installation locations

The motors are not suitable for operation

- in salt-laden or corrosive atmospheres
- outdoors

The motors are designed for operation in covered areas, such as production facilities.

2.4 Derating factors

Derating for the maximum DC link voltage

At installation altitudes of 2000 m above sea level or higher, the voltage stress on the motors must be reduced accordingly based on the table below (reciprocal values from EN 60664-1 Table A. 2).

Table 2-4 Factors for reducing the maximum DC link voltage

Installation altitude above sea level in m up to	Factor
2000	1
3000	0.877
4000	0.775
5000	0.656
6000	0.588
7000	0.513
8000	0.444

As the DC link voltage is reduced, the converter output voltage also decreases. This reduces the operating range in the torque-speed diagram.

Consider the reduced operating range when engineering your system.

Operation in a vacuum is not permissible because of the low dielectric strength and poor heat dissipation.

Derating for the static torque

For derating factors for the static torque M_0 as a function of the cooling water inlet temperature, see the table in Section "Cooling (Page 42)".

Derating for cables

For derating factors for power and signal cables as a function of the ambient temperature, see the table in Section "Electrical connection (Page 301)".

2.5 Selection and ordering data

2.5.1 Order designation

Note

Note that not every theoretical combination is possible in practice.

2.5.1.1 Order key 1FW3 general

Article number 1FW3 general

1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16	
1	F	W	3	.	.	.	–	.	.	.	.	.	–	.	.	.	.	– Z

Complete torque motor

Shaft height
15x = shaft height 150
20x = shaft height 200
28x = shaft height 280

Winding version
1 for SH 150 for n_N = H, L, P
1 for SH 200 for n_N = E, H, L
2 for SH 280 for n_N = E, G
3 for SH 200 for n_N = P, S and SH 280 for n_N= J, M

Encoder systems for motors without DRIVE-CLiQ interface
A = incremental encoder sin/cos 1 Vpp, encoder mounting = 7
E = absolute encoder Multiturn EnDat 2048 S/R, encoder mounting = 6 or 7
S = multi-pole resolver, encoder mounting = 7

Encoder systems for motors with DRIVE-CLiQ interface:
B = absolute encoder 24 bit singleturn, encoder mounting = 6
C = absolute encoder 24 bit multiturn, encoder mounting = 6
D = incremental encoder 22 bit, encoder mounting = 7
F = absolute encoder 22 bit singleturn +12 bit multiturn, encoder mounting = 6 or 7
U = resolver 15 bit, encoder mounting = 7

Without encoder
W = encoderless, linked to position 11 of the article number = 6

Rated speed
E n_N = 150 r/min
G n_N = 250 r/min
H n_N = 300 r/min
J n_N = 400 r/min
L n_N = 500 r/min
M n_N = 600 r/min
P n_N = 750 r/min for SH 150
P n_N = 800 r/min for SH 200
S n_N = 1200 r/min

Encoder mounting
4 = coaxial encoder mounting at NDE, 690 V
6 = coaxial encoder mounting at NDE
7 = belt-driven encoder

Type of construction
2 = IM B14 (for shaft heights 150 and 200)
3 = IM B35 (for shaft height 280)
4 = IM B34 (for shaft height 280)
5 = IM B5 (for shaft heights 200 and 280 Heavy Duty)
6 = IM B3 (for shaft height 280)
8 = special design (for shaft height 280 shaft-mounted design)

Terminal box
5 = cable outlet right
6 = cable outlet left
7 = cable outlet at NDE
8 = cable outlet at DE

Motor version
A = with DRIVE-CLiQ or
A = without DRIVE-CLiQ, with KTY 84
D = without DRIVE-CLiQ, with Pt1000

Shaft-design
A = hollow shaft, but not available for SH 200 High Speed
C = hollow shaft for inner ring clamping element
H = solid shaft with feather key, half key balanced
M = solid shaft, plain
P = stub shaft (only for shaft height 200/280)
S = plug-on shaft

Bearing version
0 = Standard
(DE fixed bearing; NDE floating bearing)
3 = No DE bearing

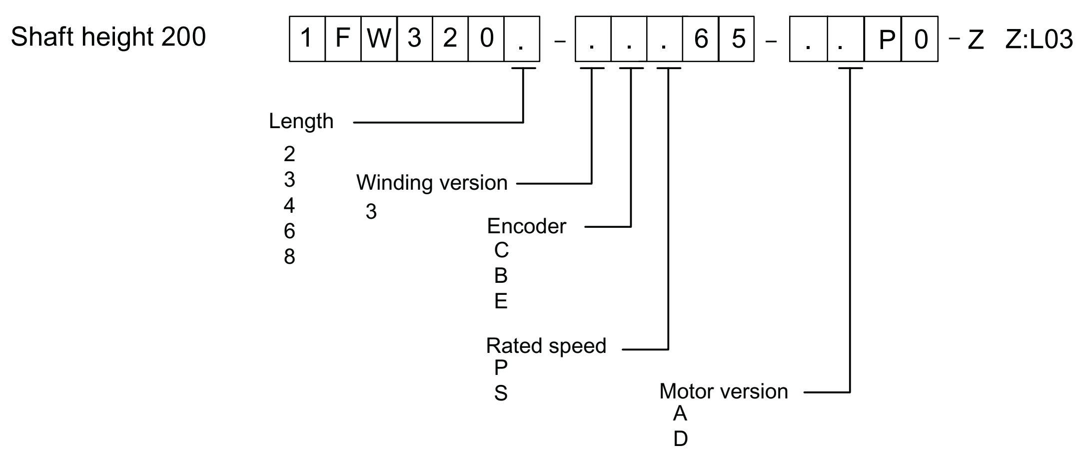
Additional data (options)

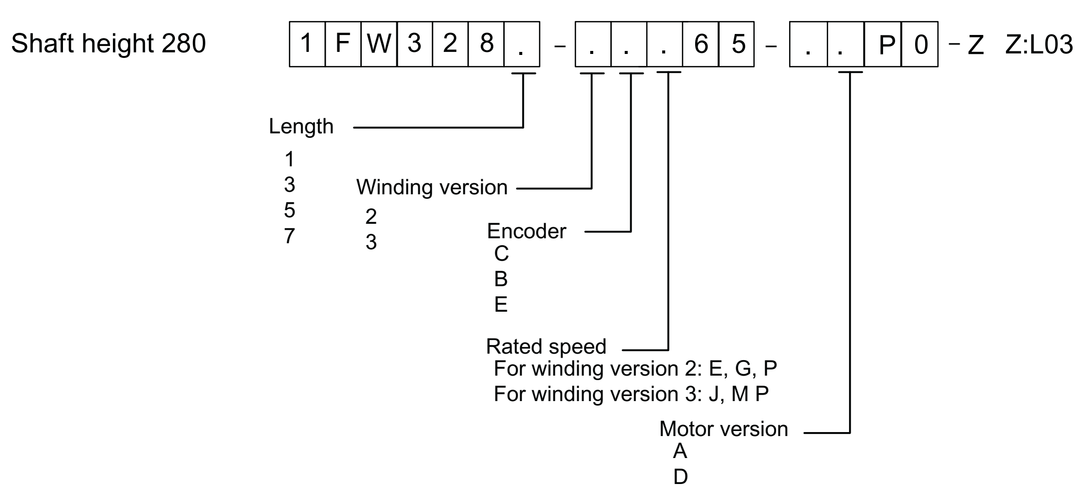
2.5.1.2 Order key 1FW3 Heavy Duty (Z option L03)

Heavy Duty is the version for increased shock loads.

Type of construction: IM B5

Article number 1FW3 Heavy Duty (Z option L03)





2.5.2 Selection and ordering data 1FW3

The data in the following tables refer to operation with an ALM (Active Line Module) and a 600 V DC link voltage. The specified efficiency η is a typical value, theoretically determined and which has its optimum in the continuous operation range.

Table 2-5 Technical data, 1FW315☐

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3150-1☐H	300	100	8.0	3.1	89	200	17	1700
1FW3150-1☐L	500	100	12	5.2	90	200	26	1700
1FW3150-1☐P	750	100	18	7.9	90	200	41	1700
1FW3152-1☐H	300	200	14	6.3	92	400	35	1700
1FW3152-1☐L	500	200	22	10.5	92	400	53	1700
1FW3152-1☐P	750	200	32.5	15.7	93	400	79	1700
1FW3154-1☐H	300	300	20.5	9.4	93	600	49	1700
1FW3154-1☐L	500	300	32	15.7	93	600	75	1700
1FW3154-1☐P	750	300	47.5	23.6	93	600	113	1700
1FW3155-1☐H	300	400	28	12.6	94	800	67	1700
1FW3155-1☐L	500	400	43	20.9	94	800	103	1700
1FW3155-1☐P	750	400	64	31.4	94	800	153	1700
1FW3156-1☐H	300	500	34	15.7	94	1000	81	1700
1FW3156-1☐L	500	500	53	26.2	94	1000	126	1700
1FW3156-1☐P	750	500	76	39.3	94	1000	183	1700

Table 2-6 Technical data, 1FW320☐ Standard

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3201-1☐E	150	300	13	4.7	91	555	28	1000
1FW3201-1☐H	300	300	23	9.4	92	555	50	1000
1FW3201-1☐L	500	300	37	15.7	92	555	82	1000
1FW3202-1☐E	150	500	21	7.9	93	925	47	1000
1FW3202-1☐H	300	500	37	15.7	94	925	81	1000
1FW3202-1☐L	500	500	59	26.2	94	925	131	1000
1FW3203-1☐E	150	750	30	11.8	94	1390	69	1000
1FW3203-1☐H	300	750	59	23.6	95	1390	132	1000
1FW3203-1☐L	500	750	92	39.3	95	1390	204	1000
1FW3204-1☐E	150	1000	40	15.7	94	1850	90	1000
1FW3204-1☐H	300	1000	74	31.4	95	1850	163	1000
1FW3204-1☐L	500	1000	118	52.3	95	1850	260	1000
1FW3206-1☐E	150	1500	65	23.6	94	2775	145	1000
1FW3206-1☐H	300	1500	118	47.1	95	2775	256	1000
1FW3206-1☐L	500	1400	169	73.3	95	2775	399	1000
1FW3208-1☐E	150	2000	84	31.4	94	3700	187	1000

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3208-1☐H	300	2000	153	62.8	94	3700	340	1000
1FW3208-1☐L	500	1850	226	96.8	94	3700	533	1000

Table 2-7 Technical data, 1FW320☐ High Speed

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3201-3☐P	800	245	37	20.5	91	500	80	1800
1FW3201-3☐S	1200	230	50	29.0	91	500	114	1800
1FW3202-3☐P	800	470	69	39.5	93	860	133	1800
1FW3202-3☐S	1200	440	92	55	93	860	190	1800
1FW3203-3☐P	800	680	96	57	94	1210	182	1800
1FW3203-3☐S	1200	630	131	79	94	1210	265	1800
1FW3204-3☐P	800	930	137	78	95	1700	265	1800
1FW3204-3☐S	1200	860	191	108	95	1700	400	1800
1FW3206-3☐P	800	1360	192	114	95	2400	365	1800
1FW3206-3☐S	1200	1210	270	152	95	2400	570	1800
1FW3208-3☐P	800	1900	270	159	95	3300	500	1800
1FW3208-3☐S	1200	1700	385	215	95	3300	800	1800

Table 2-8 Technical data 1FW328☐ Standard

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3281-2☐E	150	2500	82	39.0	94	4050	145	1000
1FW3281-2☐G	250	2450	126	64.0	95	4050	226	1000
1FW3283-2☐E	150	3500	115	55.0	95	5700	203	1000
1FW3283-2☐G	250	3450	176	90.0	96	5700	316	1000
1FW3285-2☐E	150	5000	160	79.0	95	8150	284	1000
1FW3285-2☐G	250	4950	244	130.0	96	8150	436	1000
1FW3287-2☐E	150	7000	230	110.0	96	11400	406	1000
1FW3287-2☐G	250	6900	352	181.0	96	11400	632	1000

Table 2-9 Technical data 1FW328☐ High Speed

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3281-3☐J	400	2350	188	98.0	96	4050	352	1000
1FW3281-3☐M	600	2200	256	138.0	96	4050	512	1380
1FW3281-3☐P	800	1950	315	163.0	96	4050	710	1380
1FW3283-3☐J	400	3300	275	138.0	96	5700	516	1000
1FW3283-3☐M	600	3100	357	195.0	96	5700	712	1380

Motor type	n_N	M_N	I_N	P_N	η	M_{max}	I_{max}	$n_{max\ mech.}$
	r/min	Nm	A	kW	%	Nm	A	r/min
1FW3283-3□P	800	2750	424	230.0	96	5700	953	1380
1FW3285-3□J	400	4700	376	197.0	96	8150	709	1000
1FW3285-3□M	600	4400	469	276.0	97	8150	942	1380
1FW3285-3□P	800	3950	638	331.0	97	8150	1429	1380
1FW3287-3□J	400	6600	504	276.0	97	11400	946	1000
1FW3287-3□M	600	6050	696	380.0	97	11400	1424	1380
1FW3287-3□P	800	5400	830	452.0	97	11400	1906	1380

Motor Module

The Motor Modules assigned to 1FW3 motors are dimensioned for a rated motor current I_N. If the full motor stall torque is required, then you must dimension the Motor Modules according to the motor stall current (I_0).

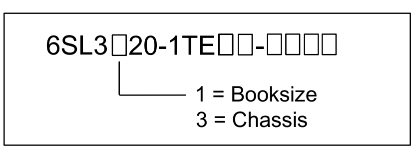
If the motor is temporarily operated at operating points above the S1 characteristic, you must take into consideration the actual current demand of the motors and appropriately select the Motor Modules.

Note

Configuration tool

The TST for SIEMENS Drives engineering tool supports you when dimensioning and engineering the drive system (see Chapter "TIA Selection Tool - TST (Page 93)").

Structure of the Article Nos. for the Motor Modules



Suitable Motor Module

Table 2-10 Assignment: Motor type - Motor Module

Motor type	Rated current / stall current I_N in A / I_0 in A	Order designation (Article No.) Motor Module SINAMICS S120	Rated current Motor Module I_N in A	Rated pulse frequency Motor f_{pulseN} in kHz
Line supply voltage of 400 V 3 AC, Active Line Module (V_{mot} = 425 V) *)				
1FW315□				
1FW3150-1□H	7.2 / 7.3	6SL3120-1TE21-0AD□	9	4
1FW3150-1□L	11 / 11.5	6SL3120-1TE21-8AC□	18	4
1FW3150-1□P	17 / 17.5	6SL3120-1TE21-8AC□	18	4

Motor type	Rated current / stall current I_N in A / I_0 in A	Order designation (Article No.) Motor Module SINAMICS S120	Rated current Motor Module I_N in A	Rated pulse frequency Motor f_{pulseN} in kHz
Line supply voltage of 400 V 3 AC, Active Line Module (V_{mot} = 425 V) *)				
1FW3152-1☐H	14 / 15	6SL3120-1TE21-8AC☐	18	4
1FW3152-1☐L	22 / 22.5	6SL3120-1TE22-4AC☐	24	4
1FW3152-1☐P	32.5 / 33.5	6SL3120-1TE24-5AC☐	45	4
1FW3154-1☐H	20.5 / 21.5	6SL3120-1TE22-4AC☐	24	4
1FW3154-1☐L	32 / 33	6SL3120-1TE24-5AC☐	45	4
1FW3154-1☐P	47.5 / 49	6SL3120-1TE26-0AC☐	60	4
1FW3155-1☐H	28 / 29	6SL3120-1TE23-0AC☐	30	4
1FW3155-1☐L	43 / 45	6SL3120-1TE24-5AC☐	45	4
1FW3155-1☐P	64 / 67	6SL3120-1TE28-5AA☐	85	4
1FW3156-1☐H	34 / 35	6SL3120-1TE24-5AC☐	45	4
1FW3156-1☐L	53 / 55	6SL3120-1TE26-0AC☐	60	4
1FW3156-1☐P	76 / 80	6SL3120-1TE28-5AA☐	85	4
1FW320☐ Standard				
1FW3201-1☐E	13 / 13	6SL3120-1TE21-8AC☐	18	4
1FW3201-1☐H	23 / 24	6SL3120-1TE22-4AC☐	24	4
1FW3201-1☐L	37 / 38	6SL3120-1TE24-5AC☐	45	4
1FW3202-1☐E	21 / 22	6SL3120-1TE22-4AC☐	24	4
1FW3202-1☐H	37 / 39	6SL3120-1TE24-5AC☐	45	4
1FW3202-1☐L	59 / 62	6SL3120-1TE26-0AC☐	60	4
1FW3203-1☐E	30 / 32	6SL3120-1TE24-5AC☐	45	4
1FW3203-1☐H	59 / 62	6SL3120-1TE26-0AC☐	60	4
1FW3203-1☐L	92 / 100	6SL3120-1TE31-3AA☐	132	4
1FW3204-1☐E	40 / 42	6SL3120-1TE24-5AC☐	45	4
1FW3204-1☐H	74 / 77	6SL3120-1TE28-5AA☐	85	4
1FW3204-1☐L	118 / 129	6SL3120-1TE31-3AA☐	132	4
1FW3206-1☐E	65 / 68	6SL3120-1TE28-5AA☐	85	4
1FW3206-1☐H	118 / 121	6SL3120-1TE31-3AA☐	132	4
1FW3206-1☐L	169 / 189	6SL3120-1TE32-0AA☐	200	4
1FW3208-1☐E	84 / 88	6SL3120-1TE28-5AA☐	85	4
1FW3208-1☐H	153 / 160	6SL3120-1TE32-0AA☐	200	4
1FW3208-1☐L	226 / 256	6SL3320-1TE32-6AA☐	260	2
1FW320☐ High Speed				
1FW3201-3☐P	37 / 38	6SL3120-1TE24-5AC☐	45	4
1FW3201-3☐S	50 / 54	6SL3120-1TE26-0AC☐	60	4
1FW3202-3☐P	69 / 72	6SL3120-1TE28-5AA☐	85	4
1FW3202-3☐S	92 / 102	6SL3120-1TE31-3AA☐	132	4
1FW3203-3☐P	96 / 102	6SL3120-1TE31-3AA☐	132	4
1FW3203-3☐S	131 / 149	6SL3120-1TE31-3AA☐	132	4
1FW3204-3☐P	137 / 145	6SL3120-1TE32-0AA☐	200	4
1FW3204-3☐S	191 / 220	6SL3120-1TE32-0AA☐	200	4

Motor type	Rated current / stall current I_N in A / I_0 in A	Order designation (Article No.) Motor Module SINAMICS S120	Rated current Motor Module I_N in A	Rated pulse frequency Motor f_{pulseN} in kHz
Line supply voltage of 400 V 3 AC, Active Line Module (V_{mot} = 425 V) *)				
1FW3206-3☐P	192 / 210	6SL3120-1TE32-0AA☐	200	4
1FW3206-3☐S	270 / 330	6SL3320-1TE33-1AA☐	310	2
1FW3208-3☐P	270 / 295	6SL3320-1TE33-1AA☐	310	2
1FW3208-3☐S	385 / 470	6SL3320-1TE35-0AA☐	490	2
1FW328☐ Standard				
1FW3281-2☐E	82 / 84	6SL3120-1TE28-5AA☐	85	4
1FW3281-2☐G	126 / 131	6SL3120-1TE31-3AA☐	132	4
1FW3283-2☐E	115 / 116	6SL3120-1TE31-3AA☐	132	4
1FW3283-2☐G	176 / 181	6SL3120-1TE32-0AA☐	200	4
1FW3285-2☐E	160 / 163	6SL3120-1TE32-0AA☐	200	4
1FW3285-2☐G	244 / 251	6SL3320-1TE32-6AA☐	260	2
1FW3287-2☐E	230 / 234	6SL3320-1TE32-6AA☐	260	2
1FW3287-2☐G	352 / 365	6SL3320-1TE33-8AA☐	380	2
1FW328☐ High Speed				
1FW3281-3☐J	188 / 200	6SL3120-1TE32-0AA☐	200	4
1FW3281-3☐M	256 / 291	6SL3320-1TE33-1AA☐	310	2
1FW3281-3☐P	315 / 403	6SL3320-1TE33-8AA☐	380	2
1FW3283-3☐J	275 / 292	6SL3320-1TE33-1AA☐	310	2
1FW3283-3☐M	357 / 402	6SL3320-1TE33-8AA☐	380	2
1FW3283-3☐P	424 / 538	6SL3320-1TE35-0AA☐	490	2
1FW3285-3☐J	376 / 400	6SL3320-1TE33-8AA☐	380	2
1FW3285-3☐M	469 / 532	6SL3320-1TE35-0AA☐	490	2
1FW3285-3☐P **)	638 / 806	6SL3320-1TE38-4AA☐	731	2
1FW3287-3☐J **)	504 / 534	6SL3320-1TE37-5AA☐	618	2
1FW3287-3☐M **)	696 / 787	6SL3320-1TE38-4AA☐	731	2
1FW3287-3☐P **)	830 / 830	6SL3320-1TE41-0AA☐	906	2

*) Other supply voltages can also be configured in TST.

**) The rated output current of the motor module includes a derating factor due to the pulse frequency.

Note

Sound pressure level when reducing the pulse frequency

When the pulse frequency is reduced, a significantly higher sound pressure level can occur.

2.6 Rating plate data

The rating plate refers to the technical data of the motor.

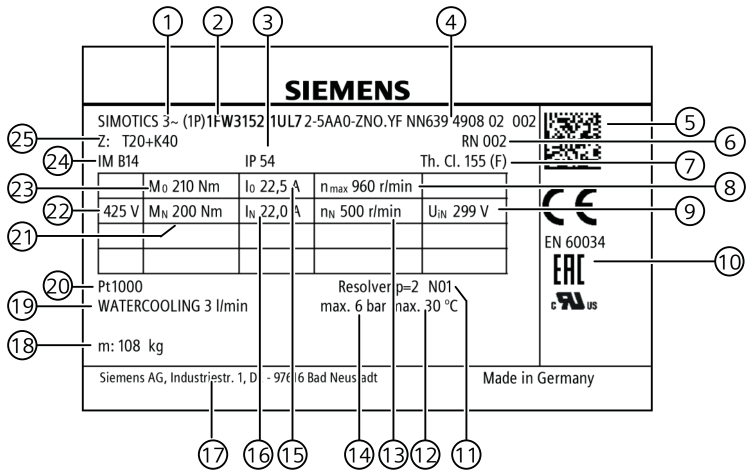


Table 2-11 Description of the rating plate data

Position	Description	Position	Description
1	Motor type	14	Maximum permitted pressure in the cooling circuit
2	Article No.	15	Stall current I_0
3	Degree of protection	16	Rated current I_N
4	Serial number	17	Production address
5	2D code, contains the motor data	18	Motor weight
6	Motor version	19	Cooling flow rate water cooling
7	Temperature class	20	Temperature sensor
8	Maximum speed n_{max}	21	Rated torque M_N
9	Induced voltage U_{iN} at rated speed n_N	22	Output voltage
10	Approvals/conformities	23	Static torque M_0
11	Code, encoder type and supplement to the encoder type	24	Type of construction
12	Cooling water intake temperature	25	Z options
13	Rated speed n_N		

Mechanical properties 3

3.1 Cooling

⚠ WARNING
Defective work on the cooling circuit
Defective work on the cooling circuit can cause injury and/or damage to property. • Only qualified personnel may assemble, install, and commission the cooling circuit. • Perform installation or service work on the cooling circuit only when the system is de-energized.

Note

Cooling circuit

Only closed and semi-open cooling circuits are permissible for motors.

3.1.1 Cooling circuit

The electrochemical processes that take place in a cooling system must be minimized by choosing the right materials. For this reason, mixed installations, i.e. a combination of different materials, such as copper, brass, iron, or halogenated plastic (PVC hoses and seals), should not be used or limited to the absolutely essential minimum.

A differentiation is made between 3 different cooling circuits:

- Closed cooling circuit
- Semi-open cooling circuit
- Open cooling circuit

Table 3-1 Description of the various cooling circuits

Definition	Description
Closed cooling circuit	The pressure equalizing tank is closed (oxygen cannot enter the system) and has a pressure relief valve. The cooling water is only routed in the motors and converters as well as the components that have to be cooled.
Semi-open cooling circuit	Oxygen can only enter the cooling system through the pressure equalization tank, otherwise the same as "closed cooling circuit".
Open cooling circuit (tower system)	The cooling water is cooled in a tower. In this case, there is intensive oxygen contact.

Note

Cooling circuits

Only closed and semi-open cooling circuits are permissible for motors. Converter systems must be connected before the motors in the cooling circuit.

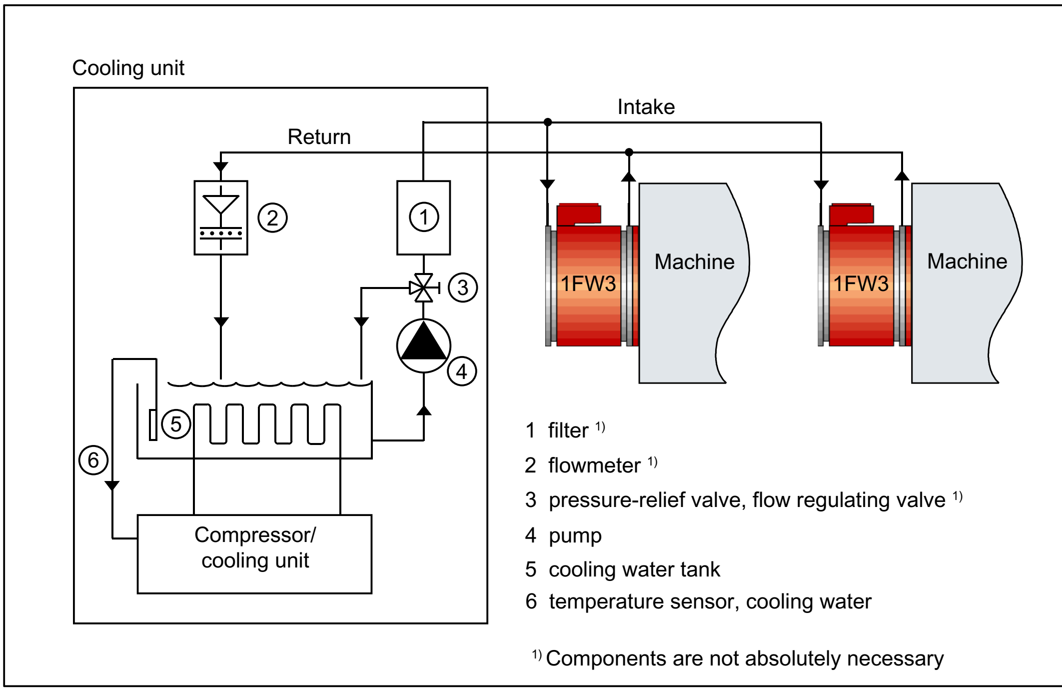


Figure 3-1 Example of a semi-open cooling circuit

Equipotential bonding

WARNING

Electric shock as a result of incorrectly routing the cooling water pipes

If electrically conductive cooling water pipes come into contact with live parts, this can cause an electric shock leading to death or severe injury.

- Ensure adequate insulation.
- Securely fasten the pipes.

- Provide all components in the cooling system (motor, heat exchanger, piping system, pump, pressure equalization tank, etc.) with equipotential bonding.
- Implement the equipotential bonding using a copper rail or finely stranded copper cable with the appropriate conductor cross-sections.

Materials used in the motor cooling circuit

The materials used in the cooling circuit must be coordinated with the materials in the motor.

Materials used in the motor (cooling jacket material): E355 AR (1.0580), DD11 (1.0332)

Materials and components in the cooling circuit

Note

Minimizing electrochemical processes in the cooling circuit

The electrochemical processes that take place in a cooling system must be minimized by choosing the right materials.

Avoid combinations of different materials, such as copper, brass, iron, or halogenated plastic (PVC hoses and seals).

The following table lists a wide variety of materials and components that may or must not be used in a cooling circuit.

Table 3-2 Materials and components of a cooling circuit

Material	Used as	Description
Zinc	Pipes, valves and fittings	Use is not permitted.
Brass	Pipes, valves and fittings	Can be used in closed circuits with inhibitor.
Copper	Pipes, valves and fittings	Can be used only in closed circuits with inhibitors in which the heat sink and copper component are separated (e.g. connection hose on units).
Common steel (e.g. St37)	Pipes	Permissible in closed circuits and semi-open circuits with inhibitors or Antifrogen N, check for oxide formation, inspection window recommended.
Cast steel, cast iron	Pipes, motors	Closed circuit and use of strainers and flushback filters. Fe separator for stainless heat sink.
High-alloy steel, Group 1 (V2A)	Pipes, valves and fittings	Can be used for drinking or tap water with a chloride content up to < 250 ppm, suitable according to definition in Chapter "Cooling water."
High-alloy steel, Group 2 (V4A)	Pipes, valves and fittings	Can be used for drinking or tap water with a chloride content up to < 500 ppm, suitable according to definition in Chapter "Cooling water."
ABS (**A**crylnitrile**B**utadiene**S**tyrene)	Pipes, valves and fittings	Suitable according to definition in Chapter "Cooling water." Suitable for mixing with inhibitor and/or biocide as well as Antifrogen N.
Installation comprising different materials (mixed installation)	Pipes, valves and fittings	Use is not permitted.
PVC	Pipes, valves, fittings and hoses	Use is not permitted.

Material	Used as	Description
Hoses		Reduce the use of hoses to a minimum (device connection). Must not be used as the main pipe for the whole system. Recommendation: EPDM hoses with an electrical resistance > 10^9 Ω (e.g. Semperflex FKD supplied by Semperit or DEMITTEL; from PE/EPD, supplied by Telle).
Gaskets	Pipes, valves and fittings	Use of FPM (Viton), AFM34, EPDM is recommended.
Hose connections	Transition Hose - pipe	Secure with clips conforming to DIN EN 14420, available, e.g. from Telle.

The following recommendation applies in order to achieve an optimum motor heatsink (enclosure) service life:

- Use a closed cooling circuit with stainless steel cooling unit. The heat is dissipated via a water-water heat exchanger.
- Use ABS, stainless steel, or general construction steel for all other components, such as pipes and fittings.

Cooling system manufacturers

ait-deutschland GmbH	www.kkt-chillers.com
BKW Kälte-Wärme-Versorgungstechnik GmbH	www.bkw-kuema.de
DELTATHERM Hirmer GmbH	www.deltatherm.de
Glen Dimplex Deutschland GmbH	www.riedel-cooling.com
Helmut Schimpke und Team Industriekühlanlagen GmbH + Co. KG	www.schimpke.org
Hydac System GmbH	www.hydac.com
Hyfra Industriekühlanlagen GmbH	www.hyfra.de
Pfannenberg GmbH	www.pfannenberg.com

Note

Other manufacturers

You can also use equivalent products from other manufacturers.

Responsibility for the properties of third-party products resides with the plant manufacturer.

3.1.2 Pressure conditions in the cooling circuit

Consider the following pressure conditions when designing the cooling circuit.

Permissible pressure

- Define the working pressure based on the flow conditions in the supply and return pipes of the cooling circuit.

The maximum permitted pressure in the cooling circuit is 0.6 MPa (6 bar).

Note

If you use a pump that reaches a higher pressure, maintain a maximum pressure of 0.6 MPa by taking appropriate measures (pressure relief valve, pressure control, etc.).

- Design the cooling circuit to have the smallest possible pressure difference between the supply and return pipes so that pumps with a shallow characteristic curve can be used.
- Design the cooling circuit with a self-cleaning filter to avoid blockage and corrosion.

Pressure equalization

If various components are connected up in the cooling circuit, it may be necessary to provide pressure equalization.

Note

Throttle elements

- You must install throttle elements at the cooling water outlet of the motor or the relevant component!

Avoiding cavitation

During uninterrupted duty, the pressure drop across a converter or motor must not exceed 0.2 MPa (2 bar). Otherwise, the high flow rate results in damage due to cavitation and/or abrasion.

Connecting motors in series

For the following reasons, connecting motors in series can be recommended only conditionally:

- The required flow rates of the motors must be approximately the same (< a factor of 2)
- An increase in the cooling water temperature can result in having to derate the second or third motor if the maximum cooling water inlet temperature is exceeded.

Cooling water inlet temperature

Note

Avoid condensation

Cooling water temperatures which are lower than the ambient temperature tend to result in increased water condensation. The difference between the cooling water inlet temperature and the ambient temperature must therefore not exceed a maximum of 5 K (Kelvin).

- Select the cooling water inlet temperature such that condensation does not form on the surface of the motor: $T_{cooling} > T_{ambient}$ - 5 K.
- Additionally shut off the coolant supply if the motor is to remain at a standstill for a long time.

Lowering the inlet temperature of the cooling water by 5 K relative to the ambient temperature permits a relative humidity up to approx. 75% for the temperatures in the "Derating factors" table below. Condensation does not occur. You will find deviations from these values in the Mollier diagram.

- If the relative humidity is higher than 75%, you will have to further increase the inlet temperature of the cooling water.
- If the actual relative humidity is lower than 75%, you can further decrease the inlet temperature of the cooling water.

The motors are designed for operation up to a cooling water inlet temperature of +30° C, as long as all of the specified motor data is maintained. For higher cooling water inlet temperatures, you must maintain a derating referred to the static torque M_0. After derating, you shift the S1 characteristic to the new base point of static torque M_0, see table "Derating factors".

Table 3-3 Derating factors

Cooling water inlet temperature	≤ 30 °C	35 °C	40 °C	45 °C
Derating factor	1.00	0.97	0.95	0.92

Note

Cooling water inlet temperatures > 45 °C

Contact your local Siemens office for cooling water inlet temperatures > 45 °C.

The following data are required to answer your inquiry about derating due to increased ambient temperatures:

- Ambient temperature in °C
- Absolute air humidity in g/m³ or relative air humidity in %
- Shaft temperature of the driven machine in °C

Note

Independence of derating factors

For water cooling, the derating factors are independent of the installation altitude.

- The ambient conditions change with increasing installation altitude. As a consequence, ensure that the required cooling water inlet temperature is available for the cooling system.

Cooling powers to be dissipated and the cooling flow rate

The values specified in the table "Cooling power to be dissipated" refer to a cooling-water temperature of +30 °C and S1 duty.

The cooling power to be dissipated specified in the table refers to the highest power loss to be dissipated for the particular shaft height for a maximum temperature difference between cooling water intake/cooling water discharge of 10 K.

Table 3-4 Cooling power to be dissipated

Motor type	Cooling power to be dissipated at n_N in kW	Pressure loss Δp in bar	Cooling flow rate *V* in l/min
SH 150 Standard			
1FW3150-1	1.4	0.1	2.0
1FW3152-1	1.6	0.1	3.0
1FW3154-1	2.3	0.2	4.5
1FW3155-1	2.7	0.1	5.5
1FW3156-1	3.4	0.2	7.0
SH 200 Standard			
1FW3201-1	1.7	0.1	3.0
1FW3202-1	2.3	0.2	4.0
1FW3203-1	3.4	0.1	5.0
1FW3204-1	3.9	0.1	6.0
1FW3206-1	5.5	0.3	8.0
1FW3208-1	8.4	0.6	10.0
SH 200 High Speed			
1FW3201-3	2.9	0.2	3.5
1FW3202-3	4.2	0.4	5.0
1FW3203-3	5.4	0.1	6.5
1FW3204-3	6.7	0.2	8.0
1FW3206-3	8.8	0.5	10.5
1FW3208-3	10.9	1.0	13.0
SH 280 Standard			
1FW3281-2	7.9	0.5	11.0
1FW3283-2	9.0	0.7	13.0
1FW3285-2	12.8	0.7	16.0
1FW3287-2	15.7	0.8	20.0
SH 280 High Speed			
1FW3281-3	8.6	0.5	11.0
1FW3283-3	10.3	0.7	13.0
1FW3285-3	13.8	0.7	16.0
1FW3287-3	18.9	0.8	20.0

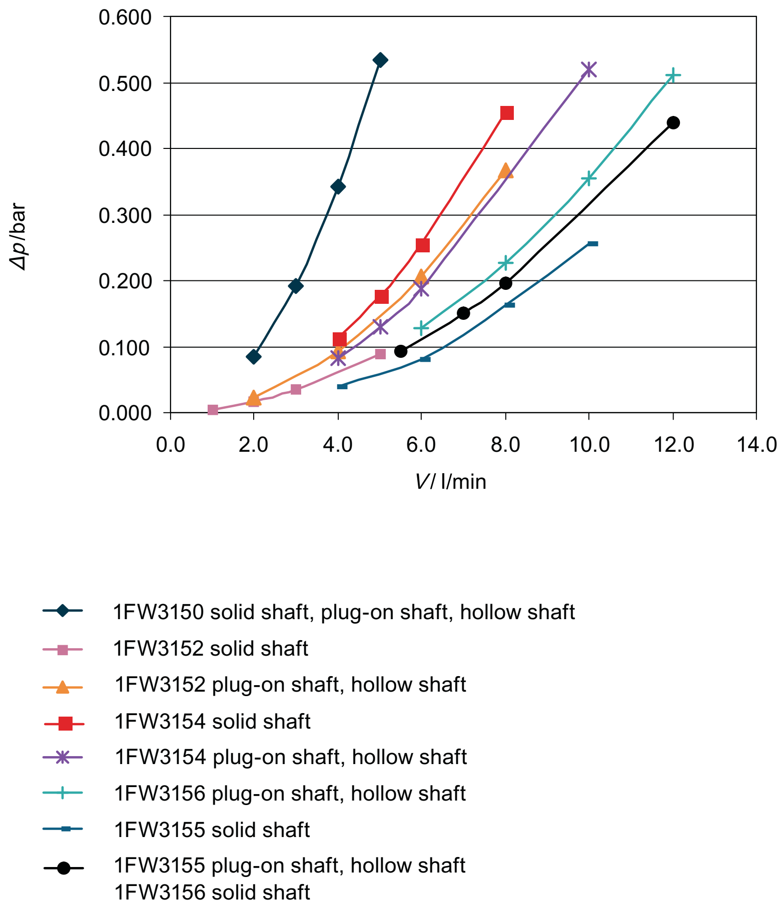


Figure 3-2 Flow rate for SH 150

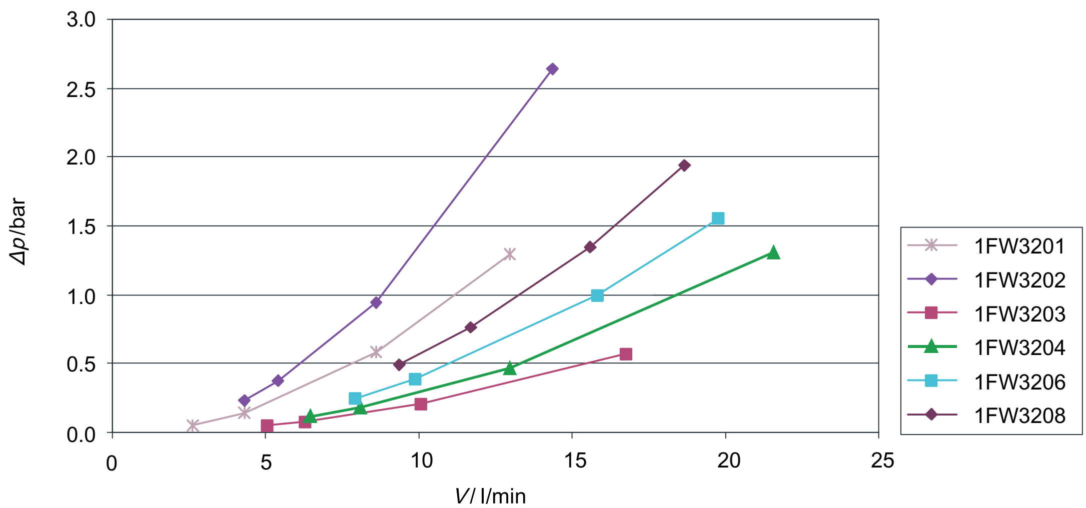


Figure 3-3 Flow rate for SH200

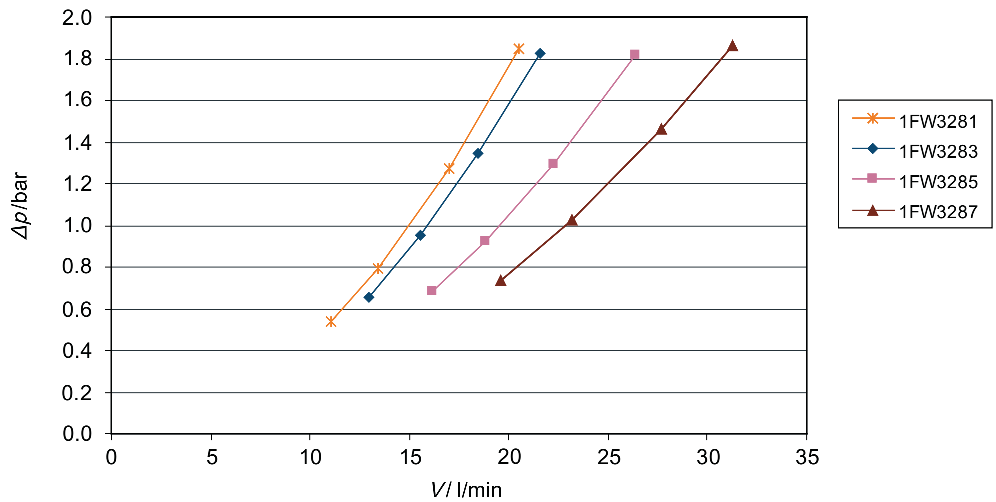


Figure 3-4 Flow rate for SH280

Coolant volume of the motor

Table 3-5 Coolant volume of the motor

Length (7th position in the Article No.)	Coolant volume of the motor (liters)				
	1FW315			1FW320	1FW328
	Hollow shaft	Plug-on shaft	Solid shaft		
0	0.23	0.11	0.11	-	-
1	-	-	-	0.33	2.24
2	0.38	0.30	0.30	0.60	-
3	-	-	-	0.80	3.23
4	0.57	0.57	0.57	1.20	-
5	0.73	0.61	0.61	-	4.10
6	0.86	0.73	0.73	1.79	-
7	-	-	-	-	5.12
8	-	-	-	2.55	-

Avoid additional heat entry

NOTICE
Demagnetization of the magnets due to additional heating of the shaft
If the motor is additionally heated through the shaft of the customer application, the magnets may become demagnetized. The following measures, for example, can be taken to avoid additional heat influx into the motor through the customer application: • Reduce the temperature of the shaft of the customer application. • Thermally insulate the shaft of the customer application from the motor. • Reduce the temperature of the medium channeled through the hollow motor shaft by the customer application. • Reduce the power. • Use a larger motor. • Contact "Technical Support" for assistance.

3.1.3 Cooling water

Table 3-6 Water specification as coolant

	Quality of the water used as coolant for motors with aluminum, stainless steel tubes + cast iron or steel jacket
Chloride ions	< 40 ppm, can be achieved by adding deionized water.
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
pH value	6 ... 9 (with aluminum 6 ... 8)
Electrical conductivity	< 500 μS/cm
Total hardness	< 170 ppm
Dissolved solids	< 340 ppm
Size of entrained particles	< 100 μm
Corrosion protection	0.2 ... 0.25% inhibitor Nalco TRAC100 (previously 0GE056)
Anti-freeze protection	If necessary 20 ... 30% Antifrogen N (manufacturer Clariant)

Biocide

The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

Closed cooling circuits with soft water are susceptible to microbes.

The following types of microbes are encountered in practice:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The suitability of a biocide depends on the type of microbe.

- Analyze the cooling water for microbes at least once a year.

Necessary biocides can be obtained from the manufacturer, e.g. Nalco. Ask the manufacturer for compatibility with an inhibitor used in your system.

- Dose the biocide as recommended by the manufacturer.

Antifrogen N already acts like a biocide at the minimum concentration of > 20%.

Note

Compatibility of coolant additives

Biocides and Antifrogen N must not be mixed.

There are other manufacturers of chemical additives in the market. You can use equivalent products from other manufacturers. Have the suitability of the third-party products determined.

Other coolants (not water-based)

If you use different cooling media (e.g. oil, cooling lubricant), derating may be necessary in order to comply with the thermal motor limit.

Note

Derating when using other cooling lubricants

Derating is required for water-oil mixtures with more than 10% oil.

To determine the derating, you need the following values of the coolant at a temperature of 30 °C:

Density	ρ / kg/m^3
Specific thermal capacitance	c_p / J/(kg•K)
Thermal conductivity	λ / W/(K•m)
Kinematic viscosity	v / m^2/s
Flow rate	V / l/min

The required derating can be obtained from Technical support.

Send your enquiry to Technical Support (https://support.industry.siemens.com/cs/ww/en/sc).

Manufacturers of chemical additives

Tyforop Chemie GmbH	http://www.tyfo.de
Clariant Produkte Deutschland GmbH (Antifrogen)	https://www.clariant.com
Cimcool Industrial Products Inc	http://www.cimcool.net
FUCHS PETROLUB SE	http://www.fuchs.com
Hebro Chemie GmbH	http://www.hebro-chemie.de

HOUGHTON Deutschland GmbH	http://www.houghton.com
Nalco Water in Germany (Ecolab)	http://www.nalco.com
Schweitzer-Chemie GmbH	http://www.schweitzer-chemie.de

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

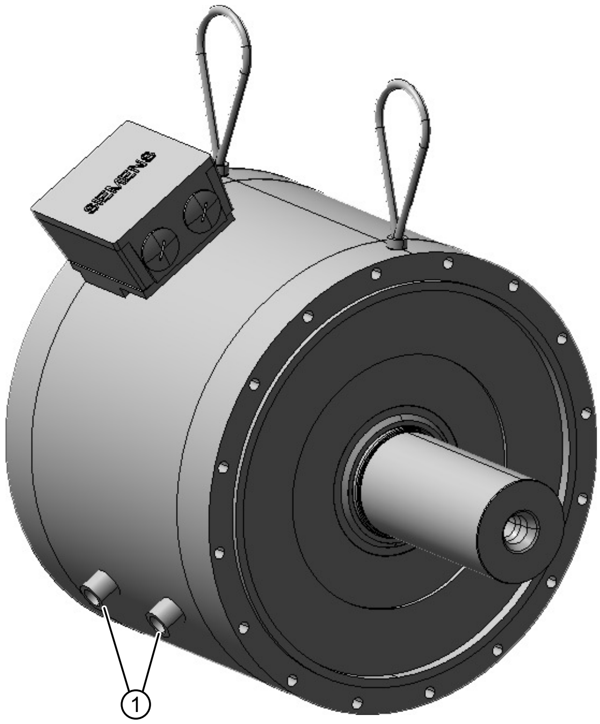
Siemens does not accept any warranty for the properties of third-party products.

3.1.4 Cooling water connection

On the side of the motor there are 2 internal threads for the motor connection to the cooling circuit.

The intake and discharge lines can be connected as required. We recommend the intake at the NDE.

To ensure mechanical decoupling, connect the devices using hoses. Observe the table "Materials and components of a cooling circuit" in this regard.



1 Cooling water connections with internal thread

Cooling water connection	
for 1FW315x and 1FW320x	G 1/2"
for 1FW328x	G 1"

3.2 Degree of protection

The degree of protection is defined according to EN 60034-5 (e.g. IP55).

The degree of protection is stamped on the rating plate.

The combination of letters and numbers has the following significance:

- IP = International Protection
- 1st digit = protection against the ingress of foreign bodies
  - "5" means complete protection against contact and protection against the ingress of dust in damaging quantity
- 2nd digit = protection against water
  - "5" means protection against water jets aimed at the enclosure from every direction.

Cooling lubricants containing oil with creepage, which can also be aggressive, are mainly used in machine tools and transfer machines. Protection against water alone is not sufficient. Covers must protect motors against cooling lubricants that contain oil, can creep and/or are corrosive.

The motor shaft seal must correspond to the selected motor protection type.

Table 3-7 Degree of protection of the 1FW3 complete torque motors

Motor	Shaft version		
	Hollow shaft	Plug-on shaft / stub shaft	Solid shaft
1FW315☐	IP54	IP55	IP55
1FW320☐ Standard	IP54	IP55	IP55
1FW320☐ High Speed	-	IP55	IP55
1FW328☐ Standard	IP54	IP54	IP54
1FW328☐ High Speed	IP54	IP54	IP54

3.3 Types of construction

You will find information on the 1FW3 motor construction types in Chapter "Overview of the mounting options (Page 112)".

3.4 Bearing version

The bearings for the complete torque motors are greased for life and designed for a minimum ambient temperature in operation of -15 °C.

Table 3-8 Bearing designation

Shaft version	Basis bearing designation		
	SH 150	SH 200	SH 280
Hollow shaft DE (fixed bearing)	61838	61838	61864
Hollow shaft NDE (floating bearing)	61832	61832	61856
Plug-on shaft DE (fixed bearing)	61838	61838	61864
Plug-on shaft NDE (floating bearing)	6213	6020	6230
Solid shaft DE (fixed bearing)	6215	6220	6230
Solid shaft NDE (floating bearing)	6213	6020	6230
Stub shaft DE, option L03 (fixed bearing)	-	61838	61864
Stub shaft NDE, option L03 (floating bearing)	-	6020	6230

You can find further information about the bearings in Chapter "Bearing change intervals (Page 70)".

3.5 Shaft end and shaft versions

The complete torque motor 1FW3 can be ordered with 3 different shaft versions:

- Hollow shaft
- Plug-on shaft / stub shaft
- Solid shaft

Note

C-shaft *)

The C-shaft is a hollow through-shaft. The data for the hollow shaft mentioned in this document also applies to the C-shaft.

*) C-shaft = Hollow shaft for inner clamping element, 15th position in the Article No.

The DE shaft end is cylindrical in accordance with DIN 748-3 (IEC 60072-1).

Table 3-9 Hollow shaft / stub shaft

Frame size	Flange centering edge d_i / mm
1FW315☐	153 H7
1FW320☐	153 H7
1FW328☐	250 H7

Table 3-10 Plug-on shaft

Frame size	Flange centering edge d_i / mm	Support d_i / mm
1FW315☐	153 H7	70 H6
1FW320☐	153 H7	85 H6
1FW328☐	250 H7	110 H7

Table 3-11 Solid shaft

Frame size	Shaft length l / mm	Shaft diameter d / mm
1FW315☐	140	65 m6
1FW320☐	170	90 m6
1FW328☐	210	120 m6

The shaft version "solid shaft" can be ordered with a plain shaft end or with keyway (according to DIN 6885-1).

Note

Shaft cover at NDE for the "hollow shaft" version

If the hollow through-shaft is not used by the customer and must be sealed at the NDE for touch protection reasons, the motor can be supplied with a shaft cover at the NDE. Ordering options: Order code T20.

See the dimension drawings for further details.

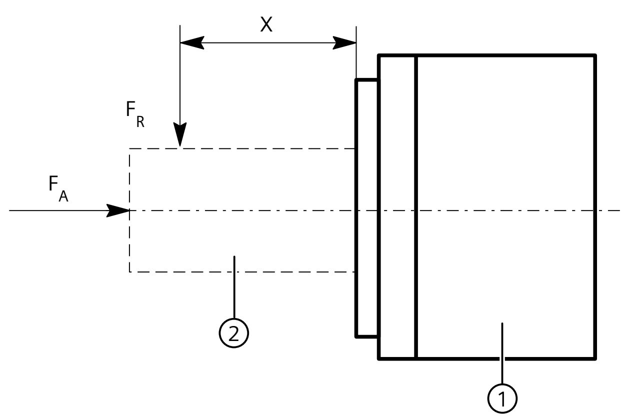
Direction of rotation

The positive direction of rotation is clockwise when viewing the drive end (flange side).

3.6 Radial and axial forces

Point of application of radial forces F_R at the torque motor

- for average operating speeds
- for a nominal bearing change interval of 20000 h



1 Complete torque motor

2 Shaft

Dimension X in mm: Distance between the point of application of force F_R and the shaft shoulder of the torque motor

Radial force F_R in N

Axial force F_A in N

Figure 3-5 Point of application of radial force F_R and axial force F_A

NOTICE

Running inaccuracy and premature bearing failure

With the types of construction IM V3, IM V19 and IM V35, the force imposed by the weight of the rotor and/or the force imposed by the weight of the customer attachment may impermissibly reduce or even nullify the spring work force of the DE bearing.

As a consequence, the specified running accuracy cannot be maintained. Furthermore, the bearings could fail prematurely.

- Get help from Technical Support. See Chapter "Introduction" for the contact information.

NOTICE
Premature bearing damage
Bearings can be prematurely damaged, if force transmission elements apply too much load to the shaft end as a result of radial forces. • When using mechanical transmission elements, ensure that the maximum limit values specified in the radial force diagrams are not exceeded.

Note

Bearing design and validity of the axial force diagram

When using the axial force diagram, observe the maximum permissible radial force.

When the bearing is designed, the motor operating speed must be rounded-off according to the next-higher speed curve.

3.6.1 Hollow shaft (1FW315❑, 1FW320❑, 1FW328❑)

Radial force diagram for 1FW315❑ hollow shaft

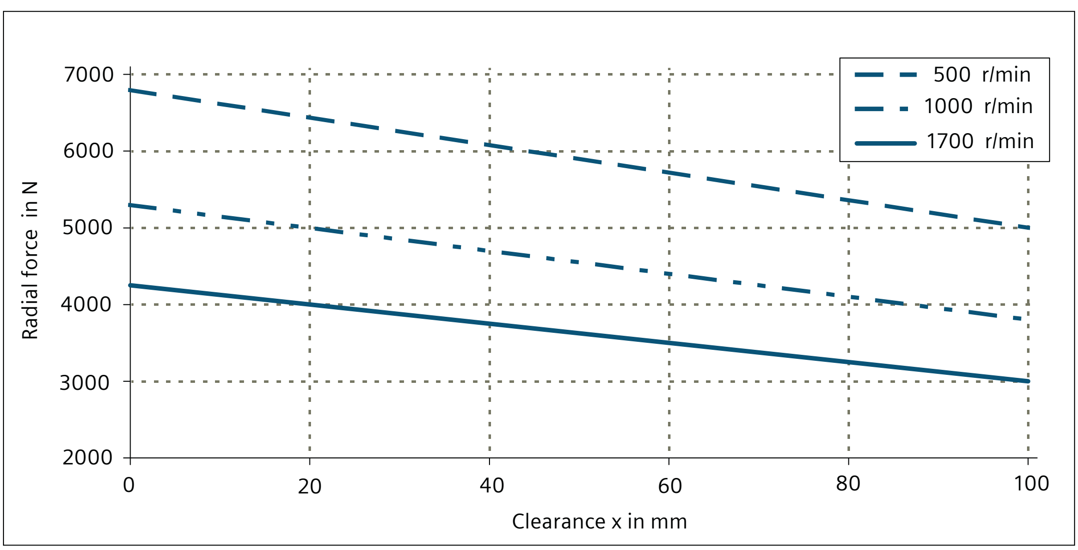


Figure 3-6 Radial force diagram for 1FW315❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❑ hollow shaft

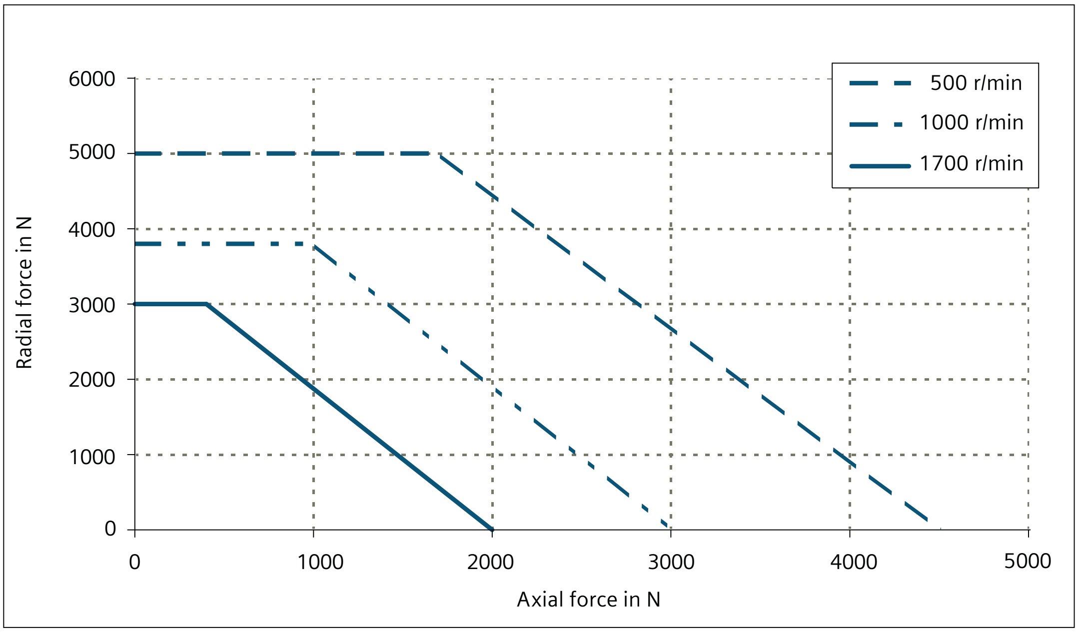


Figure 3-7 Permissible axial force as a function of radial force for 1FW315❑

Radial force diagram for 1FW320❑ hollow shaft

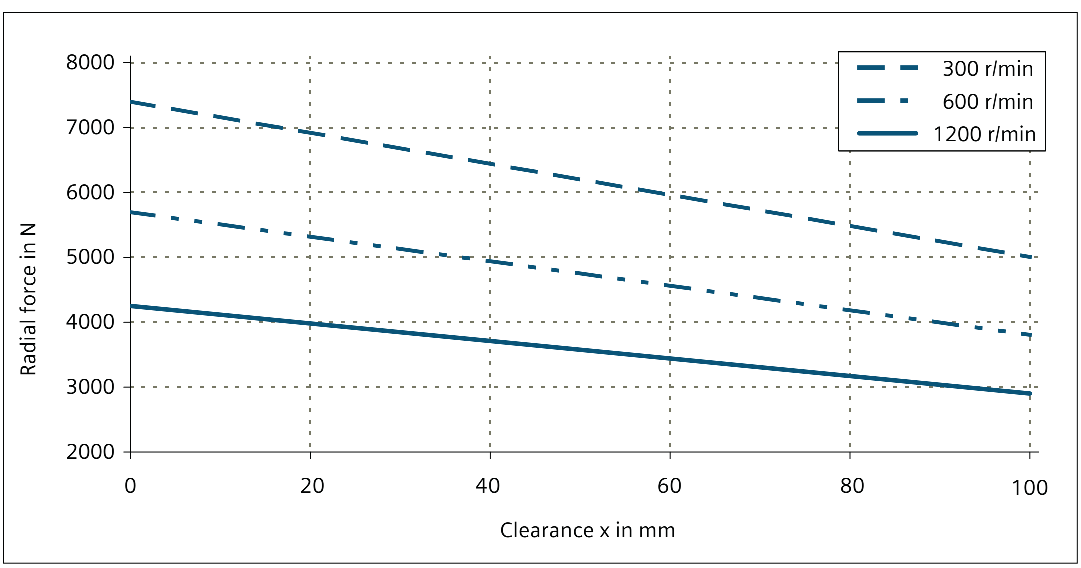


Figure 3-8 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❏ hollow shaft

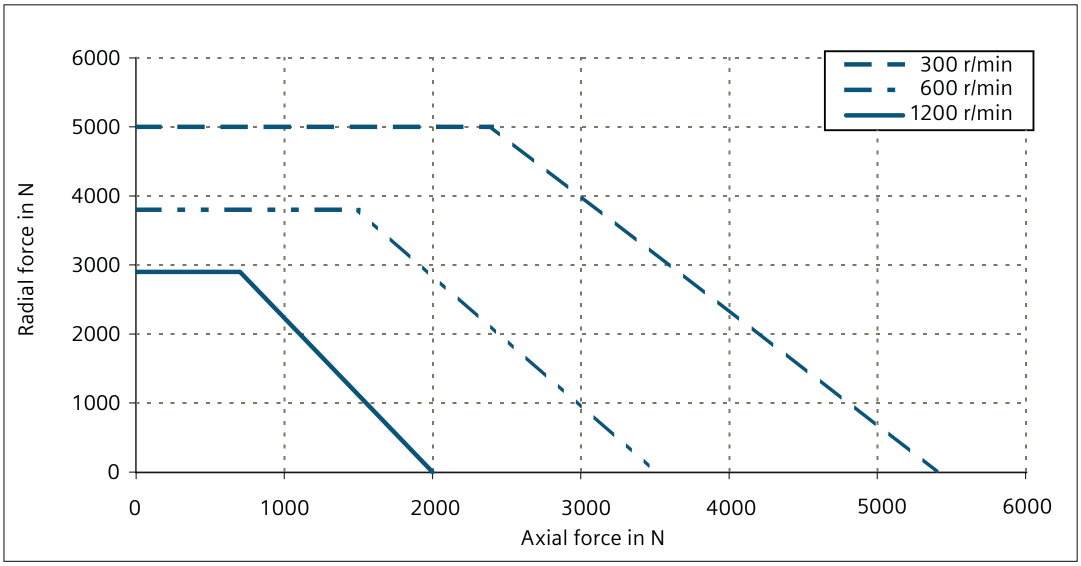


Figure 3-9 Permissible axial force as a function of radial force for 1FW320❏

Radial force diagram for 1FW328❏ hollow shaft

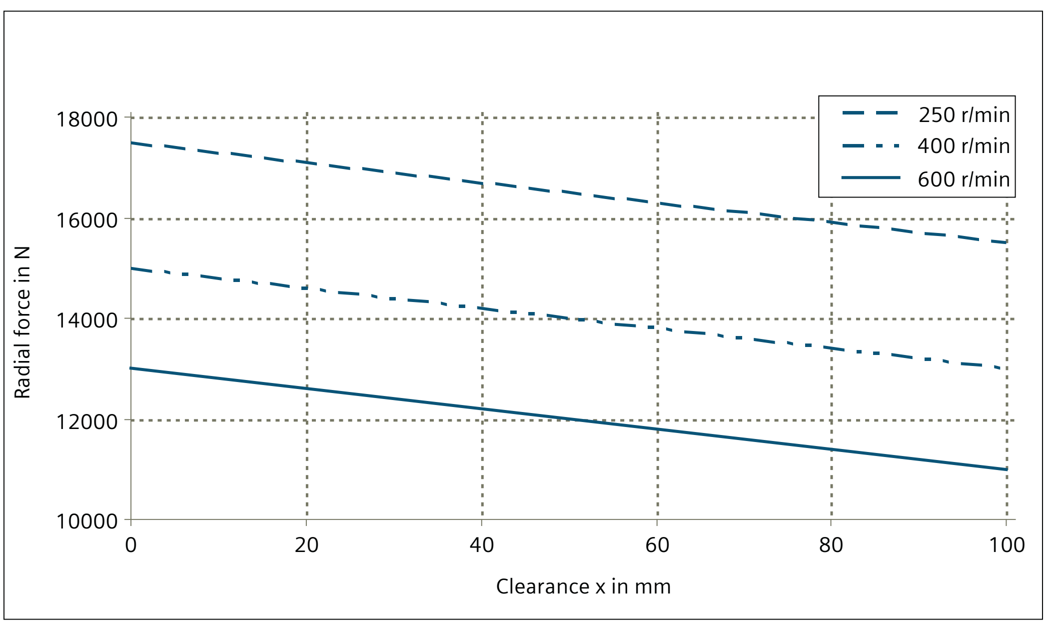


Figure 3-10 Radial force diagram for 1FW328❏, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW328❑ hollow shaft

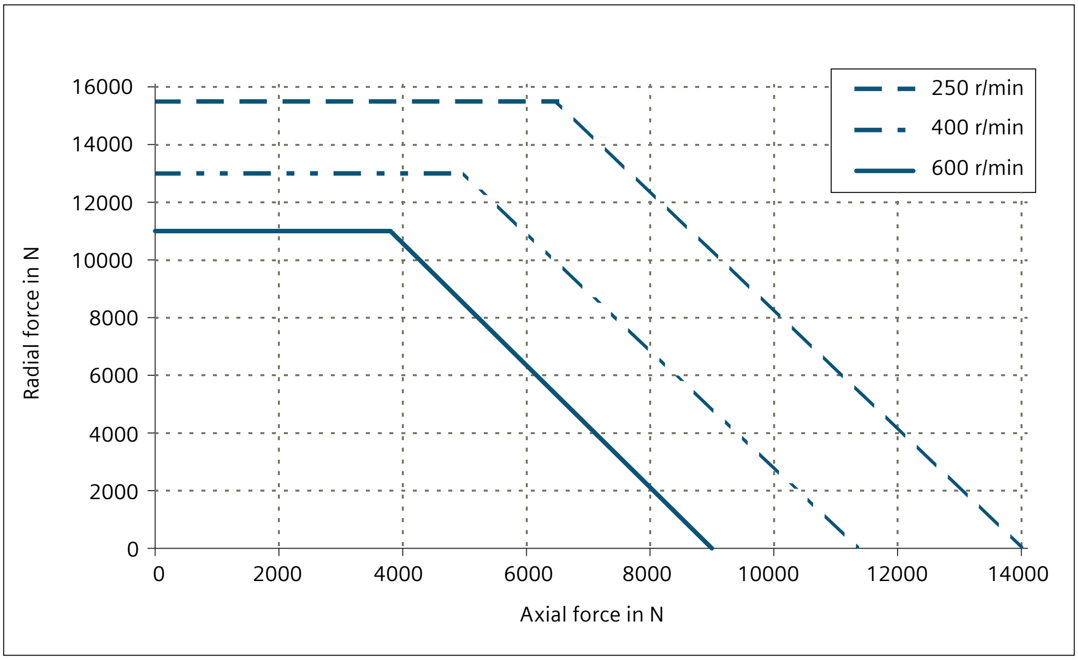


Figure 3-11 Permissible axial force as a function of radial force for 1FW328❑

3.6.2 Plug-on shaft / stub shaft (1FW315❑, 1FW320❑)

Note

Using a torque arm

For plug-on mounting (shaft mounting) we recommend that a Siemens torque arm is used (See Chapter "Siemens torque arm (Page 117)").

Radial force diagram for 1FW315❏ plug-on shaft / stub shaft

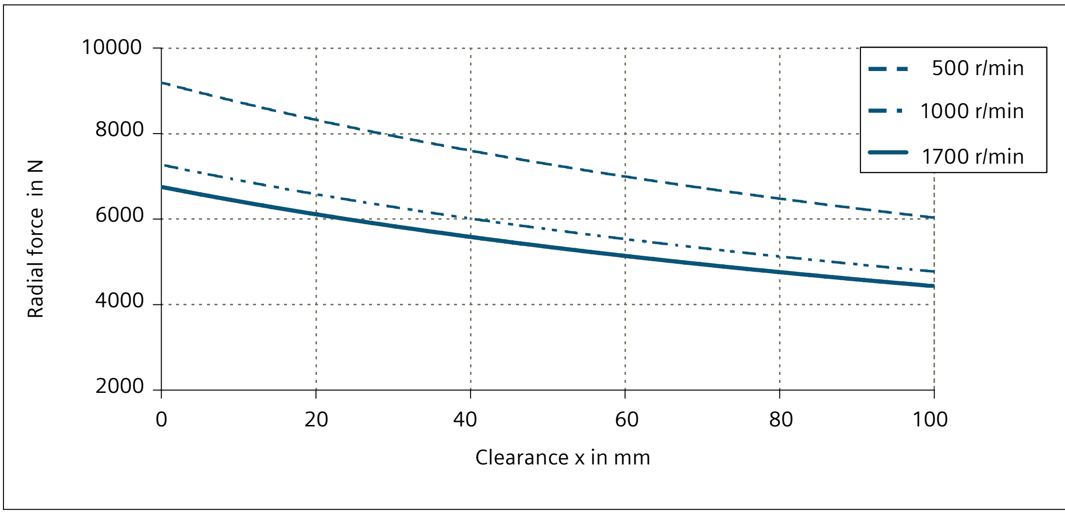


Figure 3-12 Radial force diagram for 1FW315❏, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❏ plug-on shaft / stub shaft

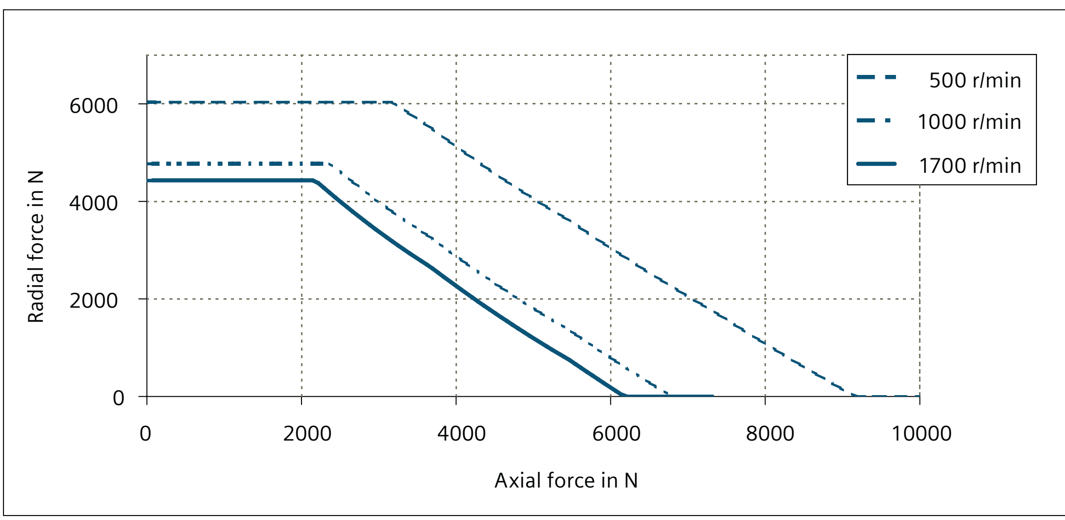


Figure 3-13 Permissible axial force as a function of radial force for 1FW315❏ (20000 h)

Radial force diagram for 1FW315❑ plug-on shaft / stub shaft

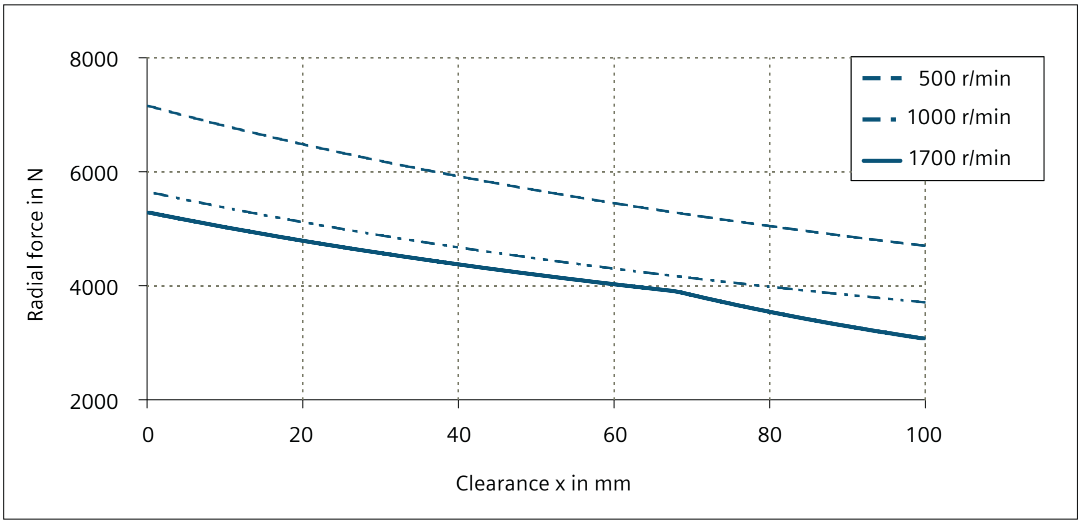


Figure 3-14 Radial force diagram for 1FW315❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW315❑ plug-on shaft / stub shaft

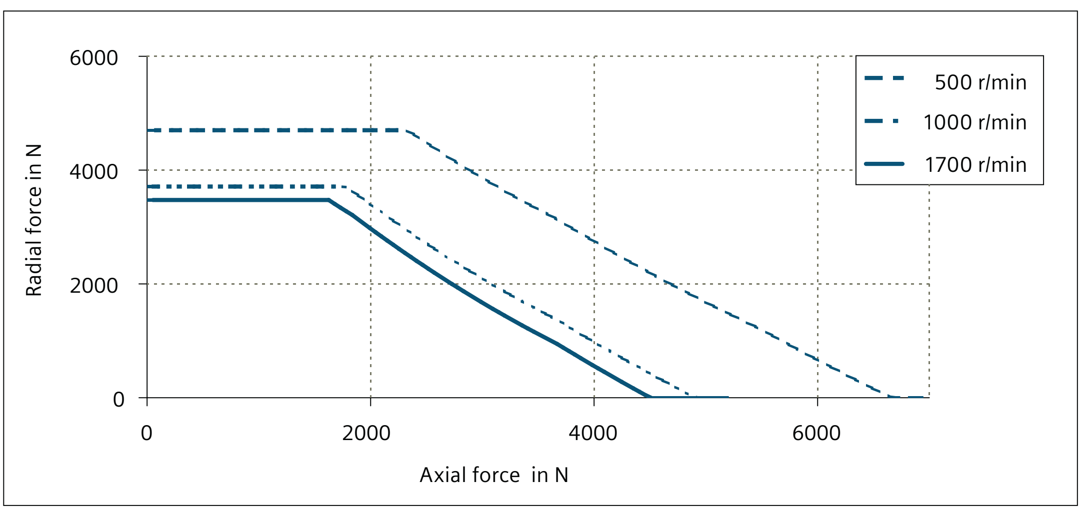


Figure 3-15 Permissible axial force as a function of radial force for 1FW315❑ (60000 h)

Radial force diagram for 1FW320❑ plug-on shaft / stub shaft

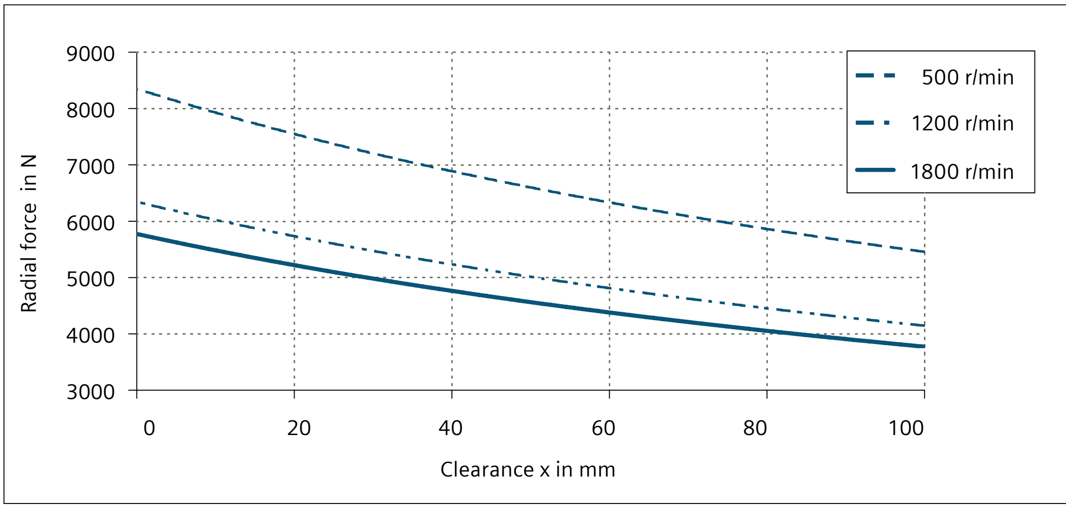


Figure 3-16 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❑ plug-on shaft / stub shaft

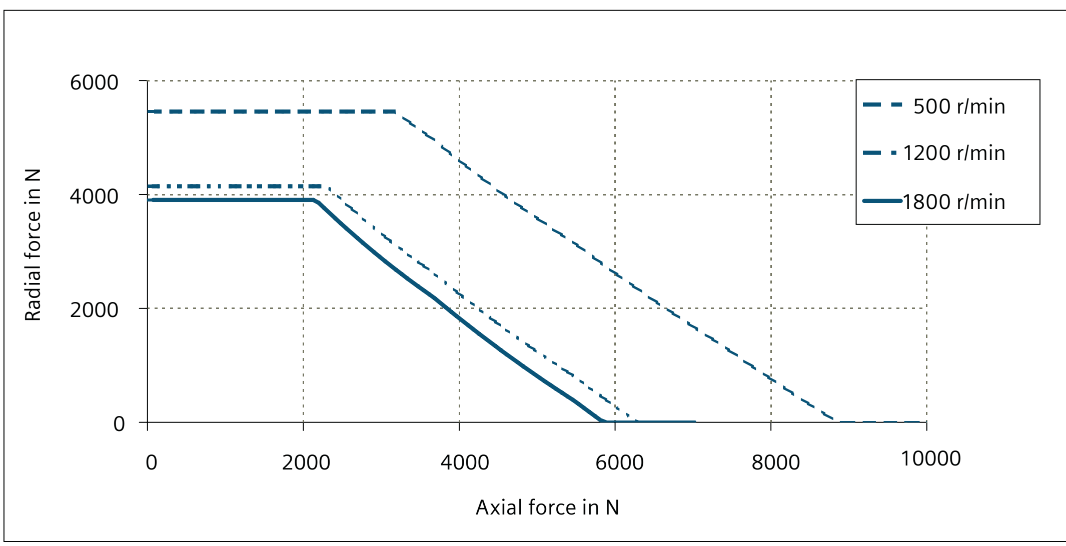


Figure 3-17 Permissible axial force as a function of radial force for 1FW320❑ (20000 h)

Radial force diagram for 1FW320❑ plug-on shaft / stub shaft

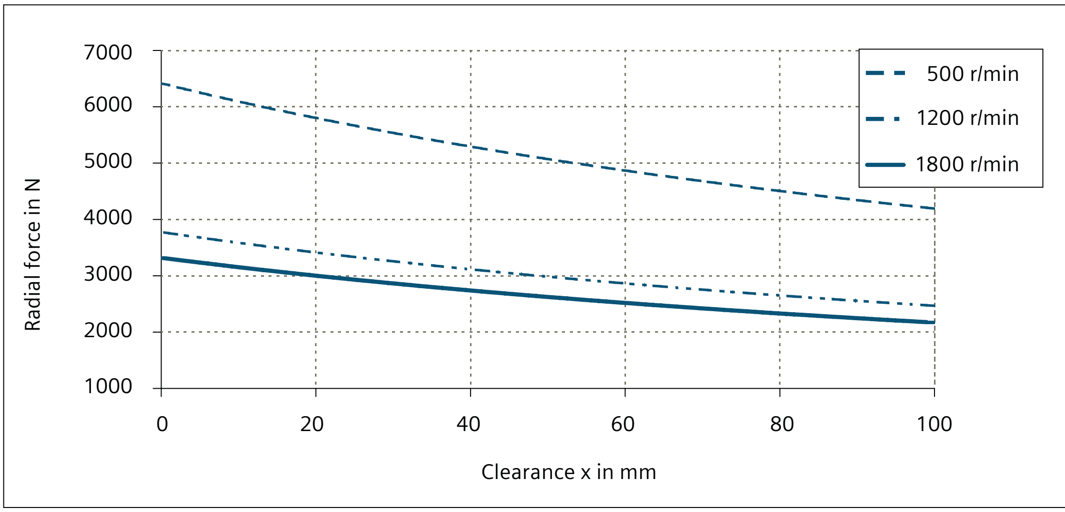


Figure 3-18 Radial force diagram for 1FW320❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW320❑ plug-on shaft / stub shaft

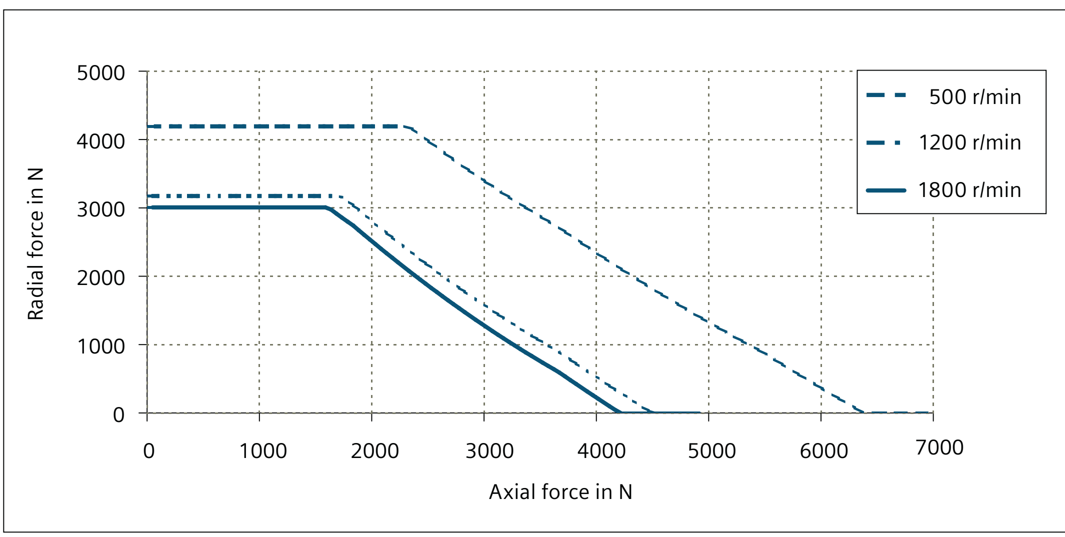


Figure 3-19 Permissible axial force as a function of radial force for 1FW320❑ (60000 h)

For motors 1FW328❑ plug-on shaft

Note

1FW328 motors with plug-on shaft (shaft-mounted design) must be mounted using a torque arm.

3.6.3 Solid shaft (1FW315❑, 1FW320❑, 1FW328❑)

Radial force diagram for 1FW315❑ solid shaft

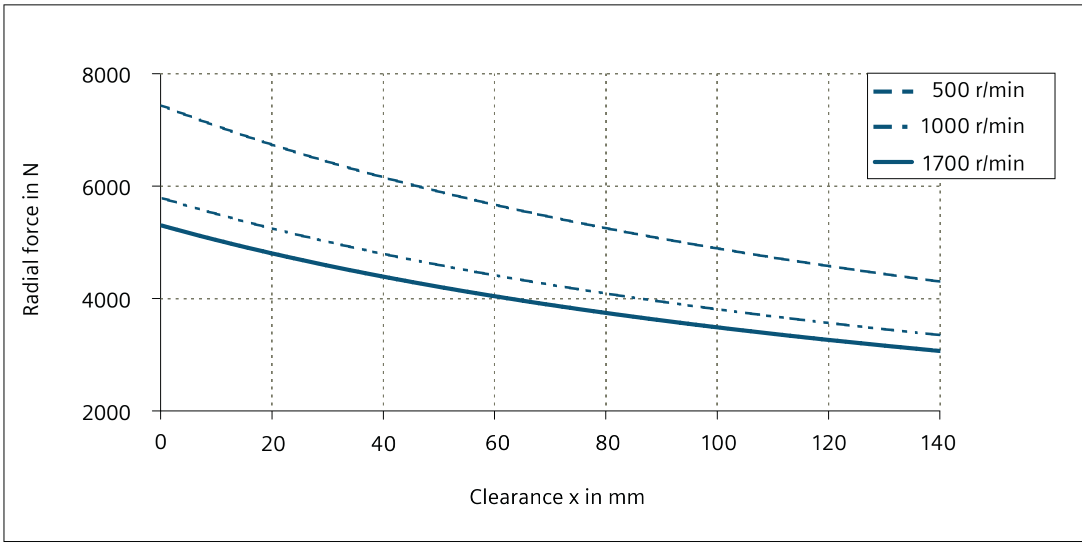


Figure 3-20 Radial force diagram for 1FW315❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❑ solid shaft

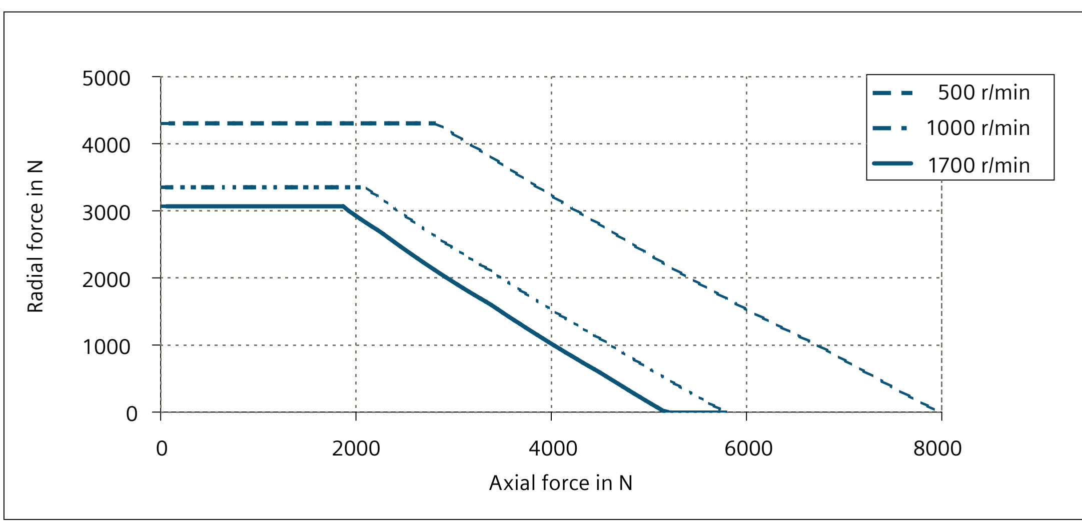


Figure 3-21 Permissible axial force as a function of radial force for 1FW315❑ (20000 h)

Radial force diagram for 1FW315❑ solid shaft

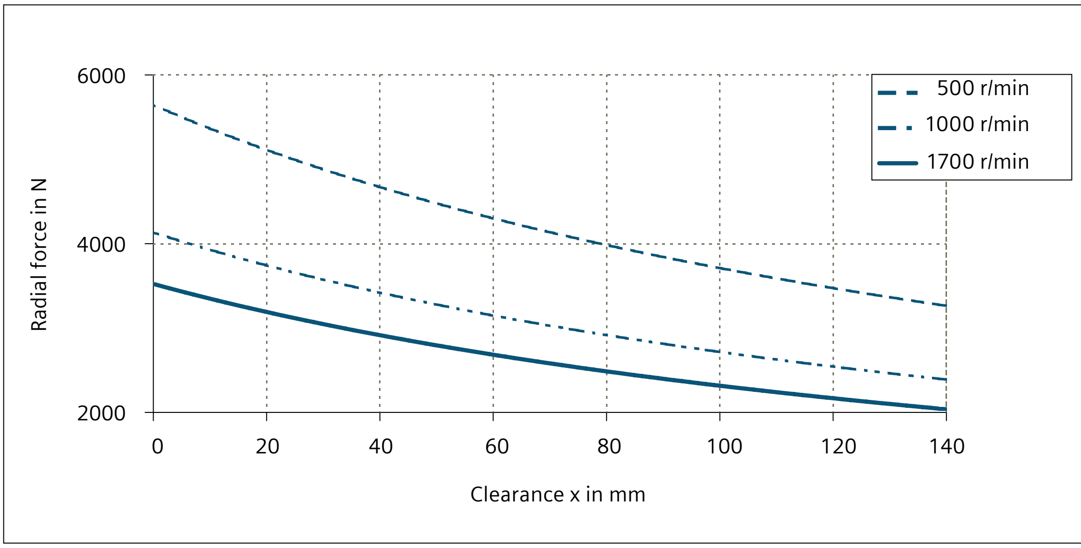


Figure 3-22 Radial force diagram for 1FW315❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW315❑ solid shaft

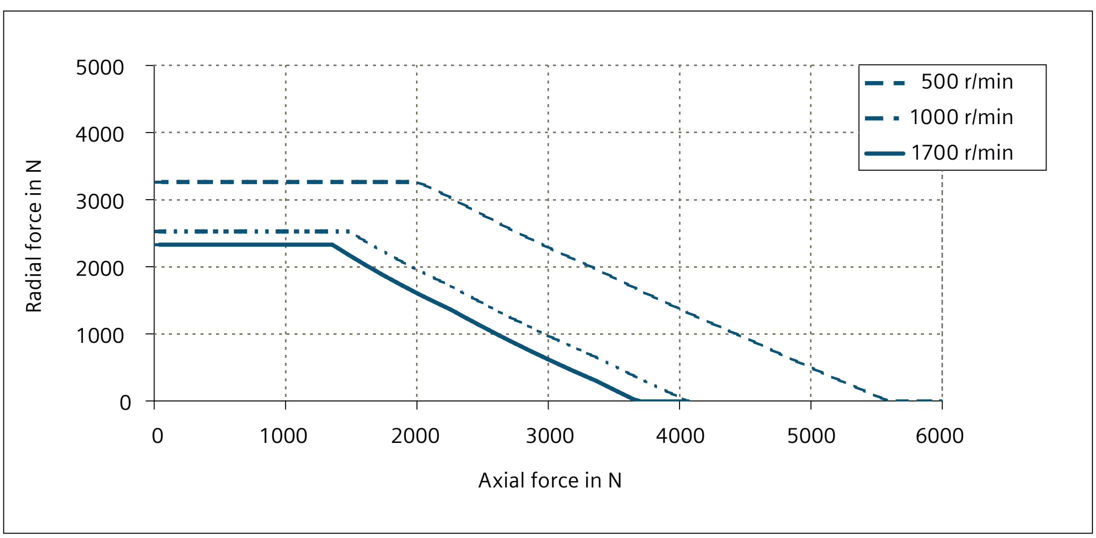


Figure 3-23 Permissible axial force as a function of radial force for 1FW315❑ (60000 h)

Radial force diagram for 1FW320❑ solid shaft

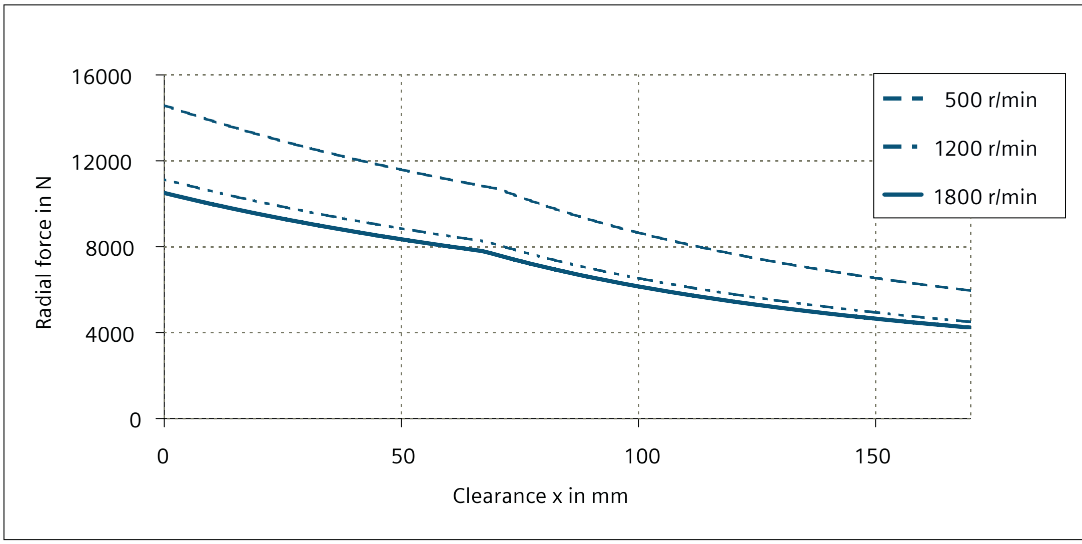


Figure 3-24 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❑ solid shaft

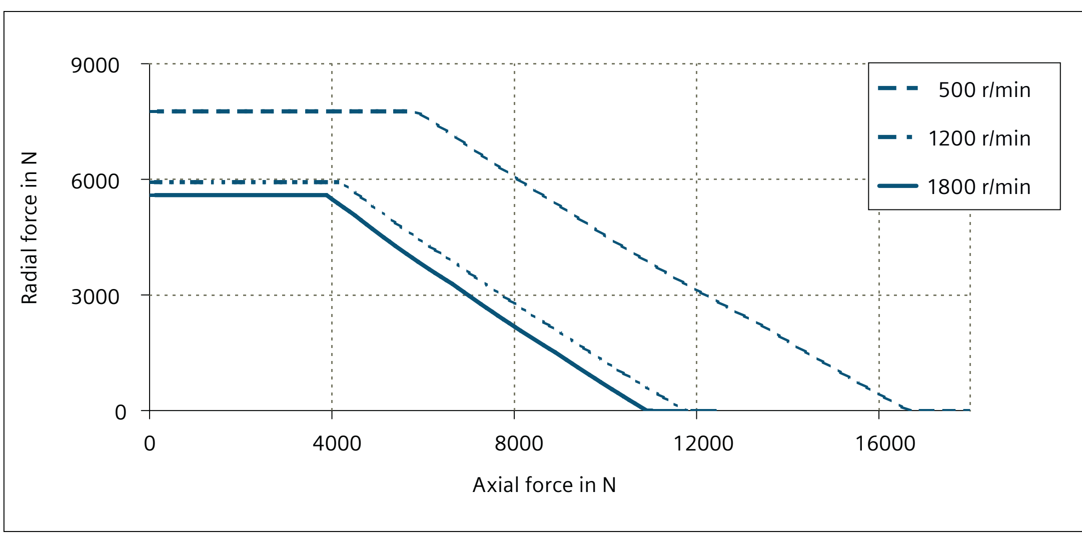


Figure 3-25 Permissible axial force as a function of radial force for 1FW320❑ (20000 h)

Radial force diagram for 1FW320❑ solid shaft

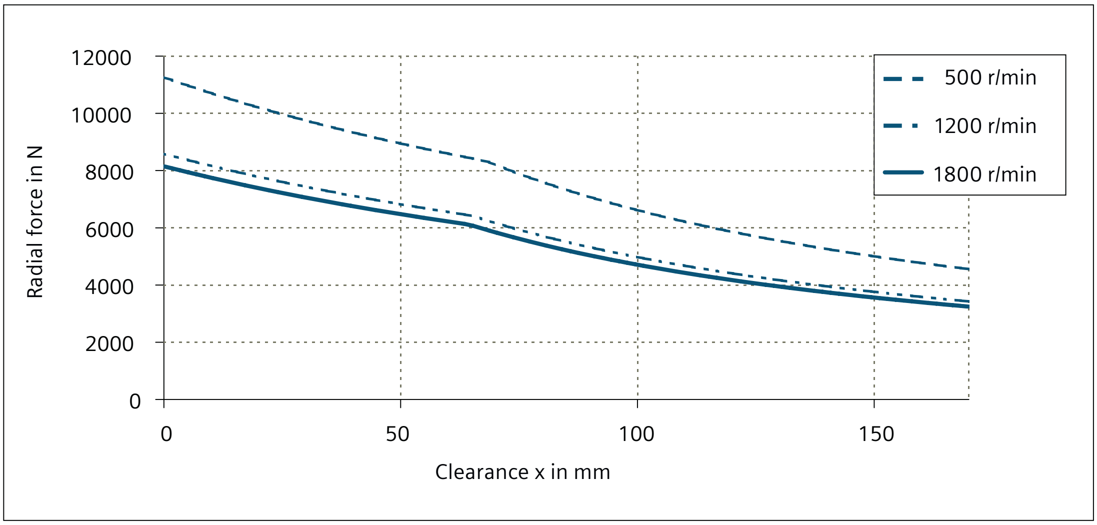


Figure 3-26 Radial force diagram for 1FW320❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW320❑ solid shaft

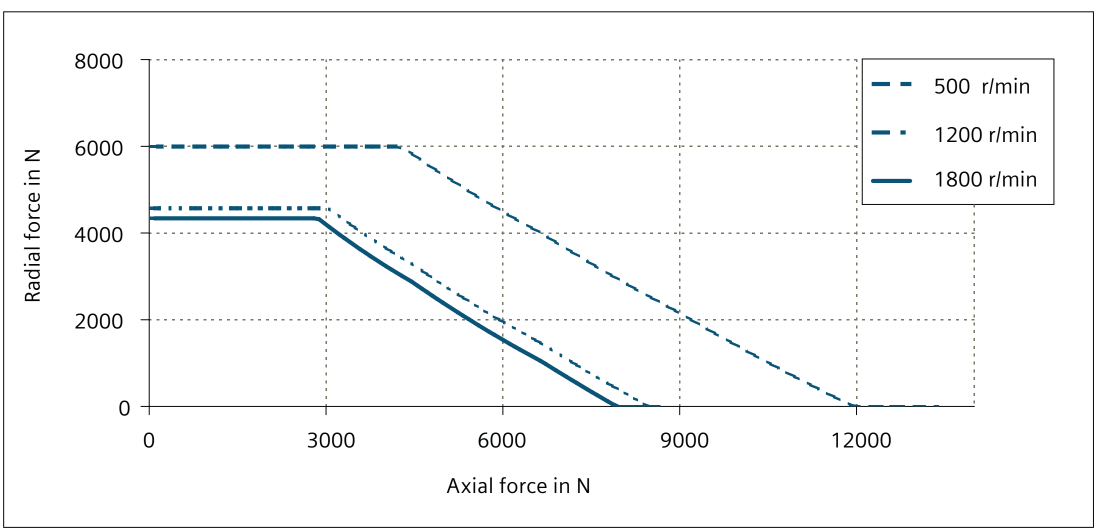


Figure 3-27 Permissible axial force as a function of radial force for 1FW320❑ (60000 h)

Radial force diagram for 1FW328❑ solid shaft

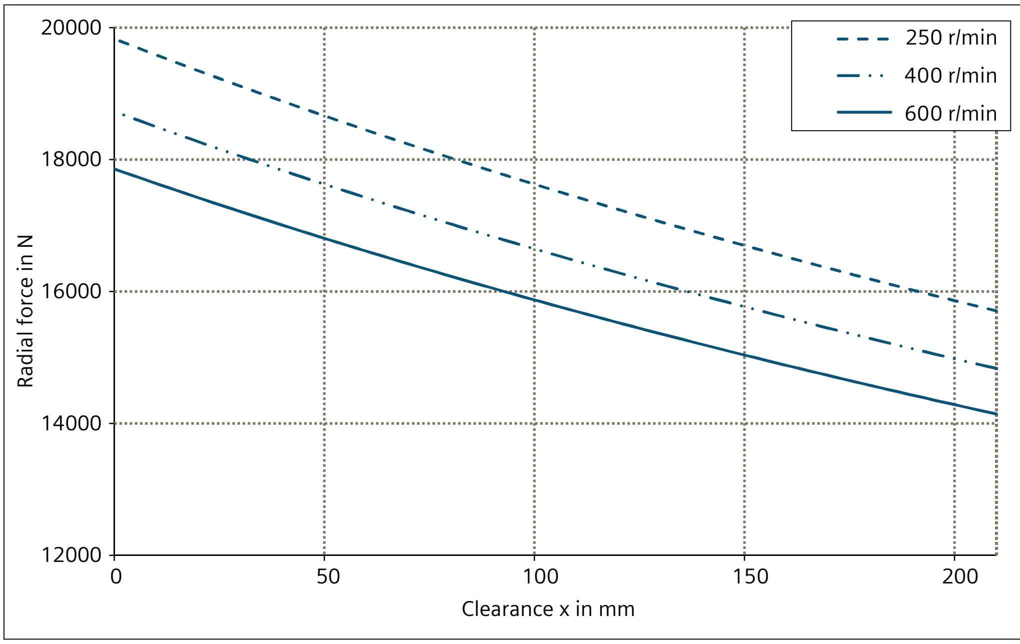


Figure 3-28 Radial force diagram for 1FW328❑, with nominal bearing change interval of 40000 h

Axial force diagram for 1FW328❑ solid shaft

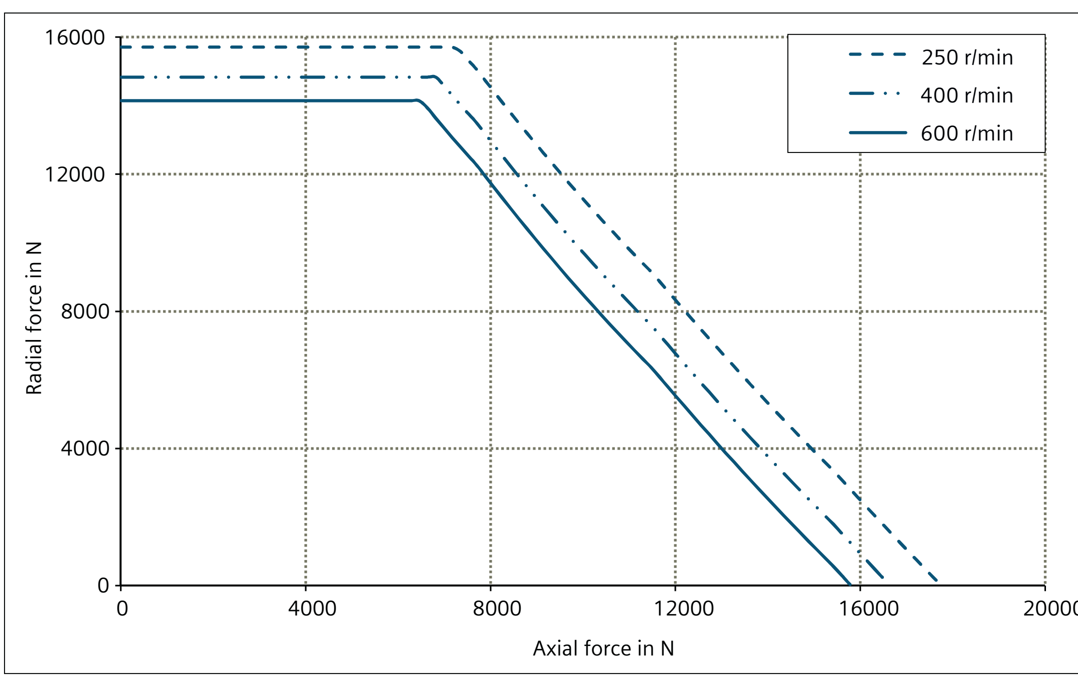


Figure 3-29 Permissible axial force as a function of radial force for 1FW328❑ (40000 h)

3.7 Balancing

Requirements placed on the balancing process for mounted components

Motors with hollow shaft and plug-on shaft must be balanced in the factory without any mounted components. Motors with solid shaft are balanced according to DIN ISO 21940-32.

In addition to the balance quality of the motor, the vibration quality of motors with mounted output elements is essentially determined by the balance quality of the mounted component.

If the motor and mounted component are separately balanced before they are assembled, then the process used to balance the output element must be adapted to the motor balancing type.

A distinction should be made between the following balancing types for solid shafts:

- Half-key balancing (an "H" is stamped on the shaft face)
- Smooth shaft end (no keyway)

The balancing type is coded in the order designation.

Special requirements

If special requirements are placed on the smooth running operation of the machine, we recommend that the motor together with the output components is completely balanced. In this case, balancing should be carried out in two planes of the output component.

3.8 Vibration response

The motors conform to vibration severity grade A in accordance with EN 60034-14.

The specified values refer to the motor only. The vibration behavior as a result of the mounting can result in increased values at the motor.

The vibration severity grade is maintained up to the rated speed (n_N).

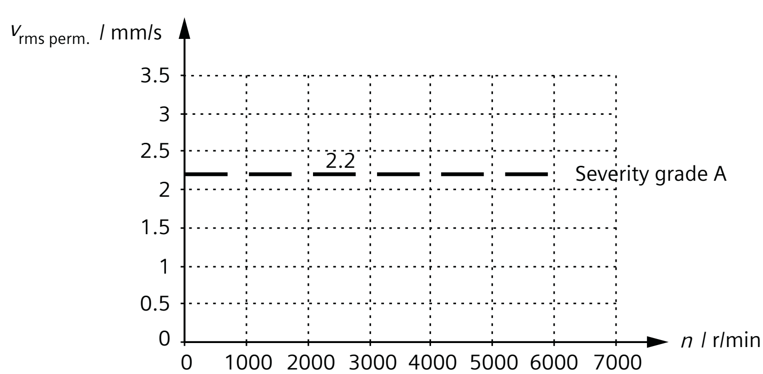


Figure 3-30 Vibration severity grade

Monitoring drive components via vibration signals

"Condition-monitoring-ready"-components

"Condition-monitoring-ready"-components in the drive train are monitoring at any time via vibration signals the drive components to avoid unexpected plant downtimes.

A change in the vibration response is an early indication of imminent damage. Condition-monitoring-ready motors are equipped with boreholes for inserting vibration sensors. This allows you to position vibration sensors optimally and install condition monitoring systems.

For further information about the Siemens condition monitoring system follow this link:

SIPLUS CMS (https://new.siemens.com/global/en/products/automation/products-for-specific-requirements/siplus-cms.html?_sm_au_=iVV514PkqnSJ0nfft2tQvK032Hv7C)

Motors with option G50

On motors with option G50, you can, for example, monitor the vibration severity at the ball bearing using sensors. Information how to mount the sensors are in chapter "Mounting vibration sensors (Z-option G50) (Page 150)".

Bearing

The ball pass frequencies of the ball bearings are stated on the bearing data labeling plate. You will find the bearing data labeling plate near the rating plate. Read out the bearing natural frequencies from the QR code on the bearing data labeling plate.

Depending on the evaluation unit you use, you will be able to detect the specific frequencies listed below.

The abbreviations have the following meaning:

BPFO: Ball Pass Frequency of Outer ring

BPFI: Ball Pass Frequency of Inner ring

BSF: Ball Spin Frequency

FTF: Fundamental Train Frequency

3.9 Vibration response 1FW3 Heavy Duty (Z option L03)

Table 3-12 Shock load 1FW3 Heavy Duty (Z option L03)

	Vibration acceleration a_{peak}
Max. permissible radial shock load	100 m/s^2
Max. permissible axial shock load	50 m/s^2

Evaluate the vibration acceleration as a peak value in the time domain in a frequency band extending from 0 up to 2000 Hz. The measurement must be made at the DE flange (based on DIN ISO 10816).

Appropriately adapt the measuring range if it is expected that noticeable vibration levels are excited above 2000 Hz (e.g. as a result of gear tooth meshing frequencies). This does not alter the maximum permissible values.

3.10 Noise emission

WARNING

Hearing damage

Hearing damage may occur if the motor exceeds a sound pressure level of 70 dB (A) due to the type of mounting or pulse frequency.

- Reduce the sound pressure level by implementing sound damping and/or soundproofing measures.

In operation, 1FW3 motors can reach the following measuring-surface sound-pressure level Lp(A):

Max. 73 dB(A) at 4 kHz rated pulse frequency at the nominal operating point

Note

Sound-pressure level when reducing the pulse frequency

When the pulse frequency is reduced, a significantly higher sound pressure level can occur.

The motors are certified for a wide range of installation and operating conditions. These installation and operating conditions, e.g. a rigid or vibration-insulated foundation design, can significantly influence the noise emission.

3.11 Bearing change intervals

Bearing lifetime and regreasing interval

The bearings for the complete torque motors are greased for life and designed for operation at a minimum ambient temperature of - 15 °C.

Note

Bearings without regreasing system

For bearings without regreasing system (SH 150 and SH 200), we recommend that the bearings are replaced after approx. 20000 operating hours for an ambient temperatures up to a maximum of 40°C, or after 5 years (after delivery) at the latest.

The bearing lifetime is reduced by 50 % when motors are mounted vertically. This is the reason that we recommend that a regreasing system is used when motors are mounted vertically.

Option +K40 "Regreasing system"

A regreasing system is:

- Standard for 1FW328☐ and 1FW320☐-☐☐☐65-☐☐P0-Z L03
- Option for 1FW315☐ and 1FW320☐

If the 1FW3 is equipped with regreasing system (bevel lubricating nipple) for the DE and NDE bearings, then the bearing change interval increases according to the table "Bearings with regreasing system". Comply with the regreasing intervals and ensure that the temperature does not exceed a maximum of 40 °C.

Table 3-13 Bearing change interval and regreasing

	SH 150	SH 200	SH 280
Bearing change interval with permanent grease lubrication, horizontal mounting position	20,000 h at max. 40 °C ambient temperature	20,000 h at max. 40 °C ambient temperature	---
Regreasing	Option +K40 See table "Bearings with regreasing system"	Option +K40 See table "Bearings with regreasing system"	Regreasing in the standard See table "Bearings with regreasing system"

Table 3-14 Bearings with regreasing system (optional for 1FW315❑ and 1FW320❑)

Motor	Bearing change interval with regreasing / h	Regreasing intervals / h
1FW315❑ Hollow shaft	40000	10000
1FW315❑ Plug-on shaft	60000	10000
1FW315❑ Stub shaft	40000	10000
1FW315❑ Solid shaft	60000	10000
1FW320❑ Hollow shaft	40000	10000
1FW320❑ Plug-on shaft	60000	10000
1FW320❑ Stub shaft	40000	10000
1FW320❑ Solid shaft	60000	10000
1FW328❑-2 Hollow shaft, n_N = 150 r/min, n_N = 250 r/min	40000	10000
1FW328❑-3 Hollow shaft, n_N = 400 r/min	40000	8000
1FW328❑-3 Hollow shaft, n_N = 600 r/min	40000	8000
1FW328❑-3 Hollow shaft, n_N = 800 r/min	40000	8000
1FW328❑-2/3 Plug-on shaft	40000	8000
1FW328❑-2/3 Stub shaft	40000	8000
1FW328❑-2 Solid shaft, n_N = 150 r/min, n_N = 250 r/min	40000	10000
1FW328❑-3 Solid shaft, n_N = 400 r/min	40000	8000

Motor	Bearing change interval with regreasing / h	Regreasing intervals / h
1FW328❑-3 Solid shaft, n_N = 600 r/min	40000	8000
1FW328❑-3 Solid shaft, n_N = 800 r/min	40000	8000

Table 3-15 Bearing grease

	Standard grease	Option +V07 "Special grease for low speeds"
Bearing grease designation	Klüberquiet BQH 72-102	LGHB 2
Manufacturer	Klüber Lubrication München KG	SKF AG
Contact	https://www.klueber.com	https://www.skf.com

Note

Specified grease quantity

For motors with the option +K40 "regreasing system", the required grease quantity is stated on the bearing data labeling plate.

Note

Vertical mounting position

The regreasing interval is reduced to 50% and therefore the bearing replacement interval when motors are mounted vertically.

Note

Selection of bearing grease for oscillating or reversing motor movements

For oscillating or reversing motor movements, depending on the application, you need a special grease, which you can obtain on request. If necessary, you must comply with other bearing change intervals and regreasing intervals than those specified in this manual.

WARNING

Danger to life as a result of parts of the body being drawn in and crushed

Operational motors can draw in body parts, crush them or cause other injuries.

- Only lubricate bearings if there is absolutely no risk to personnel.
- When working on an operational motor only wear clothes and accessories that cannot be drawn in.
- Take the appropriate measures so that your hair cannot be pulled in by the motor,
- Only regrease the bearings at the slowest speed that can be adjusted

Regreasing

Procedure

1. Set the lowest possible speed.
2. Grease the bearings at the lowest possible speed with the specified amount of grease.

You have greased the bearings.

❒

The recommended re-lubricating intervals relate to normal loads:

- Operation at speeds in accordance with the rating plate data
- Low-vibration operation, see Chapter "Vibration resistance (Page 149)"
- Use of the specified roller bearing greases

Option +V07 "Special grease for low speeds"

For option +V07 "Special grease for low speeds", for shaft heights 150 and 200, you require option K40 "Relubrication device". Motors of shaft height 280 are equipped with a relubrication device as standard. You do not require option K40 for these motors.

For motors with an average speed smaller than 100 r/min, you need the option +V07.

You can calculate the average operating speed n_m by the following formula:

$$n_m = \frac{n_1 t_1 + n_2 t_2 + \dots n_n t_n}{100}$$

Formula symbol	Unit	Description
$t_1 \dots t_n$	%	Time percentage of the bearing load
$n_1 \dots n_n$	r/min	Operating speed

You therefore calculate an average speed from the different speeds according to their time percentages.

Special versions

Unfavorable factors (e.g. effects of mounting/installation, speeds, special modes of operation or high mechanical loads) may require special measures.

Contact your local Siemens office, specifying the prevailing general conditions.

3.12 Maintenance and service intervals

3.12.1 Maintenance intervals

General

Regularly carry out maintenance work, inspections and revisions/overhauls in order to identify and resolve faults at an early stage - before these result in subsequent damage.

WARNING

Faults or unusual conditions

Faults or unusual conditions when operating the motor can result in death, severe injury or material damage.

Electrical or mechanical stress placed on the three-phase motor, such as overload, short circuit, etc. can damage it. This includes, short-circuit or overload, for example.

- Immediately perform an inspection when faults or exceptional conditions occur.

Operating conditions, maintenance intervals

Only general maintenance intervals can be specified here as a result of the different operating situations.

- Maintenance intervals should, therefore, be scheduled to suit the local conditions (pollution/dirt, switching frequency, load, etc.).
- Perform the following measures after the appropriate operating times or at the specified intervals.

Table 3-16 Measures after an operating time

Operating time	Measure
Every 20,000 h	Coaxial encoder mounting: Replace the encoder and coupling (see Chapter "Removing/mounting the encoder (Page 145)") Encoder via belt drive: Replace the encoder, auxiliary encoder bearings and toothed belts (see repair centers)
See table "Bearings with regreasing system (for 1FW315x, 1FW320x and 1FW328x, optional) in Chapter "Bearing replacement intervals".	Replace the motor bearings, the shaft sealing ring and for encoders with belt drive, the toothed belt pulley (see repair centers)

Repair centers

Note

Authorized motor repair centers

The following activities (particularly replacing parts) can only be performed by authorized motors repair centers:

- Replacing the encoder, auxiliary encoder bearings and toothed belts
- Replacing motor bearings, shaft sealing ring and toothed-belt pulley

In the event of a fault, contact the OEM/regional sales. They will then coordinate the appropriate authorized workshops.

Additional regional motor repair centers will be successively authorized in order to minimize downtimes and to be able to perform repairs quickly, at a favorable price and with a high quality standard.

For contact data of the Siemens Service Center, see "Technical Support" in Chapter "Introduction".

3.12.2 Checking the cooling water

- Check the level and discoloration or turbidity of the cooling water at least once a year.
- Every year check whether the cooling water still has the permissible specification.
- If cooling water is lost for closed or semi-open circuits top up the system using a prepared mixture of deionized water and inhibitor or Antifrogen N.

Motor components and options

4

4.1 Motor components

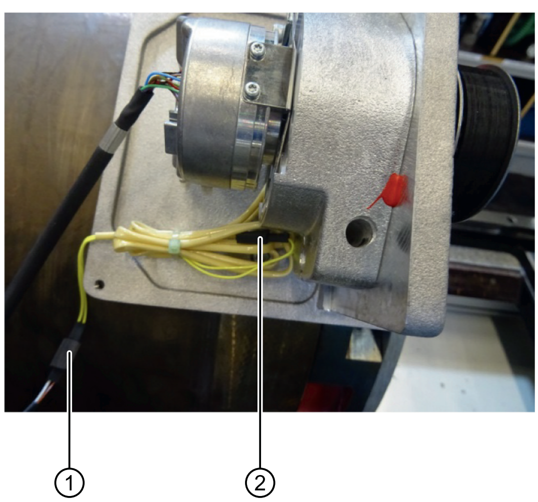
4.1.1 Thermal motor protection

NOTICE
Thermal motor damage
Windings and bearings can be destroyed if the motor overheats. Further, if a motor overheats, this can demagnetize the permanent magnets.
• Only operate the motors in conjunction with an effective temperature control.

Thermal motor protection with temperature sensors

The stator core has two temperature sensors to monitor the winding; one of these is a reserve.

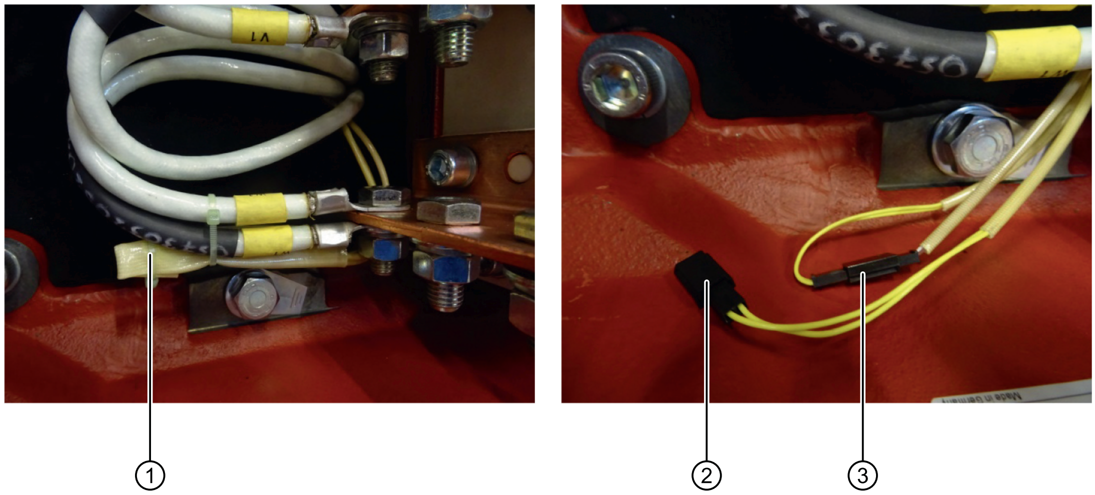
If you want to use the reserve temperature sensor, you must change the plug-in connection. The plug-in connection is at motors with encoder with belt drive in the encoder box. At all other motor versions the plug-in connection is in the terminal box. See the following pictures to this.



1 Connected temperature sensor with plug-in connector

2 Reserve temperature sensor with plug-in connector

Figure 4-1 Example: Connection in the encoder box



1 Reserve with plug-in connection in the insulating tubing
2 Reserve
3 Connected temperature sensor

Figure 4-2 Example: Connection in the terminal box

Two temperature sensor types are integrated:

KTY 84	Pt1000
Temperature sensors KTY 84 are ESD components. When delivered, they are short-circuited with a terminal.	Pt1000 temperature sensors are not ESD components.

Temperature sensors of the same type are always installed in one particular motor.

The type of temperature sensor installed is stamped on the rating plate.

Table 4-1 Features and technical data

Type	KTY 84-130	Pt1000
Resistance when cold (20 °C)	Approx. 580 Ω	Approx. 1090 Ω
Resistance when hot (100 °C)	Approx. 1000 Ω	Approx. 1390 Ω
Connection	Via signal cable	Via signal cable
Response temperature	Prewarning < 150 °C Alarm/trip at max. 170 °C ±5 °C	Prewarning < 150 °C Alarm/trip at max. 170 °C ±5 °C

The resistance change is proportional to the winding temperature change. The temperature characteristic is taken into account in the closed-loop control.

The following diagram shows the resistance characteristic as a function of the temperature for KTY 84-130 and Pt1000 temperature sensors.

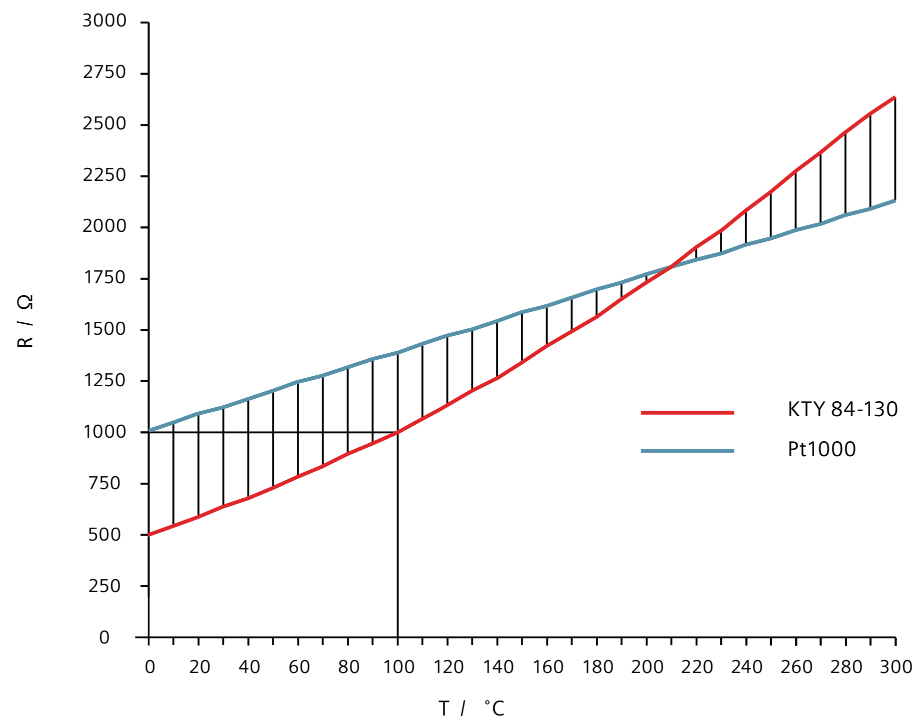


Figure 4-3 Comparison of KTY 84-130 and Pt1000 temperature sensors

The prewarning signal from the evaluation circuit in the SINAMICS drive converter can be externally evaluated.

You can find the designation of the interface for connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 310)".

NOTICE
Destruction of the motor for a thermal critical load
A thermally critical load, e.g. high overload when the motor is stationary, can destroy the motor. • Employ additional protective measures, e.g. an overcurrent relay.

NOTICE
Destruction of the temperature sensor if the insulation resistance is tested improperly
If the test voltage is connected to only one temperature sensor terminal, the temperature sensor will be destroyed. • Short-circuit ends of the temperature sensor cables before applying the test voltage.

High short-term overload conditions require additional protective measures as a result of the thermal coupling time of the temperature sensor.

PTC thermistor (option)

For special applications (e.g. when a load is applied with the motor stationary or for extremely low speeds), additional temperature monitoring of all three motor phases using a PTC thermistor triplet makes sense.

Ordering options: order code A11.

The PTC connections are located on the signal terminal block in the power terminal box. A cable entry hole M16 x 1.5 on the terminal box is provided for the connection. Exceptions to this rule are motors with shaft heights of 150 and 200 with Sensor Module Integrated (SMI). In these motors, the PTCs are evaluated via the SMI. The following encoder variants use an SMI: "D" = IC22DQ, "F" = AM22DQ, "U" = R15DQ.

Table 4-2 Technical data for the PTC thermistor triplet

Designation	Description
Type	PTC thermistor triplet
Thermistor resistance (20 °C)	≤ 750 Ω
Resistance when hot (180 °C)	≥ 1710 Ω
Response temperature	180 °C
Connection	Via external evaluation unit
Note: PTC thermistors do not have a linear characteristic and are, therefore, not suitable to determine the instantaneous temperature. Characteristic to DIN VDE 0660 Part 303, DIN 44081, DIN 44082.	

You can find the designation of the interface for connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 310)".

4.1.2 Encoders

WARNING

Uncontrolled motor motion as a result of incorrect adjustment

The encoders are adjusted in the factory for SIEMENS drive converters. Another encoder adjustment may be required when operating the motor with a third-party converter.

Incorrect adjustment of the encoder regarding motor EMF can lead to uncontrolled motion which can cause injury and material damage.

- Only replace an encoder and adjust it if you are appropriately qualified to do so.
- When a belt-driven encoder is replaced, adjust the position of the encoder system with respect to the motor EMF.
- You must re-reference the system when replacing an absolute encoder.

Note

Replacing a coaxially mounted encoder

When replacing a coaxially mounted encoder, you do not have to adjust the encoder system. The position with respect to the motor EMF is ensured using mechanical components.

Encoder selection and identification in the Article No.

The type of installed encoder can be identified at various positions of the Article No.

Table 4-3 Identification letter at the 9th position in the Article No.

Encoder type	9th position in the Article No.
Motors without DRIVE-CLiQ interfaces	
Incremental encoder, sin/cos 1 V_{pp}, 2048 S/R with C and D tracks, encoder IC2048S/R, belt mounted	A
Absolute encoder 2048 S/R singleturn, 4096 revolutions multiturn, with EnDat interface, encoder AM2048S/R, belt mounted or coaxially mounted at NDE	E
Multi-pole resolver (p = x), belt mounted	S
Motors with DRIVE-CLiQ interfaces	
Absolute encoder 24 bit singleturn (resolution 16777216), encoder AS24DQI	B
Absolute encoder 24 bit singleturn (resolution 16777216) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM24DQI	C
Incremental encoder, 22-bit (resolution 4194304, internal 2048 S/R) + commutation position, 11 bit, encoder IC22DQ, belt-mounted	D
Absolute encoder 22 bit singleturn (resolution 4194304, internal 2048 S/R) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM22DQ, belt-mounted	F
Resolver 15-bit (resolution 32.768, internal, multi-pole), R15DQ encoder, belt mounted	U
Encoderless	W

Identification at the 11th and 15th position in the Article No.

belt-driven encoder	11th position in the Article No. = 7 15th position in the Article No. = A or C
Coaxial encoder mounting	11th position in the Article No. = 6 15th position in the Article No. = H, M, P or S
Encoderless	11th position in the Article No. = 6 15th position in the Article No. = A or C for shaft hight 150 and 200; only A for shaft hight 280

4.1.2.1 Safety Integrated Functions

Note

Safety Integrated Extended Functions

Certain Safety Integrated Extended Functions of the SINAMICS S120 drive system and the SINUMERIK Safety Integrated Functions require a suitable encoder.

At the following link you will find a PDF document with a list of motors from the Motion Control portfolio with and without DRIVE-CLiQ interface. Furthermore, this list contains individual encoders and measuring systems that you can use in conjunction with Safety Integrated:

Safety encoders (https://support.industry.siemens.com/cs/ww/en/view/33512621)

4.1.2.2 Encoder connection for motors with DRIVE-CLiQ interface

For motors with a DRIVE-CLiQ interface, the analog encoder signal is internally converted to a digital signal. There is no further conversion of the encoder signal in the drive system required. Motors with DRIVE-CLiQ interface simplify commissioning and diagnostics, as the motor and encoder system are identified automatically.

WARNING

Danger to life when using an incorrect encoder module

The DRIVE-CLiQ encoder contains motor and encoder-specific data and an electronic type plate. If you use an incorrect DRIVE-CLiQ encoder, this can result in death, severe injury and severe material damage.

- Only use the DRIVE-CLiQ encoder and the electronic type plate for the original motor.
- Do not mount the DRIVE-CLiQ encoder onto other motors.
- Do not replace a DRIVE-CLiQ encoder by a DRIVE-CLiQ encoder belonging to another motor.
- Only appropriately trained Siemens service personnel should replace DRIVE-CLiQ encoders.

NOTICE

Damage to components that are sensitive to electrostatic discharge

The DRIVE-CLiQ interface has direct contact to components that can be damaged/destroyed by electrostatic discharge (ESDS). Components that are sensitive to electrostatic discharge can be damaged if you touch the connections with your hands or with electrostatically charged tools.

- Carefully observe the information in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

Cables

For all encoder types (incremental encoder, absolute value encoder and Resolver) the same DRIVE-CLiQ cables you can use between the motor and converter.

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX☐002-☐DC☐☐-☐☐☐0.

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

4.1.2.3 Encoder connection for motors without DRIVE-CLiQ interface

For motors without an integrated DRIVE-CLiQ interface, the analog encoder signal in the drive system is converted into a digital signal. For these motors as well as external encoders, the encoder signals must be connected to SINAMICS S120 via Sensor Modules.

4.1.2.4 Incremental encoder sin/cos 1 Vpp

Description

This encoder senses relative movements and does not supply absolute position information. In combination with an evaluation logic, a zero point can be determined using the integrated reference mark, which can be used to calculate the absolute position.

The encoder outputs sine and cosine signals. These signals can be interpolated using evaluation logic (usually 2048x).

The direction of rotation can be evaluated using the encoder.

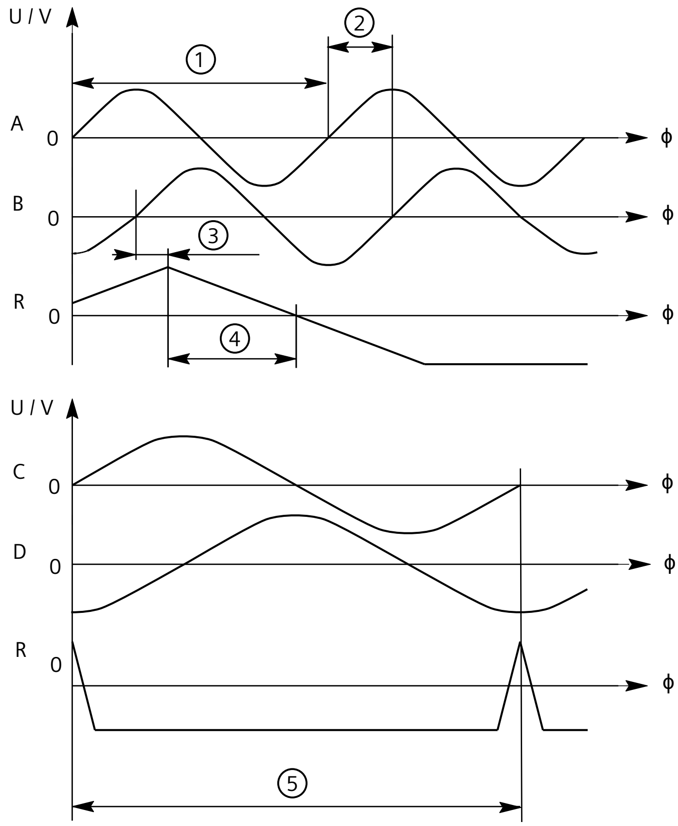
In the version with DRIVE-CLiQ interface, this evaluation logic is already integrated in the encoder.

Function and technical data

- Angular measuring system for the commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop
- One zero pulse (reference mark) per revolution

Table 4-4 Technical data for incremental encoders

Encoder type	9th position in the Article No.	Operating voltage	Max. current drain	A-B track: Resolution incremental (sin/cos periods per revolution)	C-D track: Rotor/ commutation position (sin/cos periods per revolution)	Angular error
without DRIVE-CLiQ interface						
Incremental encoder sin/cos 1 V_{pp}, 2048 S/R with C and D tracks	A	5 V ± 5 %	140 mA	2048 S/R (1 V_{pp})	1 S/R (1 V_{pp})	± 40"
with DRIVE-CLiQ interface						
Incremental encoder 22 bit resolution 4.194.304, internal 2048 S/R) + commutation position 11 bit	D	24 V	180 mA	4,194,304 (=22 bits)	2048 (= 11 bits)	± 40"



1 360° electrical = 360° mechanical / 2048

2 90° electrical

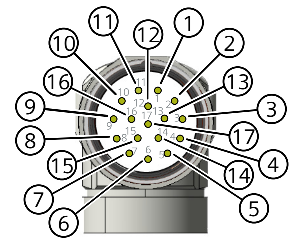
3 45° electrical

4 180° electrical +/- 90° electrical

5 360° electrical = 360° mechanical

Figure 4-4 Signal sequence and assignment for encoder IC2048S/R without DRIVE-CLiQ interface for a positive direction of rotation

Connection assignment for 17-pin signal connector

PIN No.	Signal	Diagram
1	A	
2	A*	
3	R	
4	D*	
5	C	
6	C*	
7	M encoder	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	−1R2 (KTY 84) or 1R2 (Pt1000)	
10	P encoder	
11	B	
12	B*	
13	R*	
14	D	
15 *)	M sense	
16 *)	P sense	
17	Not connected	

*) Cable break and voltage control

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-2CA31-□□□0, mating connector 6FX2003-0SU17 (socket).

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

4.1.2.5 Absolute encoders

Description of multiturn absolute encoders

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. An internal measuring gearbox enables the encoder to differentiate between 4096 revolutions.

Description, absolute value singleturn

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. Contrary to a multiturn absolute encoder, the encoder has no measuring gearbox and can therefore only supply the position value within one revolution.

Function and technical data

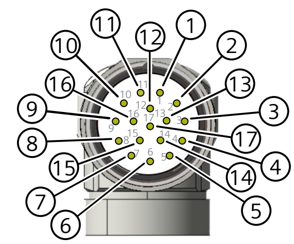
- Angular measuring system for the commutation
- Speed actual value sensing
- For single-turn encoders: indirect measuring system for absolute position sensing within a traversing range of 1 revolution
- For multi-turn encoders: indirect measuring system for sensing the absolute position within a traversing range of 4096 revolutions

Table 4-5 Technical specifications, absolute encoder

Encoder type	9th position in the Article No.	Operating voltage	Max. current consumption	Absolute resolution (single-turn)	Traversing-range (multi-turn)	A-B track: Resolution incremental (sin/cos periods per revolution)	Angular error
without DRIVE-CLiQ interface							
Absolute encoder 2048 S/R, (4096 revolutions, multi-turn, with EnDat interface 2.1	E	5 V ± 5 %	200 mA	---	4096 (= 12 bits)	2048 S/R (1 V_{pp})	± 40"
with DRIVE-CLiQ interface							
Absolute encoder, single-turn, 24 bit	B	24 V	110 mA	16777216 (= 24 bits)	---	---	± 40"
Absolute encoder 24 bit + 12 bit multiturn	C	24 V	110 mA	16777216 (= 24 bits)	4096 (= 12 bits)	---	± 40"
Absolute encoder single-turn 22 bit + 12 bit multi-turn	F	5 V ± 5 %	200 mA	4194304 (= 22 bits)	4096 (= 12 bits)	---	± 40"

Connection pin assignment for 17-pin flange socket with pin contacts

Table 4-6 Connection pin assignment, 17-pin flange socket

PIN No.	Signal	Diagram
1	A	
2	A*	
3	Data	
4	Not connected	
5	Clock	
6	Not connected	
7	M encoder	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	−1R2 (KTY 84) or 1R2 (Pt1000)	
10	P encoder	
11	B	
12	B*	
13	Data*	
14	Clock*	
15 *)	M sense	
16 *)	P sense	
17	Not connected	

*) Cable break and voltage control

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX☐002-2EQ10-☐☐☐0, mating connector 6FX2003-0SU17 (socket).

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

4.1.2.6 Multi-pole resolver

Description

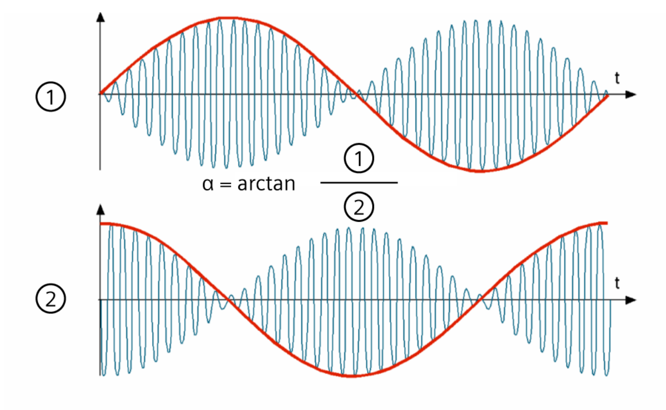
The number of sine and cosine periods per revolution corresponds to the number of pole pairs of the resolver. Resolvers can detect relative motion. The absolute position within one resolver output signal period can be determined.

Function and technical data

- Angular measuring system for the commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop

Table 4-7 Technical specifications, resolvers

Properties	**8-pole (for SH 200)**	**4-pole (for SH 150 and SH 280)**
Excitation voltage	$+ 5\ V_{rms}$ to $+ 13\ V_{rms}$	
Excitation frequency	4 kHz to 10 kHz	
Current consumption	$< 80\ mA_{rms}$	
Angular error, peak-to-peak (mech.)	< 4'	< 10'
Electrical transformation ratio	0.5	



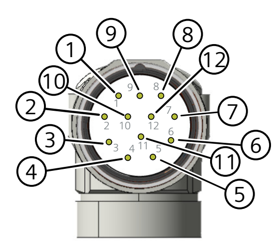
1 $U_{sinetrack}$

2 $U_{cosinetrack}$

Figure 4-5 Output signals, resolver

Connection pin assignment for 12-pin flange socket with pin contacts

Table 4-8 Connection pin assignment, 12-pin flange socket

PIN No.	Signal	Fig.
1	S2	
2	S4	
3	Not connected	
4	Not connected	
5	Not connected	
6	Not connected	
7	R2	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	−1R2 (KTY 84) or 1R2 (Pt1000)	
10	R1	
11	S1	
12	S3	

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-2CF02-□□□0, mating connector 6FX2003-0SU12 (socket).

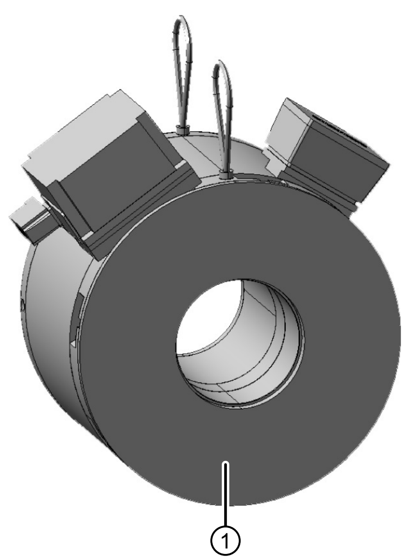
For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

4.1.2.7 Encoder with belt drive

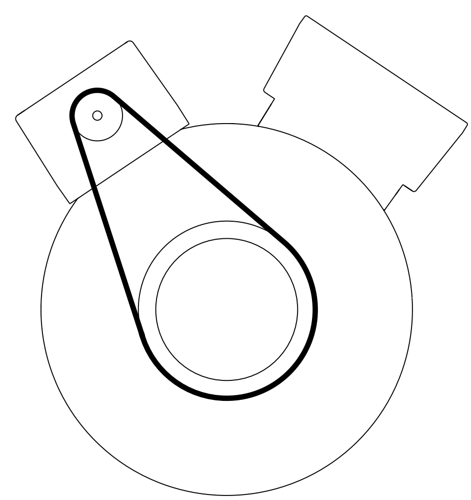
The encoder in the encoder box (on the stator side) is coupled via a belt. This means, for example, the hollow shaft can be used to route media. Gear ratio, see the table "Ratio" in this Chapter.

Note

Only qualified personnel may replace a belt. To do this, a device is required to measure the belt tension.



1 Cover for the toothed belt



Schematic diagram of the toothed belt drive

For the "hollow shaft" version, the encoder can be driven by a toothed belt. 11th position in the Article No. = 7. The gear ratio is in accordance with the table "Gear ratio".

Table 4-9 Ratio

Shaft height	*i*	Remarks
1FW315□	-3.5	The encoders are connected to the motor shaft through a belt drive (toothed belts). The sign for the gear ratio is negative due to the reverse direction of rotation of the encoder with respect to the motor.
1FW320□	-3.5	
1FW328□	-5	

4.1.2.8 Coaxial encoder mounting

Coaxial encoder mounting is available for high dynamic requirements and the highest precision. The encoder module can be easily replaced without requiring readjustment.

Further information can be found in Chapter "Removing/mounting the encoder (Page 145)."

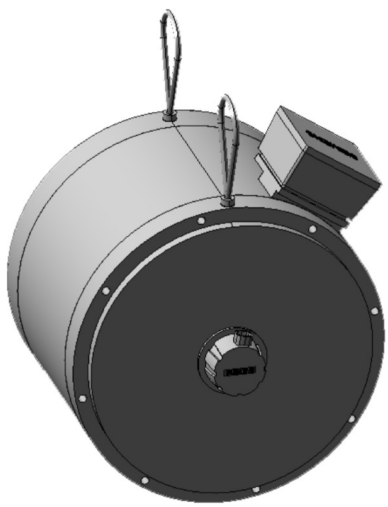


Figure 4-6 1FW3 with coaxially mounted encoder

4.1.2.9 Motor version without encoder

To connect the temperature sensors, use the separate terminal in the terminal box. The terminal box has a cable entry for this purpose.

You can find further information about connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 310)"

4.2 Options

When ordering a complete torque motor with options, **"-Z"** should be added to the article number. The order code should also be specified for each option that is required.

Order codes must not be repeated in plain text in the order.

Table 4-10 List of order codes

Order code	Designation
A11	Motor protection using PTC thermistors (3 × PTC)
B02	Manufacturer's test certificate
G50	Sensor hole M8; DE and NDE
K40	Regreasing system
L03	Heavy-duty version for increased shock loads
M02	Terminal box GK 603 with removable front plate

P01	Cable entry plate with 3 × M63 × 1.5 for 1XB7-700 terminal box
P04	Cable entry plate with 4 x M63 x 1.5 for 1XB7-712 terminal box
Q30	Clamping elements
Q95	Special paint finish ALEXIT in color (X01 to X91)
T20	Shaft cover at NDE for a hollow shaft
T32	Siemens torque arm
V07	Special grease for low speeds
X01	Paint finish, matt black RAL9005 paint finish
X02	Paint finish, cream white RAL9001
X03	Paint finish, reseda green RAL 6011
X04	Paint finish, pebble gray RAL 7032
X05	Paint finish, sky blue RAL 5015
X06	Paint finish, light ivory RAL 1015
X08	Paint finish, white aluminum, RAL 9006
X13	Paint finish, pastel blue RAL 5024
X18	Paint finish, papyrus white RAL 9018
X22	Paint finish, gray white RAL 9002
X28	Paint finish, azure blue RAL 9009
X29	Paint finish, mouse gray RAL 7005
X30	Paint finish, ivory RAL 1014
X31	Paint finish, brilliant blue RAL 5007
X32	Paint finish, pale green RAL 6021
X36	Paint finish, traffic white RAL 9016
X53	Paint finish, light gray RAL 7035

Configuration 5

5.1 Configuring software

5.1.1 TIA Selection Tool - TST

Overview

The TIA Selection Tool supports you in the technical dimensioning of the hardware and firmware components required for a drive task.

The TIA Selection Tool supports the following configuration steps:

- Configuring the power supply
- Designing the motor and gearbox, including calculation of mechanical transmission elements
- Configuring the drive components
- Compiling the required accessories
- Selection of the line-side and motor-side power options

The configuration process produces the following results:

- A parts list of components required (Export to Excel)
- Technical specifications of the system
- Characteristic curves
- Comments on system reactions
- Installation information of the drive and control components
- Energy considerations of the configured drive systems

You can find additional information that you can download in the Internet at TIA Selection Tool (https://support.industry.siemens.com/cs/ww/en/view/109767888).

5.1.2 SINAMICS Startdrive commissioning tool

The SINAMICS Startdrive commissioning tool offers

- Commissioning
- Optimization
- Diagnostics

You can find additional information that you can download in the Internet at SINAMICS Startdrive (https://support.industry.siemens.com/cs/ww/en/view/109794362)

Table 5-1 Article number for SINAMICS Startdrive commissioning tool

Commissioning tool	Article no. of the DVD
SINAMICS Startdrive V17 German, English, French, Italian, Spanish, Chinese (simplified)	Startdrive Basic V17: 6SL3072-4HA02-0XA0 Startdrive Advanced V17: 6SL3072-4HA02-0XA5 Startdrive Advanced V17 Upgrade: 6SL3072-4HA02-0XE5 Software Update Service (SUS) for Startdrive Advanced: 6SL3072-4AA02-0XL8

5.2 Configuring workflow

Motion Control

Servo drives are optimized for motion control applications. They execute linear or rotary movements within a defined movement cycle. All movements should be optimized in terms of time.

As a result of these considerations, servo drives must meet the following requirements:

- High dynamic response, i.e. short rise times
- Capable of overload, i.e. a high reserve for accelerating
- Wide control range, i.e. high resolution for precise positioning

General procedure when engineering

The function description of the machine provides the basis when engineering the drive application. The definition of the components is based on physical interdependencies and is usually carried-out as follows:

	Step	Description of the engineering activity
See following sections	1.	Clarify the type of drive/infeed type
	2.	Define the supplementary conditions and integrate the drive/infeed into an automation system
	3.	Define the load, calculate the max. load torque and select the motor

	Step	Description of the engineering activity
See Catalog	4.	Select a SINAMICS Motor Module
	5.	Repeat step 3 and step 4 for additional axes
	6.	Calculate the required DC link power and select an appropriate SINAMICS Line Module
	7.	Select the line-side options (main switch, fuses, line filters, etc.)
	8.	Select a Control Unit based on the specification of the required control performance, and define the component cabling
	9.	Define and select the additional system components
	10.	Calculate the current demand of the 24 V DC supply for the components and specify the power supplies (SITOP devices, control supply modules)
	11.	Select the components for the connection system
	12.	Configurate the components of the drive line-up

5.2.1 Clarify the drive type

The motor is selected based on the required torque, which is defined by the application. Typical applications are, for example:

- Traversing drives
- Hoisting drives
- Test stands
- Centrifuges
- Paper and rolling mill drives
- Feed drives
- Main spindle drives

Gear units to convert motion or to adapt the motor speed and motor torque to the load conditions must also be considered.

As well as the load torque, which is determined by the application, the following mechanical data are among those required to calculate the torque to be provided by the motor:

- Masses moved
- Leadscrew pitch, gear ratios
- Frictional resistance
- Mechanical efficiency
- Traversing paths
- Maximum velocity
- Maximum acceleration and maximum deceleration
- Cycle time

You must decide whether synchronous or induction motors are to be used.

Synchronous motors are the best choice if it is important to have low envelope dimensions, low rotor moment of inertia and therefore maximum dynamic response. These motors are operated in control type "servo". For additional applications, the 1FW3 can also be operated in the "Vector" control mode.

The following factors must be taken into account when engineering the drive system:

- The line system configuration, when using specific types of motor and/or line filters on IT systems (non-grounded systems)
- The ambient temperatures and the installation altitude of the motors and drive components.

The motor-specific limiting characteristics provide the basis for defining the motors. These define the torque or power characteristic versus the speed and take into account the motor limits based on the DC-link voltage of the Power or Motor Module.

The DC-link voltage, in turn, is dependent on the supply voltage and, with multi-motor drives, on the type of the Line Module.

5.2.2 Define the supplementary conditions and integrate the drive into the automation system

If high maximum speeds are to be reached, then induction motors can be used in the field weakening range. Induction motors are also suitable for higher power ratings.

The drives should either be defined as single-axis drives or in a group as multi-axis drives.

When engineering the system, the motor utilization according to rated values for winding temperature rise 60 K or 100 K should be taken into account.

Other supplementary conditions apply when integrating the drives into an automation environment such as SIMATIC or SIMOTION.

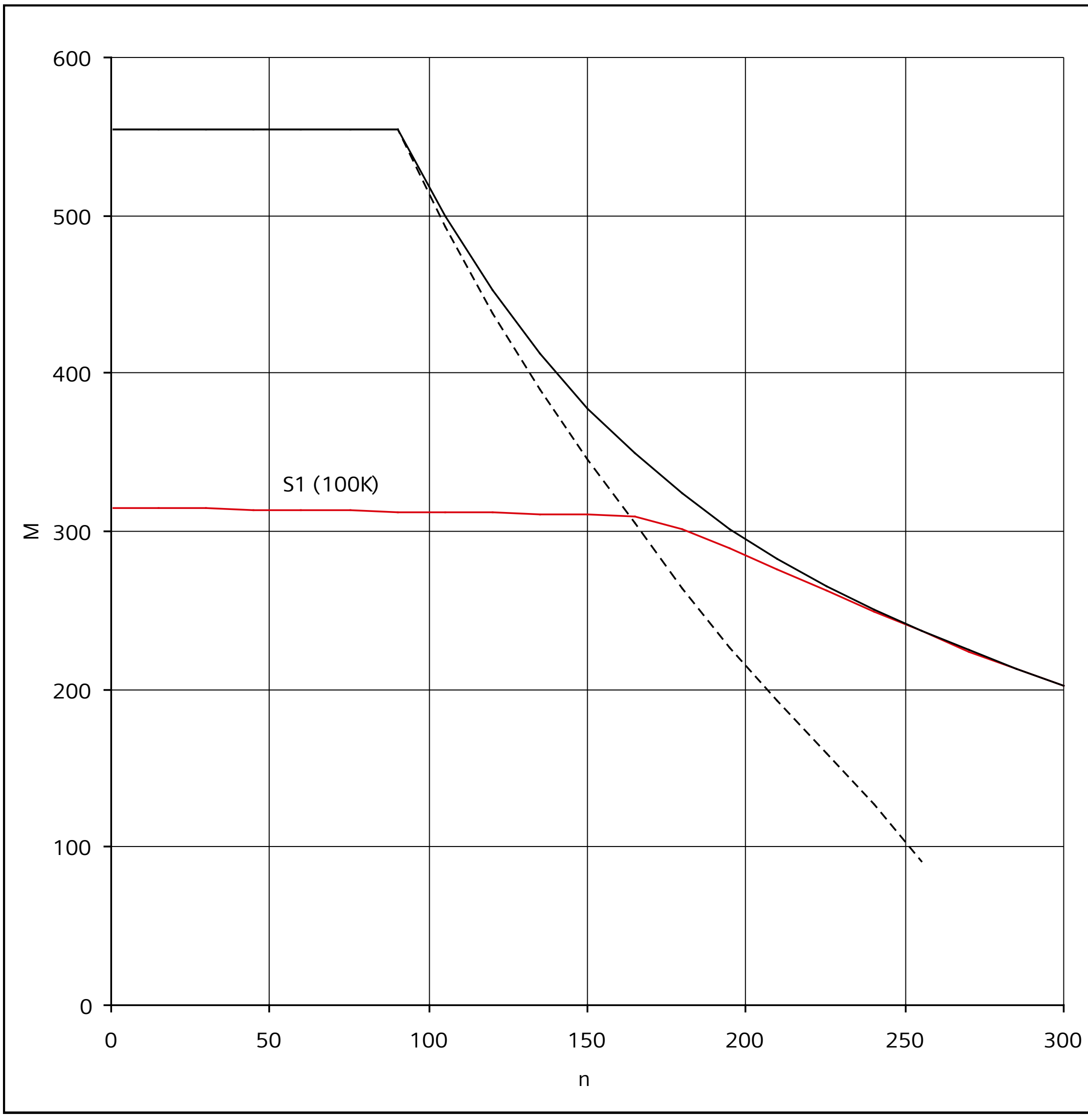
For motion control and technology functions (e.g. positioning), as well as for synchronous operation functions, the corresponding automation system, e.g. SIMOTION D, is used.

The drives are interfaced to the higher-level automation system via PROFIBUS.

5.2.3 Define the load case, calculate the maximum torque, select the motor

The motor-specific limiting curves are used as basis when selecting a motor.

These define the torque characteristic with respect to speed and take into account the motor limits based on the line supply voltage and the function of the infeed.



SINAMICS ALM 400 V line supply (600 V DC link voltage)

M in Nm; n in r/min

Figure 5-1 Limiting characteristics for synchronous motors 1FW3201-1☐E☐

The motor is selected on the basis of the load specified by the application. Different characteristics must be used for different loads.
The following operating scenarios have been defined:

- Load duty cycles with constant on period
- Load duty cycles with varying on period
- Duty cycle, variable

The objective is to identify characteristic torque and speed operating points, which can be used as a basis for selecting the motor depending on the load.

Once the operating scenario has been defined and specified, the maximum motor torque is calculated. Generally, the maximum motor torque is required when accelerating. The load torque and the torque required to accelerate the motor are added.

The maximum motor torque is then verified using the motor limiting curves.

The following criteria must be taken into account when the motor is selected:

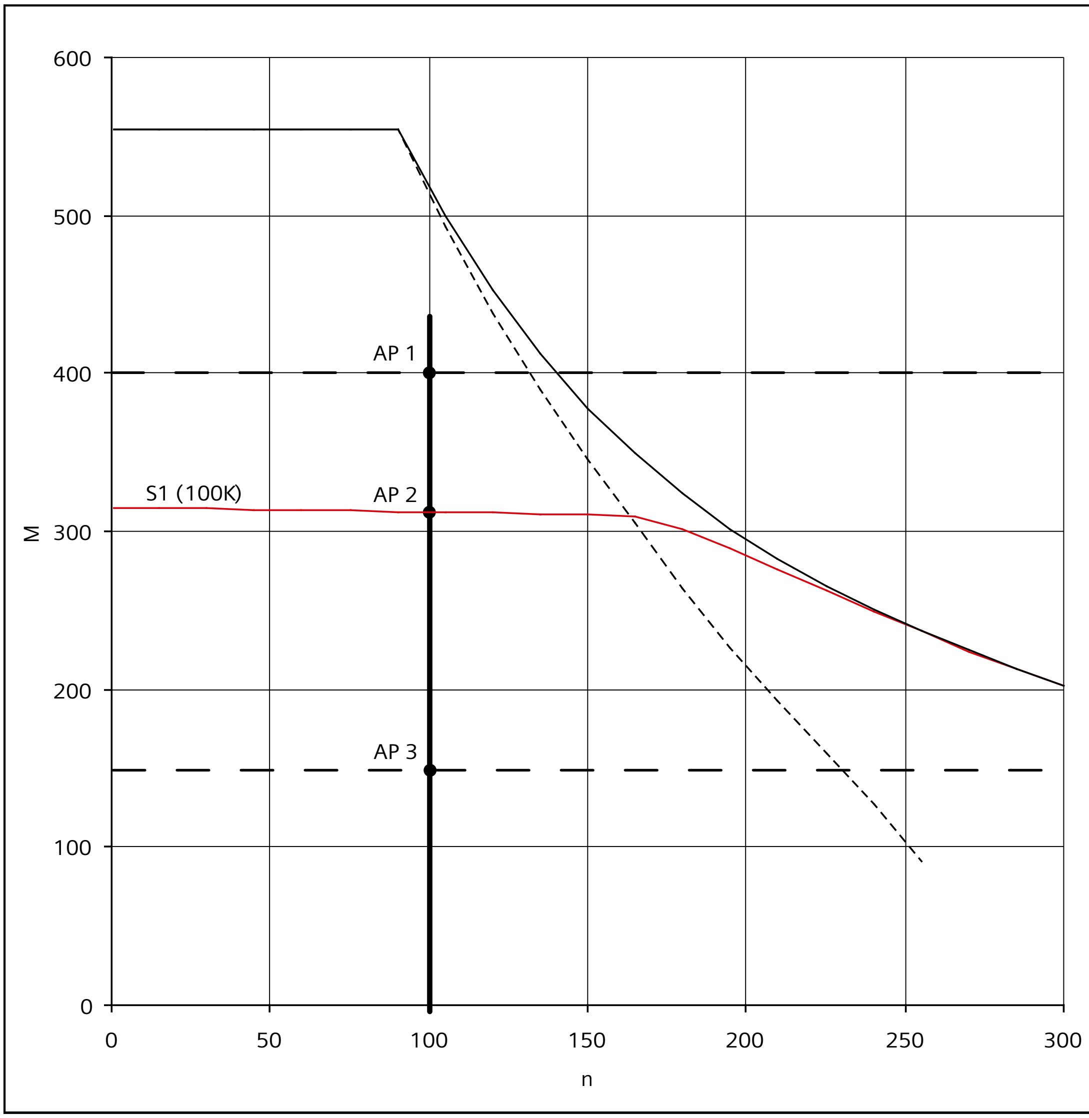
- The dynamic limits must be observed, that is, all speed-torque points of the load must lie below the relevant limiting curve.
- The thermal limits must be observed, that is, in the case of synchronous motors, the RMS motor torque at the medium motor speed resulting from the load duty cycle must lie below the S1 curve (continuous duty).
- In the case of synchronous motors, note that the maximum permissible motor torque is reduced at higher speeds as a result of the voltage limiting curve. A clearance of 10% from the voltage limiting characteristic should also be observed to safeguard against voltage fluctuations.

Load duty cycles with constant on period

For load duty cycles with constant on time, specific requirements are placed on the torque characteristic as a function of the speed
e.g. M = constant, $M \sim n^2$, $M \sim n$ or P = constant.

These drives typically operate at a specific operating point. and are dimensioned for a base load. The base load torque must lie on or below the S1 curve.

In the event of transient overloads (e.g. during acceleration), an overload must be taken into account. For synchronous motors, the peak torque must lie below the voltage limiting characteristic.



SINAMICS ALM 400 V line supply (600 V DC link voltage)

M in Nm; n in r/min

AP 1	Operate for e.g. 1 min
AP 2	Continuous operation (S1) for x h (with water cooling)
AP 3	Continuous operation (S1) for x h (without water cooling)

Figure 5-2 Selecting motors for load examples with constant on time 1FW3201-☐E☐

Note

Free convection must be possible for operation without water cooling.

Load duty cycles with varying on period

As well as continuous duty (S1), standard intermittent duty types (S3) are also defined for load duty cycles with varying on periods. This involves operation that comprises a sequence of similar load cycles, each of which comprises a time with constant load and an off period.

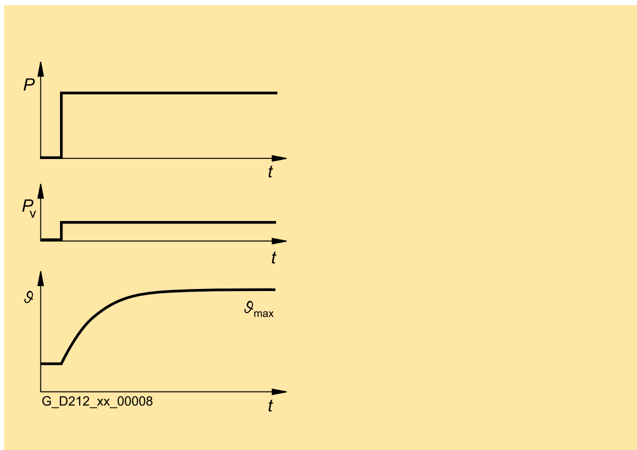


Figure 5-3 S1 duty (continuous operation)

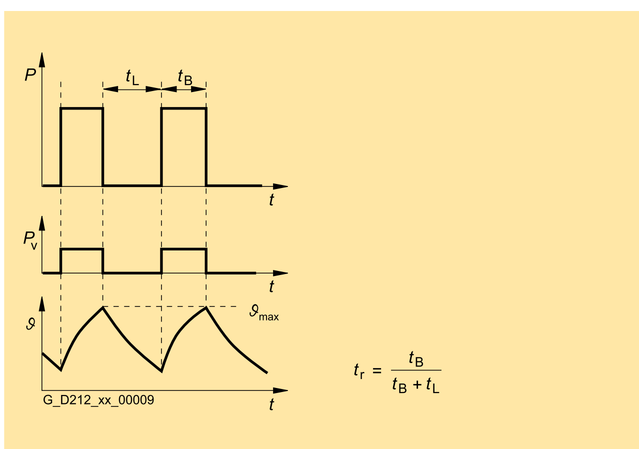


Figure 5-4 S3 duty (intermittent operation without influencing starting)

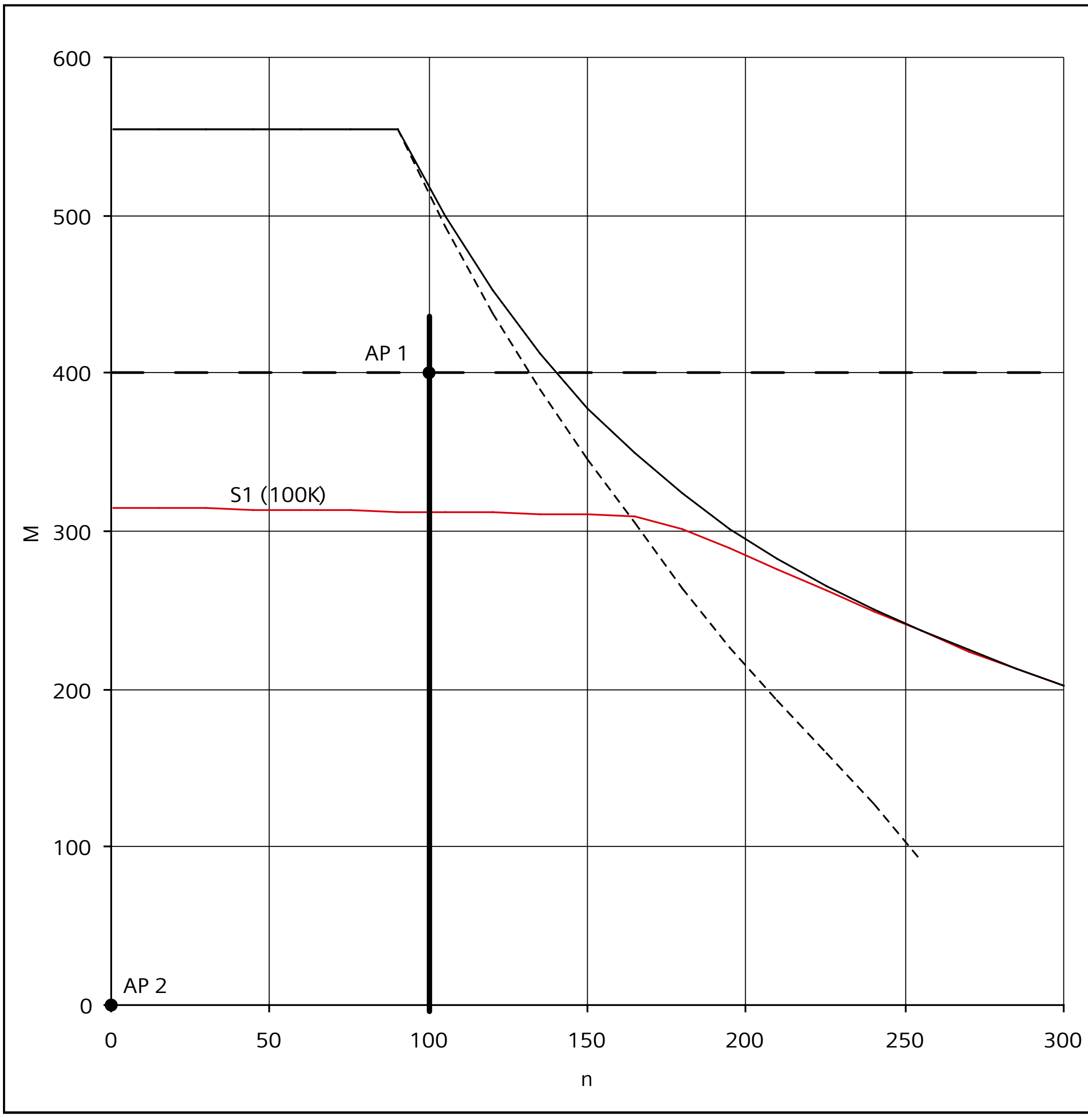
The load torque must lie below the corresponding thermal limiting characteristic of the motor. An overload must be taken into consideration for load duty cycles with varying on times.

Note

For duty cycles in the field weakening range, the TST for SIEMENS Drives engineering tool must be used. The following formulas can be used for duty cycles outside the field weakening range.

$$M_{\text{Mot, rms}} = \sqrt{\frac{\sum M_{\text{Mot, i}}^2 \cdot \Delta t_i}{T}}$$

$$n_{\text{Mot, medium}} = \frac{\sum \frac{n_{\text{Mot, k, A}} + n_{\text{Mot, k, E}}}{2} \cdot \Delta t_i}{T}$$



SINAMICS ALM 400 V line supply (600 V DC link voltage)

M in Nm; n in r/min

AP 1 = 400 Nm at 100 r/min

AP 2 = 0 Nm at 0 r/min

Figure 5-5 Selecting motors for load duty cycles with different on time 1FW3201-☐E☐

Note

A holding torque may be required when the motor is stationary. This holding torque must be taken into consideration for M_{rms}. The reason could be that self-locking gearboxes are not used.

Duty cycle, variable

A load duty cycle defines the characteristics of the motor speed and the torque with respect to time.

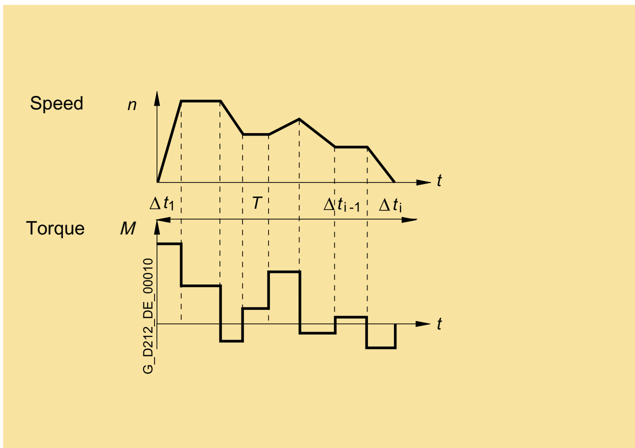


Figure 5-6 Example of a load duty cycle

A load torque is specified for each time period. In addition to the load torque, the medium load moment of inertia and motor moment of inertia must be taken into account for acceleration. It may be necessary to take into account a frictional torque that opposes the direction of motion.

The gear ratio and gear efficiency must be taken into account when calculating the load and/or accelerating torque to be provided by the motor.

Note

For duty cycles in the field weakening range, the TST for SIEMENS Drives engineering tool must be used. The following formulas can be used for duty cycles outside the field weakening range.

For the motor torque in a time slice Δt_i the following applies:

$$M_{Mot,rms} = (J_M + J_G) \cdot \frac{2\pi}{60} \cdot \frac{\Delta n_{load,i}}{\Delta t_i} \cdot i + \left(J_{load} \cdot \frac{2\pi}{60} \cdot \frac{\Delta n_{load,i}}{\Delta t_i} + (M_{load,i} + M_R) \cdot \frac{1}{i \cdot \eta_G}\right)$$

Calculation of the motor speed

$$n_{Mot,i} = n_{load,i} \cdot i$$

Calculating the rms torque

$$M_{Mot,rms} = \sqrt{\frac{\sum M_{Mot,i}^2 \cdot \Delta t_i}{T}}$$

Calculating the medium motor speed

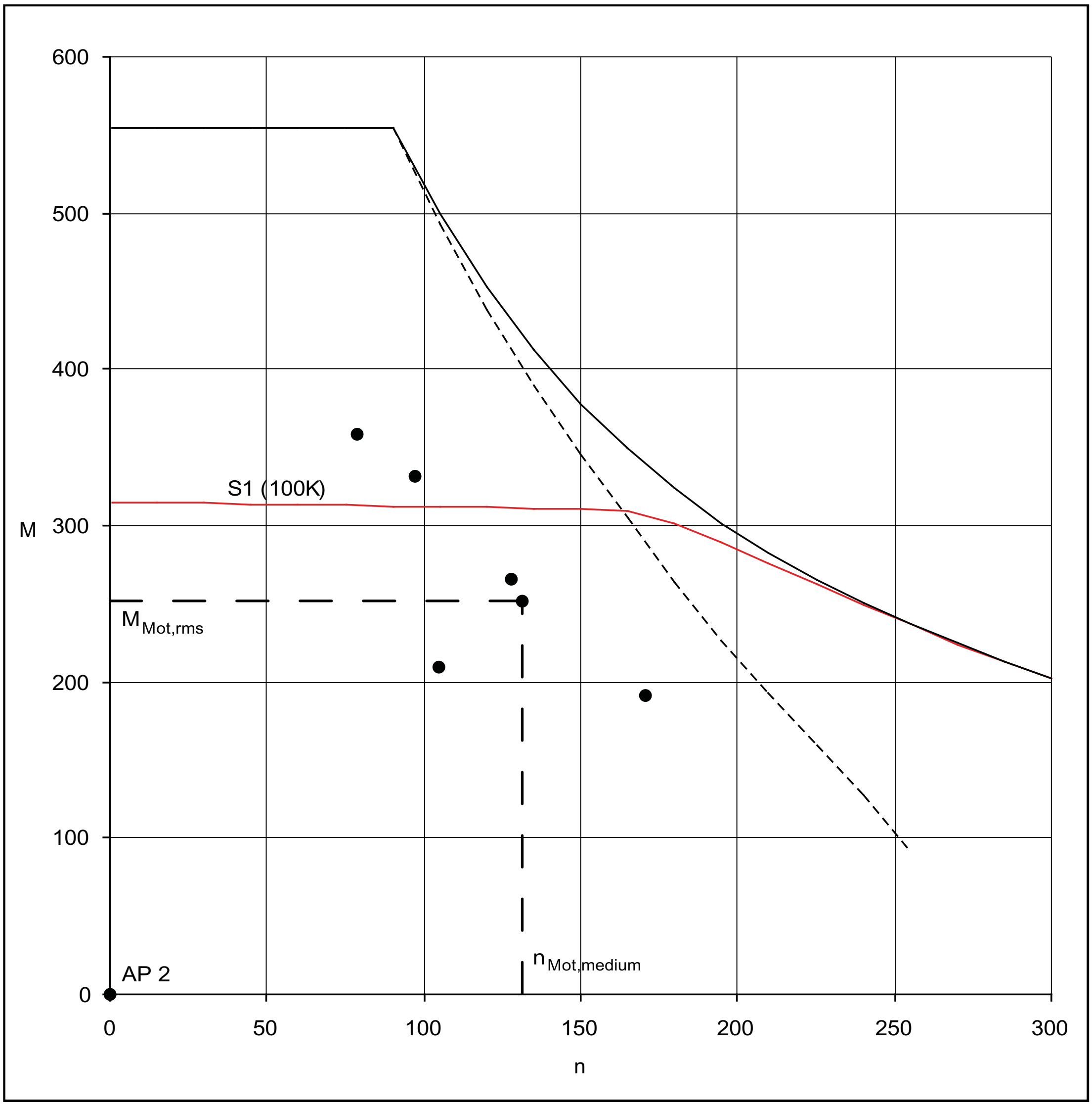
$$n_{Mot,medium} = \frac{\sum \frac{n_{Mot,k,A} + n_{Mot,k,E}}{2} \cdot \Delta t_i}{T}$$

J_M	Motor moment of inertia
J_G	Gearbox moment of inertia
J_{load}	Load moment of inertia
n_{Load}	Load speed
i	Gear ratio
η_G	Gearbox efficiency
M_{load}	Load torque
M_R	Frictional torque
T	Cycle time, clock cycle time
A;E	Initial value, final value in time slice Δt_i
t_e	On period
Δt_i	Time interval

The rms torque $M_{Mot, rms}$ must, for $n_{Mot, medium}$, lie below the S1 curve.

The maximum torque M_{max} is required when the drive is accelerating and for synchronous motors must lie below the voltage limiting curve/M_{max} characteristic.

In summary, the motor is selected as follows:



SINAMICS ALM 400 V line supply (600 V DC link voltage)

M in Nm; n in r/min

Figure 5-7 Selecting motors according to the load duty cycle for motor 1FW3201-☐E☐

Motor selection

By making the appropriate iterations, a motor can now be selected that precisely fulfills the operating conditions and application

In a second step, a check is made as to whether the thermal limits are maintained. To do this, the motor current at the base load must be calculated. When engineering a drive according to the load duty cycle with a constant on period with overload, the overload current based on the required overload torque must be calculated. The calculation rules for this purpose depend on the type of motor used (synchronous motor, induction motor) and the operating scenario (duty cycles with constant or with different switch-on duration).

Finally, the other motor features must be defined This is realized by appropriately configuring the motor options.

5.3 Braking resistors (armature short-circuit braking)

5.3.1 Function description

Function description

For transistor PWM converters, when the DC link voltage values are exceeded or if the electronics fails, then electrical braking is no longer possible. If the drive which is coasting down, can represent a potential hazard, then the motor can be braked by short-circuiting the armature. Armature short-circuit braking should be initiated at the latest by the limit switch in the traversing range of the feed axis.

The friction of the mechanical system and the switching times of the contactors must be taken into account when determining the distance that the feed axis takes to come to a complete stop. In order to avoid mechanical damage, mechanical stops should be located at the end of the absolute traversing range.

For servomotors with integrated holding brake, the holding brake can be simultaneously applied to create an additional braking torque – however, with some delay.

NOTICE

Damage to the converter

If an armature short-circuit contactor is energized or de-energized before the converter pulses are canceled, then the contactor contacts can burn and the converter can be destroyed.

- You must always ensure that the converter pulses are first canceled and this actually implemented.

WARNING

Operational braking not functioning

If the brake is not connected to the setpoint input intended for the purpose, then the brake is not controlled and the motor will not be braked.

- For operational braking, connect the brake via the setpoint input. Observe the information in the converter configuration manual.

For electrical braking using armature short-circuit of the stator, consult the documentation of the drive system being used.

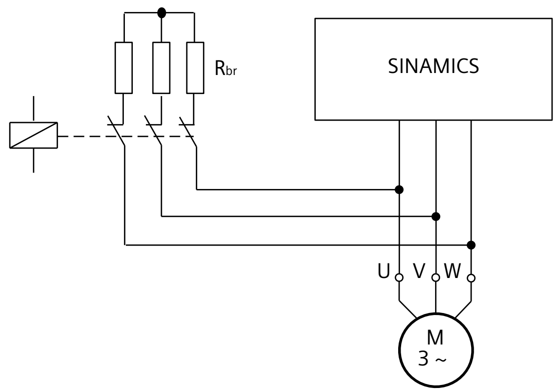


Figure 5-8 Circuit (schematic) with brake resistors

Ordering address

	Frizlen GmbH & Co. KG
	Gottlieb-Daimler-Str. 61, 71711 Murr
	Germany
Phone:	+49 (0) 7144 / 8100 - 0
Fax:	+49 (0) 7144 / 2076 - 30
E-mail:	info@frizlen.com
Internet at:	www.frizlen.com

Note

Other manufacturers

It goes without saying that equivalent products from other manufacturers may be used. Our recommendations should be considered as such. We cannot accept any liability for the quality and properties/features of third-party products.

Rating

The ratings of the resistors must match the particular I^2t load capability. The resistors can be dimensioned so that a surface temperature of 300° C can occur briefly (max. 500 ms). In order to prevent the resistors from being destroyed, braking from the rated speed can occur max. every 2 minutes. Other braking cycles must be specified when ordering the resistors. The external moment of inertia and the intrinsic motor moment of inertia are decisive when dimensioning these resistors.

The kinetic energy must be specified when ordering in order to determine the resistor rating.

$$W = \frac{1}{2} \cdot J \cdot \omega^2$$

$$\omega = \frac{2 \cdot \pi}{60} \cdot n$$

W = Kinetic energy in Ws
J = Moment of inertia in kgm^2
ω = Angular speed in s^{-1}
n = Speed in r/min

Match the ratings of the braking resistors to the ability to withstand I^2t.

Calculating the braking time

Braking time: $t_B = \frac{J_{Tot} \cdot n}{9.55 \cdot M_B}$

Moment of inertia: $J_{Tot} = J_{Mot} + J_{Ext}$

t_B = braking time / s
n = operating speed / r/min
M_B = average braking torque / Nm
J_{Tot} = moment of inertia / kgm^2
J_{Mot} = motor moment of inertia / kgm^2
J_{Ext} = external moment of inertia / kgm^2

Note

When determining the run-on distance, the friction (taken into account as allowance in M_B) of the mechanical transmission elements and the switching delay times of the contactors must be taken into consideration. In order to prevent mechanical damage, mechanical end stops should be provided at the end of the absolute traversing range of the machine axes.

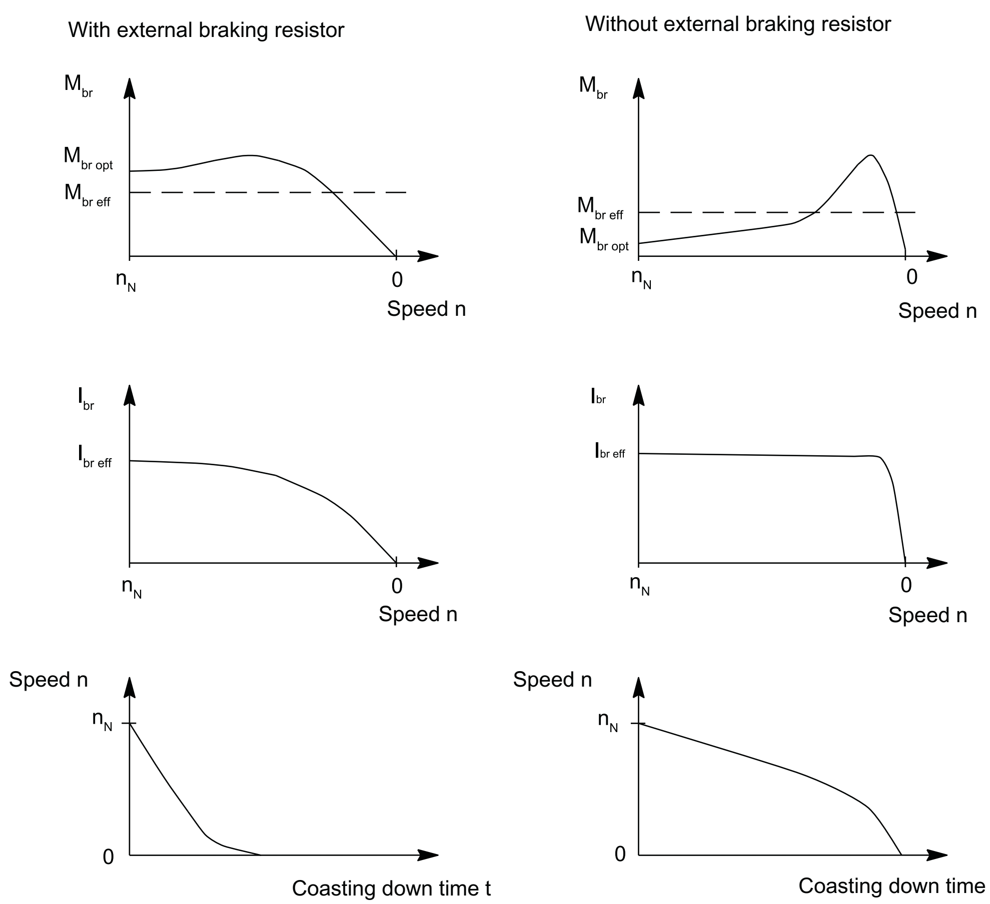


Figure 5-9 Armature short-circuit braking

5.3.2 Dimensioning of braking resistors

The correct dimensioning ensures an optimum braking time. The braking torques which are obtained are also listed in the tables. The data applies for braking from the rated speed. If the motor brakes from another speed, then the braking time **cannot** be linearly reduced. However, longer braking times cannot occur if the speed at the start of braking is less than the rated speed.

The data in the following table is calculated for rated values according to the data sheet. The variance during production as well as iron saturation have not been taken into account here. Higher currents and torques can occur than those calculated as a result of the saturation.

The ratings of the resistors must match the particular I^2t load capability.

Dynamic braking

Table 5-2 Dynamic braking 1FW3, SH 150 Standard

Motor type	External braking resistor R_{opt} / Ω	Average braking torque $M_{br\,av}$ / Nm		Max. braking torque $M_{br\,max}$ / Nm	rms braking current $I_{br\,rms}$ / A	
		without external braking resistor	with external braking resistor		without external braking resistor	with external braking resistor
Standard						
1FW3150-1☐H	11	21.5	32.5	40.5	5.3	4.75
1FW3150-1☐L	8.3	17.8	34.5	42.5	8.6	7.7
1FW3150-1☐P	5.5	14.8	35.5	44.0	13.5	12.1
1FW3152-1☐H	5.0	46.5	75	93	12.2	11.0
1FW3152-1☐L	3.7	37.5	80	99	20.0	17.9
1FW3152-1☐P	2.4	32.0	85	105	32.0	28.5
1FW3154-1☐H	3.3	73	122	151	19.3	17.3
1FW3154-1☐L	2.4	60	130	161	32.0	28.5
1FW3154-1☐P	1.6	50	137	170	51.0	45.0
1FW3155-1☐H	2.3	97	164	205	27.0	24.0
1FW3155-1☐L	1.7	77	173	215	43.5	39.0
1FW3155-1☐P	1.1	66	188	235	71	64.0
1FW3156-1☐H	2.0	119	205	255	32.5	29.5
1FW3156-1☐L	1.4	96	215	270	54	48.0
1FW3156-1☐P	0.97	84	240	295	85	76.0

Table 5-3 Dynamic braking 1FW3, SH 200 Standard and High Speed

Motor type	External braking resistor R_{opt} / Ω	Average braking torque $M_{br\ av}$ / Nm		Max. braking torque $M_{br\ max}$ / Nm	rms braking current $I_{br\ rms}$ / A	
		without external braking resistor	with external braking resistor		without external braking resistor	with external braking resistor
Standard						
1FW3201-1☐E	4.4	76	106	132	10.4	9.4
1FW3201-1☐H	3.2	54	110	136	19.5	17.5
1FW3201-1☐L	2.2	39	109	135	31.5	28.0
1FW3202-1☐E	2.5	133	196	245	19.1	17.3
1FW3202-1☐H	1.8	94	205	255	36.0	32.0
1FW3202-1☐L	1.2	69	205	255	57.0	52.0
1FW3203-1☐E	1.8	192	290	355	27.5	25.0
1FW3203-1☐H	1.0	141	310	390	58.0	52.0
1FW3203-1☐L	0.77	101	310	385	89.0	80
1FW3204-1☐E	1.3	265	410	510	38.5	35.0
1FW3204-1☐H	0.82	200	450	560	78.0	70.0
1FW3204-1☐L	0.57	144	455	560	126	113
1FW3206-1☐E	0.76	400	610	760	62.0	56.0
1FW3206-1☐H	0.54	270	630	780	115	103
1FW3206-1☐L	0.37	215	670	830	190	170
1FW3208-1☐E	0.58	550	850	1060	83	75
1FW3208-1☐H	0.38	395	910	1130	164	147
1FW3208-1☐L	0.31	255	790	980	225	200
High Speed						
1FW3201-3☐P	1.1	118	205	255	70	64
1FW3201-3☐S	0.97	84	195	240	95	86
1FW3202-3☐P	0.67	194	390	485	130	117
1FW3202-3☐S	0.52	151	390	485	186	167
1FW3203-3☐P	0.49	270	570	710	186	166
1FW3203-3☐S	0.36	205	570	710	270	245
1FW3204-3☐P	0.31	365	830	1030	280	255
1FW3204-3☐S	0.22	280	830	1030	425	380
1FW3206-3☐P	0.24	510	1210	1500	395	350
1FW3206-3☐S	0.15	385	1210	1500	620	560
1FW3208-3☐P	0.17	670	1670	2100	550	495
1FW3208-3☐S	0.1	520	1670	2100	880	790

Table 5-4 Dynamic braking 1FW3, SH 280 Standard and High Speed

Motor type	Braking resistor external R_{opt} / Ω	Average braking torque $M_{br\ av}$ / Nm		Max. braking torque $M_{br\ rms}$ / Nm	rms braking current $I_{br\ rms}$ / A	
		without external braking resistor	with external braking resistor		without external braking resistor	with external braking resistor
Standard						
1FW3281-2☐E	0.63	850	1230	1520	94	85
1FW3281-2☐G	0.5	640	1230	1530	148	133
1FW3283-2☐E	0.48	1120	1720	2150	131	118
1FW3283-2☐G	0.37	840	1720	2150	205	184
1FW3285-2☐E	0.36	1520	2450	3050	184	166
1FW3285-2☐G	0.28	1120	2450	3050	285	255
1FW3287-2☐E	0.25	2050	3450	4250	265	235
1FW3287-2☐G	0.19	1500	3450	4300	410	370
High Speed						
1FW3281-3☐J	0.36	480	1230	1530	230	205
1FW3281-3☐M	0.26	360	1220	1520	335	300
1FW3281-3☐P	0.19	300	1240	1540	470	415
1FW3283-3☐J	0.24	620	1710	2150	335	300
1FW3283-3☐M	0.2	460	1710	2100	460	410
1FW3283-3☐P	0.15	385	1740	2150	620	560
1FW3285-3☐J	0.18	830	2450	3050	465	415
1FW3285-3☐M	0.16	630	2500	3100	620	550
1FW3285-3☐P	0.096	495	2450	3000	920	820
1FW3287-3☐J	0.14	1090	3450	4250	610	550
1FW3287-3☐M	0.098	830	3450	4300	930	830
1FW3287-3☐P	0.076	650	3400	4200	1210	1090

5.4 Mounting

5.4.1 Safety notes for mechanical mounting

WARNING

Danger to life from permanent magnet fields

Torque motor rotors are equipped with strong permanent magnets. This is the reason that when the motors are open there are **strong magnetic fields** and **high magnetic forces of attraction**. The permanent magnets in the motors represents a danger for people with active medical implants, who come close to the motors. This is also the case when the motor is switched off. Examples of active implants include: Heart pacemakers, metal implants, insulin pumps. Further, people that have magnetic or electrically conductive implants are at risk.

- If you are such a person (with heart pacemaker or implant) then keep a minimum distance of 300 mm from an opened motor.

WARNING

Danger to life when incorrectly mounting the motor

If you incorrectly mount the motor then there is a risk of severe injury and material damage.

- Only carry out mounting and maintenance work at the motor if you are appropriately qualified to do so.
- Only work on the motor when the plant/system is in a no-voltage condition.
- Use the cable slings provided when transporting the motors.
- Thoroughly clean the connection flange of corrosion protection agent. Use commercially available solvents to do this.
- Rotate the output elements by hand. Remove the cause of possible grinding noise or contact the manufacturer.
- Use only spare parts approved by the manufacturer.
- Ensure that the conditions at the installation site match the permissible ambient conditions (e.g. temperature, installation altitude).
- It is forbidden to use motors in hazardous zones unless they are explicitly designed for these zones.

WARNING

Danger to life due to electric shock

As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock.

- Do not touch the cable ports.
- Connect the motor cable ports correctly, or insulate them properly.

NOTICE
Thermal damage to temperature-sensitive parts
The motors can have surface temperatures of over +100° C. Temperature-sensitive parts in contact with the motor or attached to the motor can be damaged. Temperature-sensitive parts include cables and electronic components, for example. • Never attach temperature-sensitive parts to the motor. • Ensure that no temperature-sensitive parts are in contact with the motor.

NOTICE
Data loss due to strong magnetic fields
If you are located close to the rotor, any magnetic or electronic data storage media as well as electronic devices that you might be carrying could be damaged. • Do not wear or carry any magnetic or electronic data storage media (e.g. credit cards, USB sticks, floppy disks) and no electronic devices (e.g. watches) if you are close to a rotor!

5.4.2 Overview of the mounting options

Torque motors are generally used as direct drives, i.e. without any intermediate gearbox or belt.

You can see the principle difference between mounting motors for conventional drives and for direct drives in the following diagram.

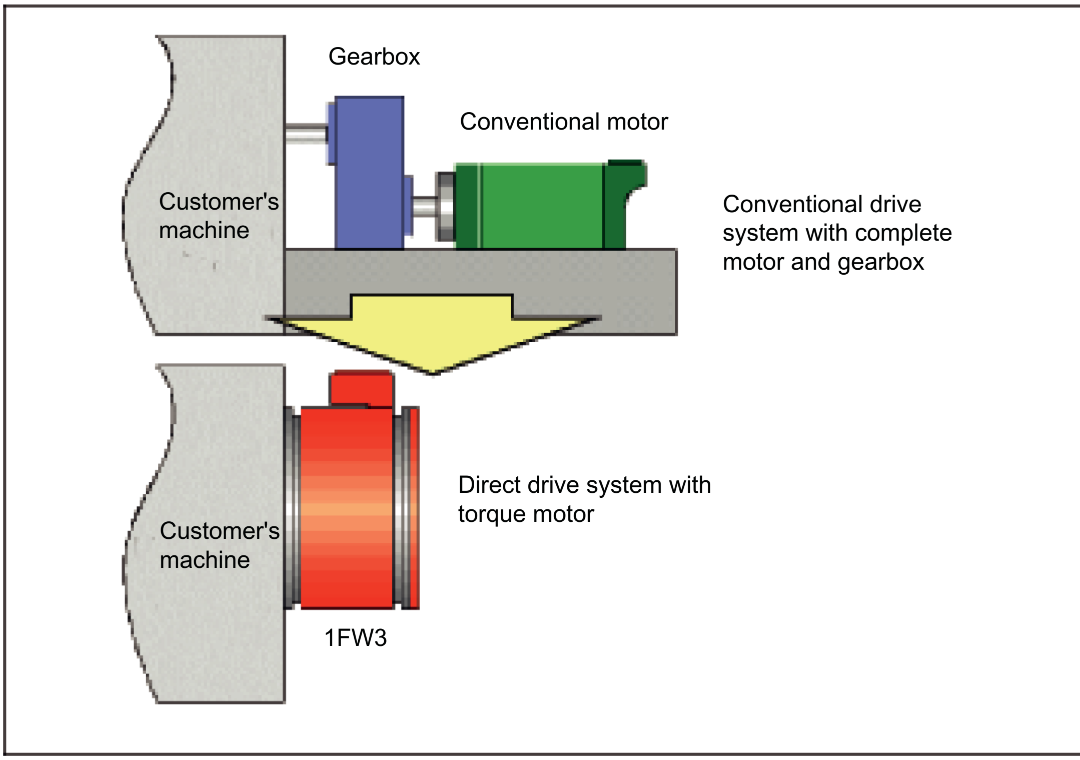


Figure 5-10 Comparison between conventional and direct drive systems

The torque motors are complete motors equipped with deep-groove ball bearings.

NOTICE

Motor bearing damage caused by overdetermined shaft bearings

An overdetermined bearing system can result in immediate bearing damage or significantly reduce the bearing change interval.

- Comply with the maximum permissible radial and axial forces.
- Mount the motor so that the bearing system is not overdetermined by the machine bearings on the customer side.

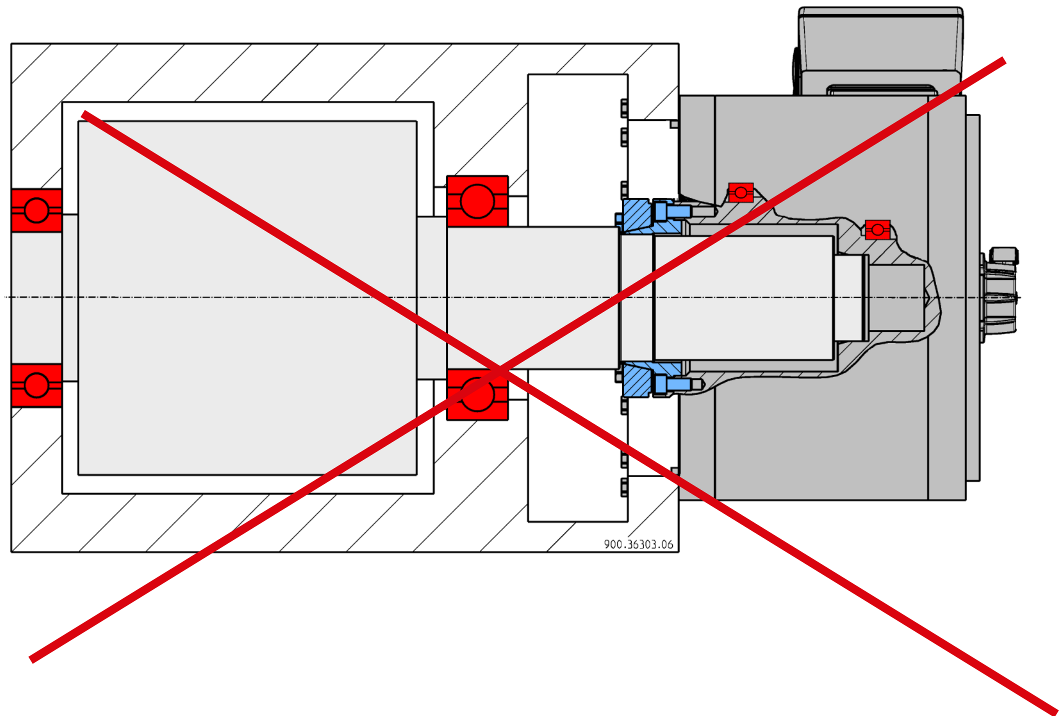
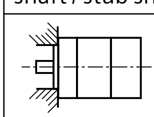
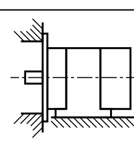
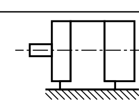
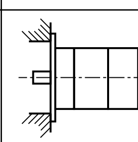
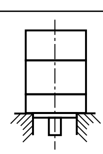
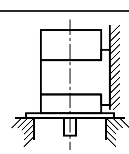
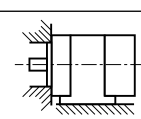
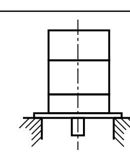
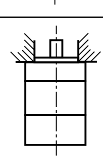
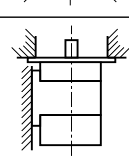
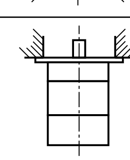


Figure 5-11 Overdetermined bearing of a shaft

Mounting the motor frame to the machine on the customer's side

You can mount the motor enclosure of the complete 1FW3 torque motor to the customer's machine corresponding to the following table:

Table 5-5 Types of construction

Type of construction	Designation	Type of construction	Designation	Type of construction	Designation	Type of construction	Designation
1FW315☐ / 1FW320☐ with hollow shaft, plug-on shaft / stub shaft or solid shaft		1FW328☐ with hollow shaft / stub shaft		1FW328☐ with solid shaft / stub shaft		1FW320☐-☐☐☐☐5 / 1FW328☐-☐☐☐☐5 with stub shaft (Z option L03)	
	IM B14		IM B35		IM B3		IM B5
	IM V18		IM V15		IM B34		IM V1
	IM V19		IM V35	-	-		IM V3

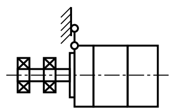
Type of construction	Designation	Type of construction	Designation	Type of construction	Designation	Type of construction	Designation
1FW315 / 1FW320 / 1FW328 with plug-on shaft							
			Plug-on mounting with torque arm (not standardized)				

Table 5-6 Mounting the motor frame via flange assembly

Shaft height	Type of construction	Holes at the DE housing flange	Pitch circle diameter
150	IM B14, IM V18/19	12 x M10	295 mm
200	IM B14, IM V18/19	16 x M10	380 mm
200	IM B5, IM V1/3 (with Z option L03)	16 x Ø 13 mm	500 mm
280	IM B35, IM V15/35	24 x Ø 13 mm	532 mm
280	IM B5, IM V1/3	24 x Ø 13 mm	532 mm
280	IM B5, IM V1/3 (with Z option L03)	24 x Ø 17.5 mm	650 mm
280	IM B34	8 x M20	525 mm

Connecting the rotor to the drive shaft

You can connect the rotor of the 1FW3 motor to the customer drive shaft either using a flange or a clamping element:

Shaft height	Threaded hole at the rotor DE (face side)	Tensioning elements in the inner diameter of the rotor
150	12 x M12, 24 mm deep, pitch circle diameter Ø 170 mm	Inside diameter, 153 mm H7
200	12 x M12, 24 mm deep, pitch circle diameter Ø 170 mm	Inside diameter, 153 mm H7
280	24 x M16, 34 mm deep, pitch circle diameter Ø 280 mm	Inside diameter 250 mm H7

Note

Maintain the permissible clamping ranges.

Maintain the permissible surface pressure.

Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation include:

- A stable foundation design
- Precise motor alignment.

Comply with the following mounting instructions:

- Ensure a stiff mounting design, especially when flange mounting high-speed motors. As a consequence, you shift the natural mounting frequency above the maximum rotational frequency.
- Align the motors using shims under the mounting feet. This avoids deforming/distorting the motor. Use the fewest possible shims.
- To securely fix the motor and transfer the drive torque, use bolts with property class 8.8.

5.4.3 Plug-on installation

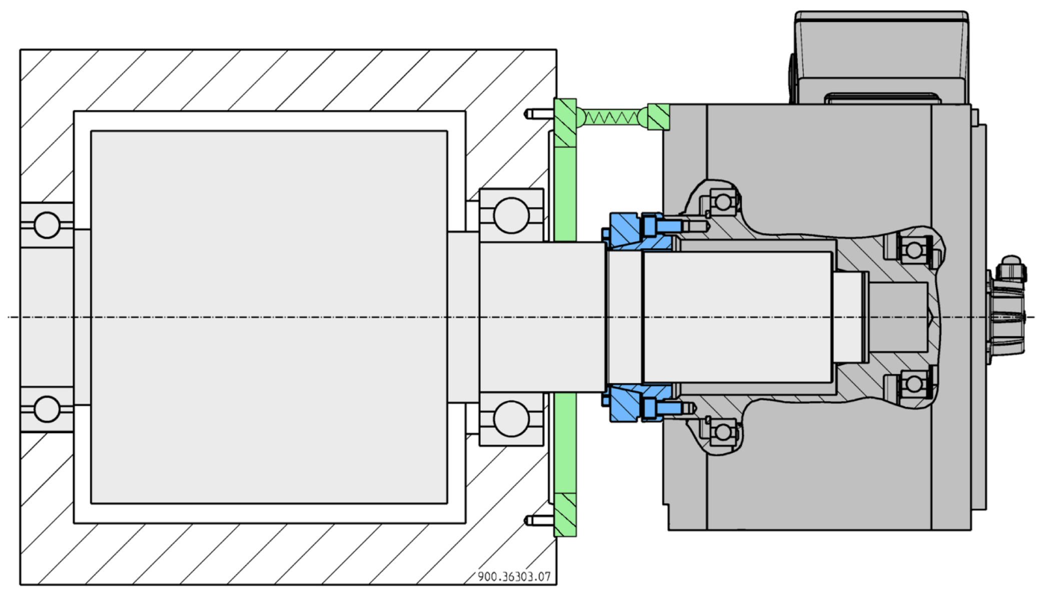


Figure 5-12 Decoupling the stator from the machine base using a torque arm (schematic representation)

For shaft mounting, the motor weight is solely carried by the shaft extension of the driven machine.

The mounting to the motor frame cannot accept any cantilever forces and therefore does not support the motor.

- Adequately dimension the shaft extension and the machine bearings.

The natural bending frequency can be shifted as a result of the lower stiffness of the mounting to the motor frame.

- Avoid operating with a rotational frequency in the range of the natural bending frequency.

5.4.3.1 Siemens torque arm

Option T32

In Chapter "Overview of the mounting options (Page 112)", it explains that it is not permissible that the customer's machine bearings overdetermine the bearing of a shaft.

One possible solution is the Siemens torque arm.

Advantage: Torque arms ensure a torsionally-rigid motor connection in a radial direction and balance axial tolerances and misalignments. This reduces the bearing load. A bearing service life of up to 60,000 h (with the exclusion of 1FW328) can be achieved for motors with regreasing irrespective of the radial force diagram.

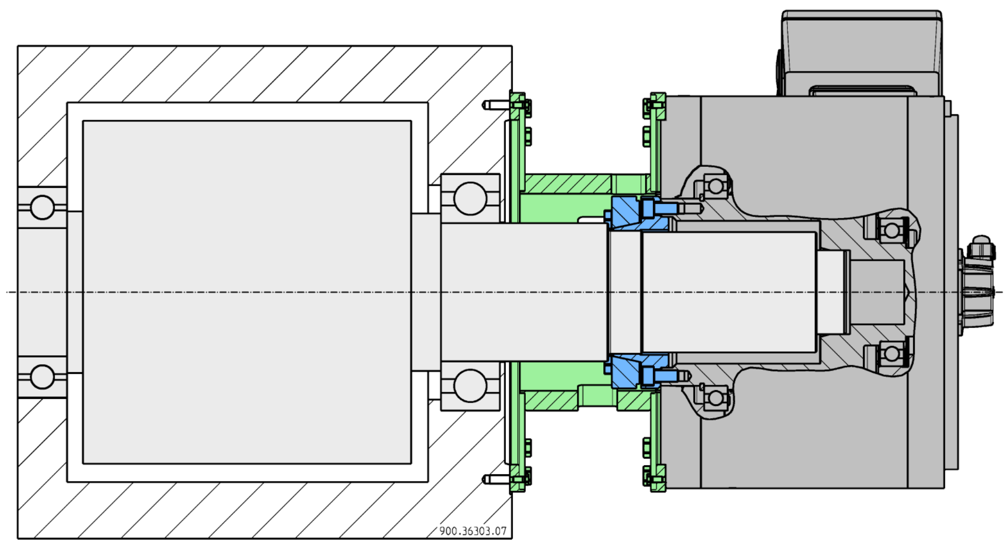


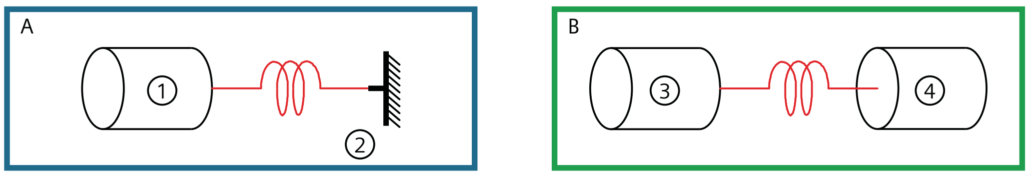
Figure 5-13 Schematic representation of the Siemens torque arm

- When designing the mounting assembly you must ensure that a possible (thermal) expansion of the shaft extension remains in a range less than 0.1 mm.
- Before mounting, the motor must only be stored prisms. This rules out that the mounting flange of the Siemens torque arm is subject to inadmissibly high cantilever forces.
- The motor can be vertically mounted when using Siemens torque arms. When attaching the torque arms it must be ensured that there is no axial deformation or distortion.

Regarding this, refer to Chapter "Bearing change intervals (Page 70)".

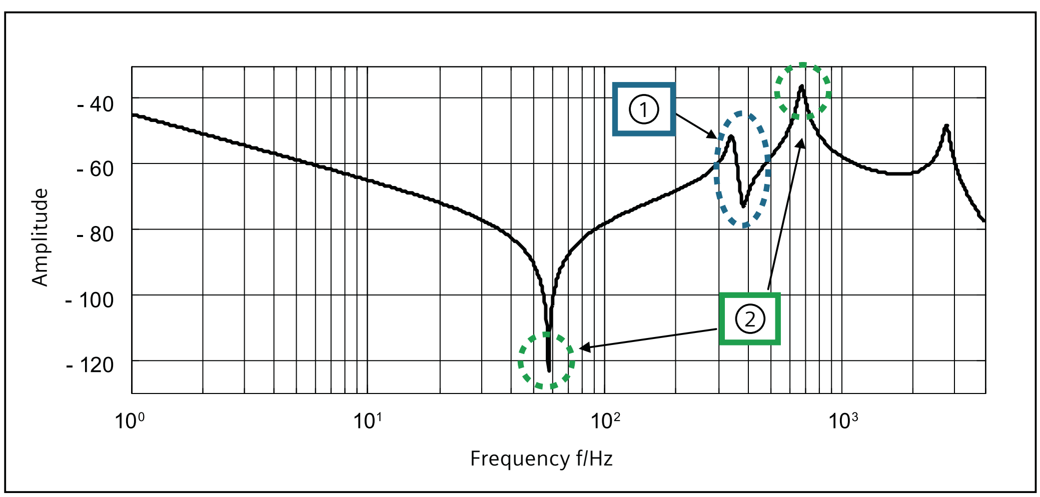
Influence of the torque arm on the speed control loop

By connecting the stator through a flexible element, with respect to the machine foundation, the stator represents an additional system that can oscillate (see Fig A), in addition to the two-mass system comprising the load and rotor (see Fig. B).



① Stator
② Machine bed
③ Load
④ Rotor

The influence of the Siemens torque arm is shown qualitatively in the following diagram. The two-mass oscillating system comprising motor and load still dominates the system response; however, coupling the stator through the Siemens torque arm is manifested in the form of additional resonance effects, which must be dampened by the closed-loop control.



① Mass oscillating system, stator - machine bed (Fig. A)
② Mass oscillating system, load - rotor (Fig. B)

Figure 5-14 Speed control loop – influence of the Siemens torque arm

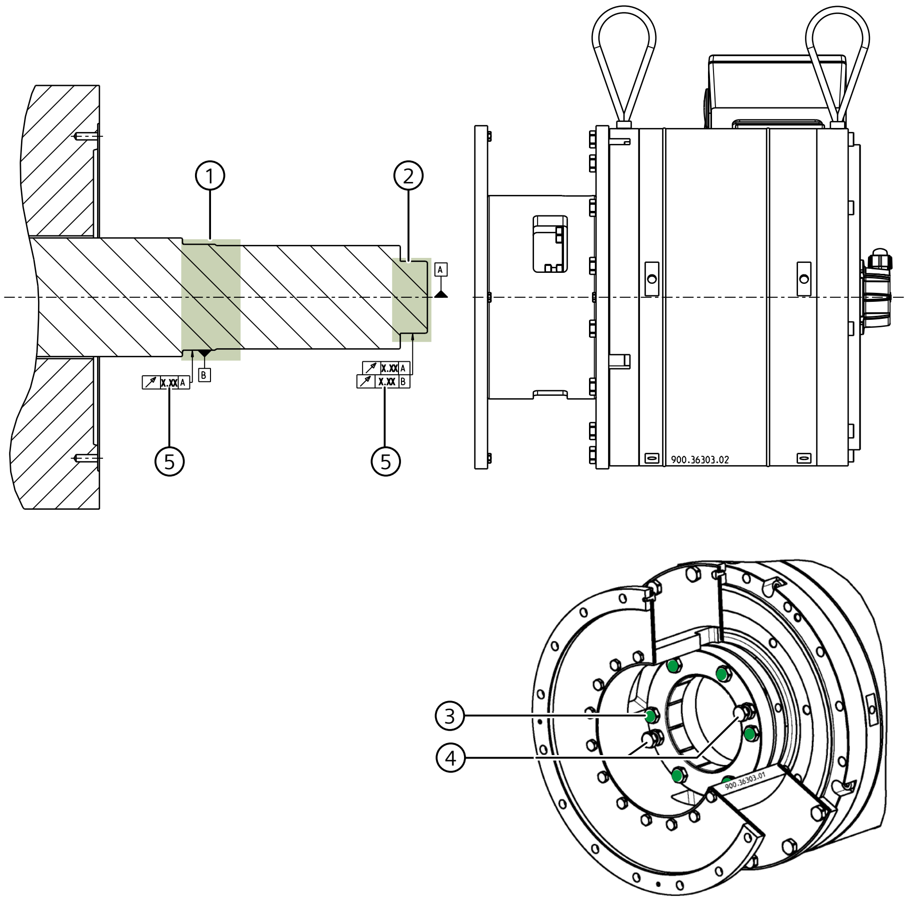
Table 5-7 Resonant frequency, stator coupling

Motor	Resonant frequency to be expected / Hz	Note
1FW315☐		Depending on the particular application, the resonant frequency can be up to 20% higher.
1FW3150	650	
1FW3151	624	
1FW3152	583	
1FW3153	562	
1FW3154	537	
1FW3155	498	
1FW3156	464	
1FW320☐		
1FW3201	340	
1FW3202	310	
1FW3203	290	
1FW3204	260	
1FW3206	240	
1FW3208	220	
1FW328☐		
1FW3281	183	
1FW3283	172	
1FW3285	159	
1FW3287	145	

Mounting sequence, Siemens torque arm with clamping element

Procedure

1. Check the rotor and prepare the shaft seat:



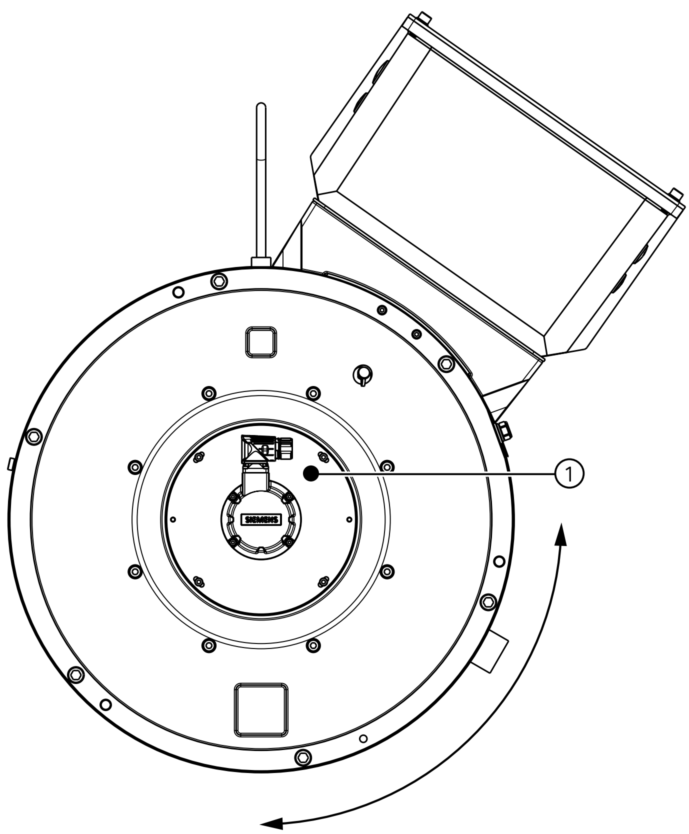
1	Clamping seat: must be free of any lubricant
2	Centering seat: Apply assembly paste, e.g. Molykot
3	Clamping screws (all of the screws shown in green in this diagram)
4	Forcing-off screws: Remain for removal, tightened as when originally delivered
5	The values are in the dimension drawings in this chapter

Figure 5-15 As delivered state and preparations for mounting

2. Axially slide the motor onto the customer's flange:

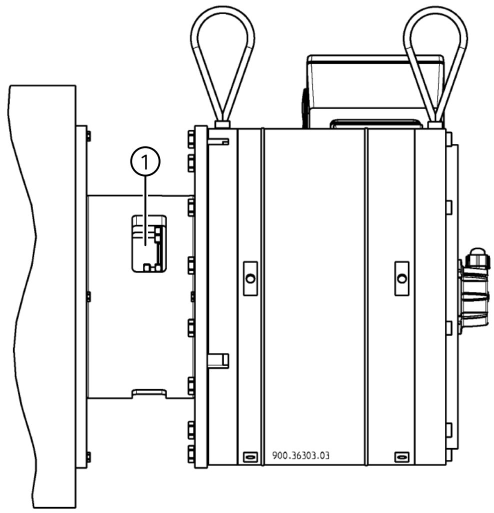
- The motor is slid onto the shaft extension and is in the correct axial position when the torque arm is located on the machine-side flange. The motor is **not** axially positioned on the shaft side.
- Tighten the clamping screws of the ring clamping element according to the mounting instructions "Mounting sequence, clamping elements, option +Q30" in Chapter "Shaft-side clamping element (Page 127)".
- You can rotate the motor using the shaft extension so that you can easily access the screws.

WARNING
Risk of injury caused by the motor falling
The motor center gravity is outside the motor axis.
• While it is being mounted, ensure that the motor cannot unintentionally drop.



1 Center of gravity outside the motor axis

Figure 5-16 Center of gravity

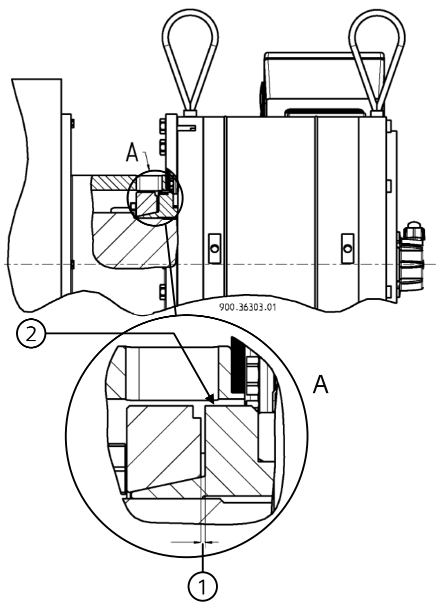


1 3 window to tighten the screws

Figure 5-17 Pre-mounting

3. Check the gap in the clamping element, and if required, measure the motor alignment (run out):

- The gap between the two clamping element parts must be able to be identified around the complete circumference.
- In order to achieve a higher smooth running quality, you can check the alignment of the motor to the machine at the surface shown. If the deviation is too high, then alignment is possible by tightening the clamping screws.
- For further information on checking, see the mounting instructions "Mounting sequence, clamping elements of option +Q30" in Chapter "Shaft-side clamping element (Page 127)".



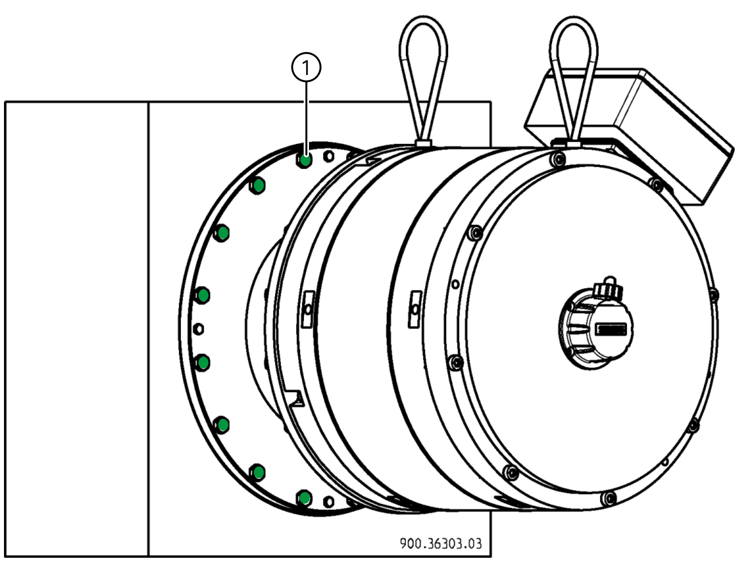
1 Gap

2 Measurement with respect to the machine axis when rotating

Figure 5-18 Check

4. Mounting the Siemens torque arm:

After successfully carrying out steps 1 – 3, screw the Siemens torque arm to the machine.



1 Mounting screws (all of the screws shown in green in this diagram)

Figure 5-19 Final mounting

The motor has been mounted.

❒

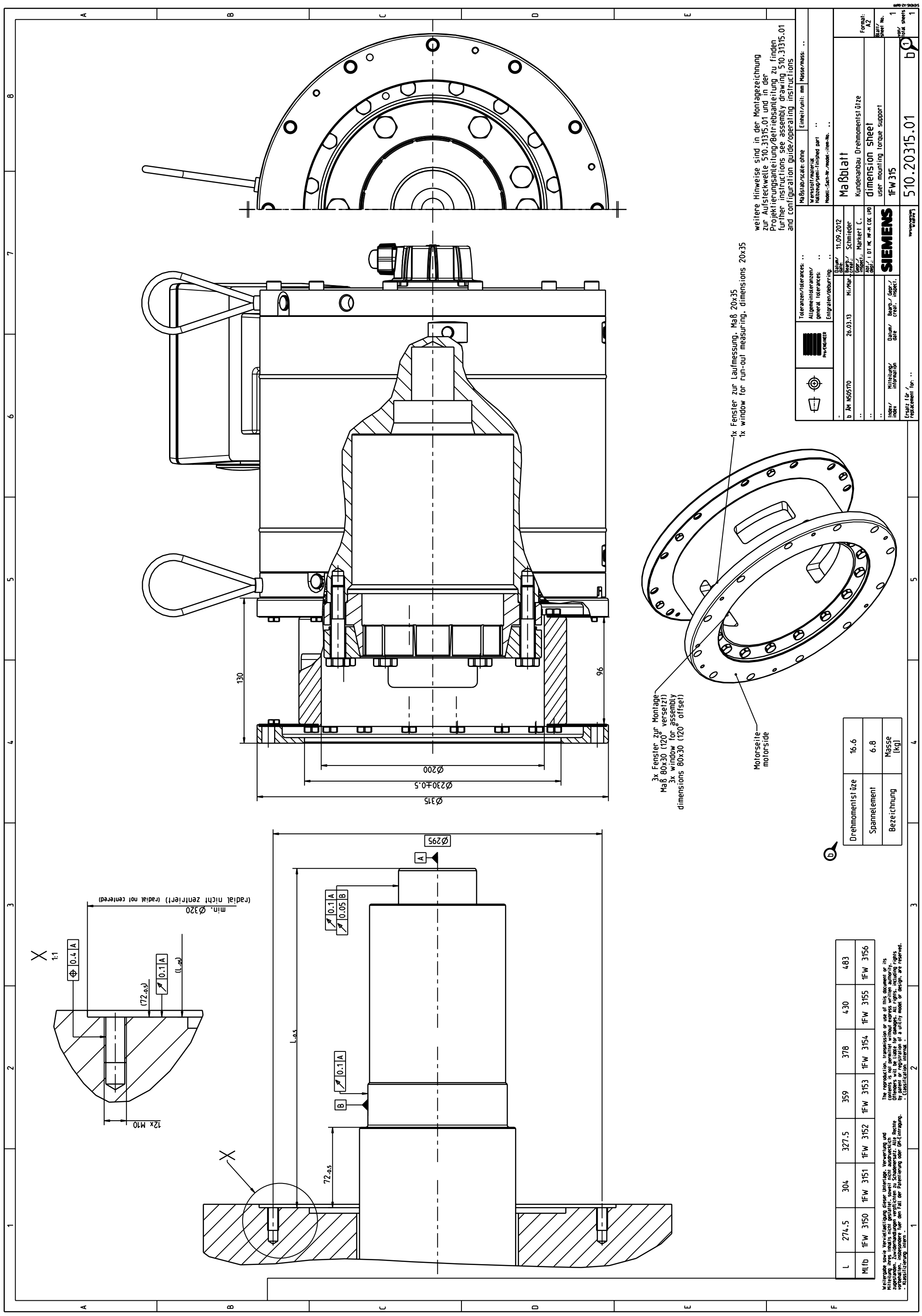


Figure 5-20 1FW3150 Siemens torque arm, dimension drawing 510.20315.01

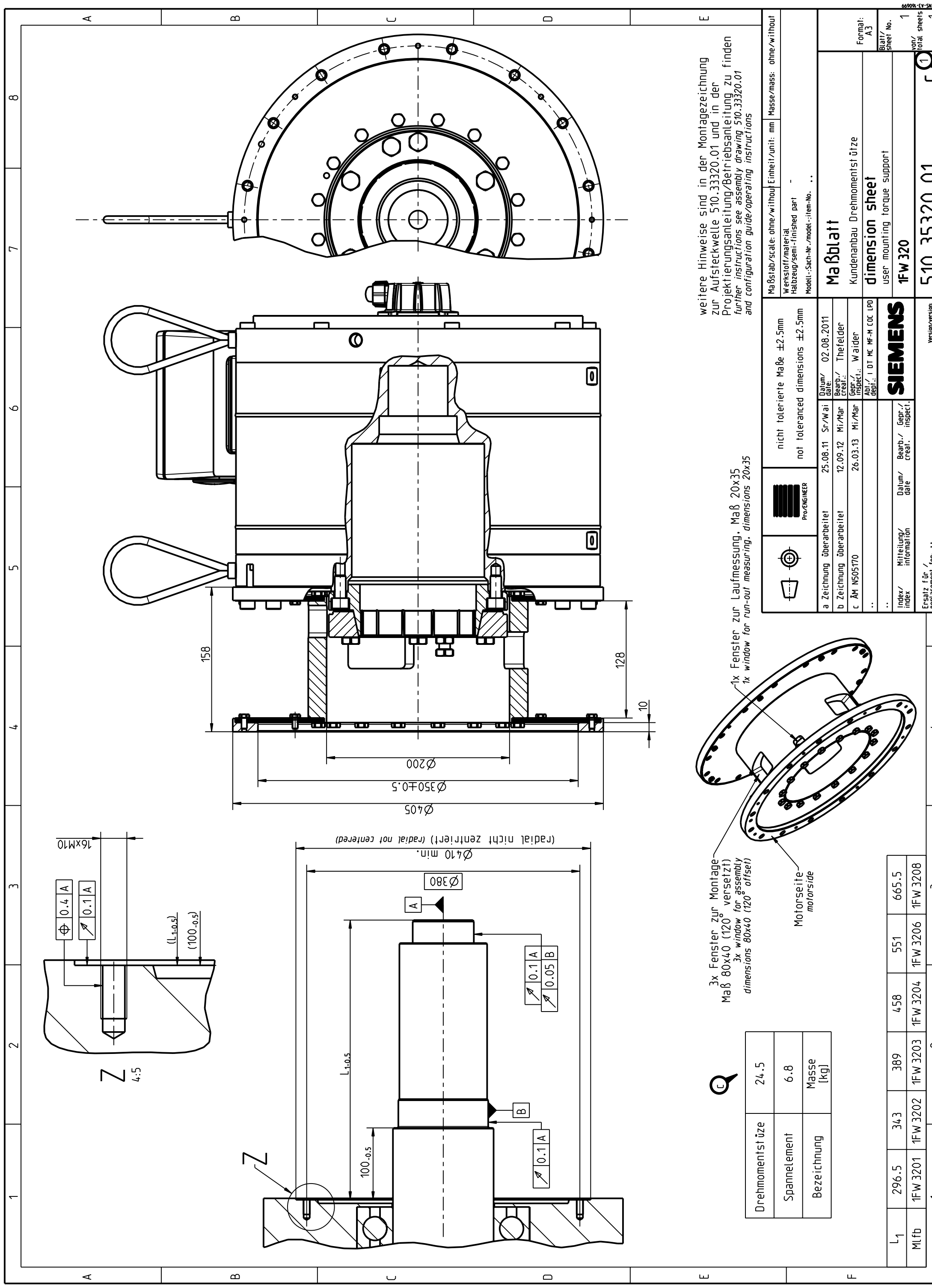


Figure 5-21 1FW320 Siemens torque arm, dimension drawing 510.35320.01

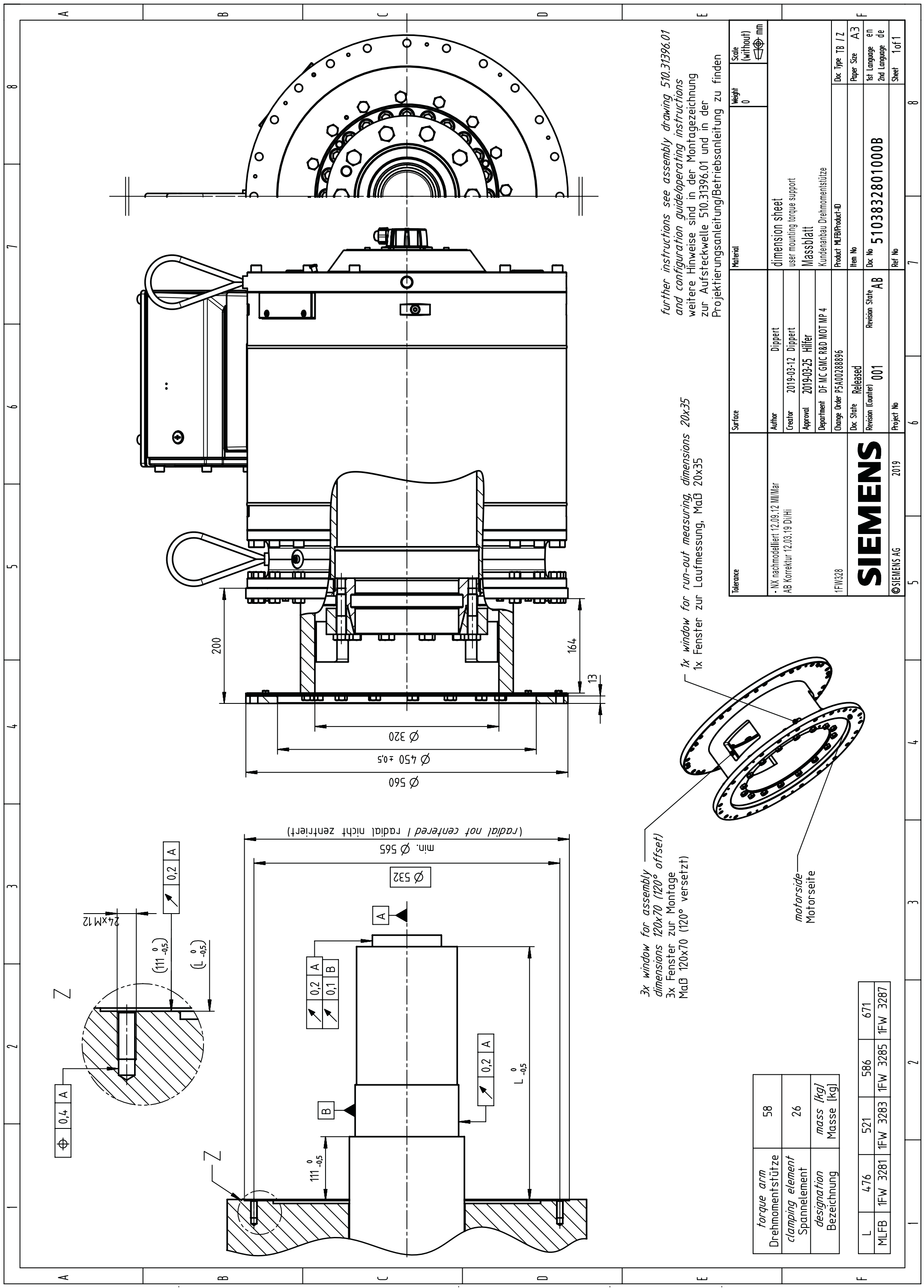


Figure 5-22 1FW328 Siemens torque arm, dimension drawing 510.38328.01

5.4.3.2 Shaft-side clamping element

Various mounting options using clamping elements are shown in this Chapter.

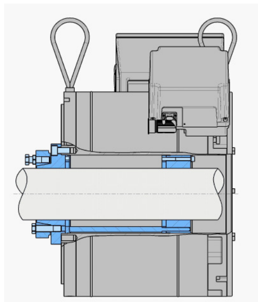
Note

The stub shaft is not intended for shaft-mounted design.

Siemens AG in cooperation with RINGSPANN GmbH has developed various clamping system solutions to ensure secure, friction-locked connection of torque motors to cylindrical machine shafts - with the following objectives.

- Safely and reliably transmitting the torque
- Precisely centering the torque motor on the machine shaft
- Avoid inadmissible deformation to the torque motor components
- No distortion caused by different temperature changes in the torque motor and in the machine shaft
- Simple mounting
- Simple removal, even after longer periods of operation

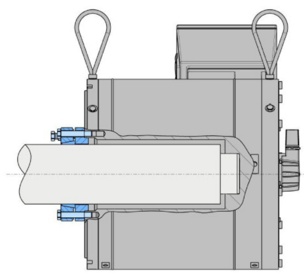
Mounting using suitable clamping elements is explained in the following.



Hollow shaft with option, clamping element and centering part

1FW315□-□□□□□-□□A□ + Q30
1FW320□-□□□□□-□□A□ + Q30

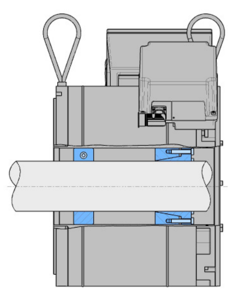
You can find details in Chapter "Hollow shaft with option +Q30 (Page 135)"



Plug-on shaft with clamping element

1FW3□□□-□□□□□-□□S□ + Q30

You can find details in Chapter "Plug-on shaft with option +Q30 (Page 131)"

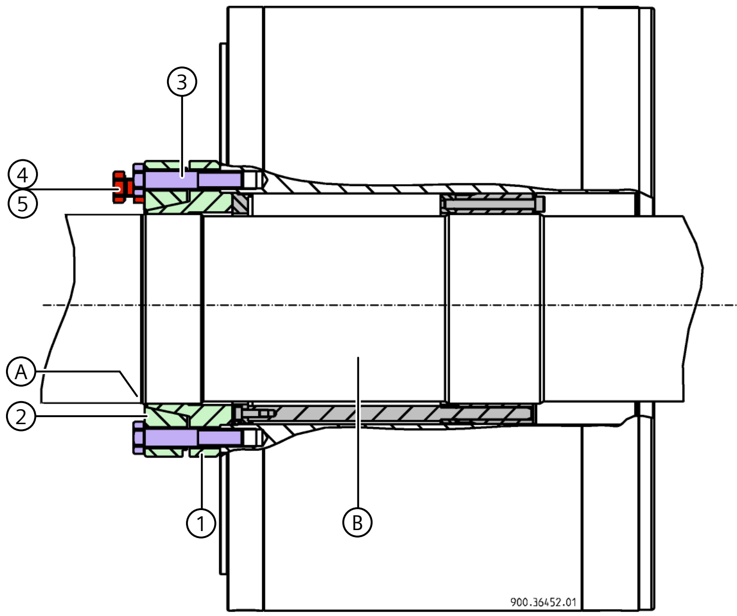


Hollow shaft with inner clamping element from the Ringspann company

1FW315□-□□□□□-□□C□
1FW320□-□□□□□-□□C□

You can find details in Chapter "Hollow shaft, inner clamping element (Page 137)"

Mounting the clamping elements of option +Q30



A Shaft shoulder	2 Tapered ring	B Shaft journal	5 Lock nut
1 Tapered sleeve	3 Clamping screw	4 Forcing-off screw	

Procedure

1. Using the clamping element (possibly with centering sleeve), mount the motor at the intended position on the shaft extension.
2. Using screws (3) clamp the tapered ring (2) onto the tapered sleeve (1). Initially tighten all screws diagonally so that they are hand tight (5 to 8 Nm).
3. Then tighten all of the screws (3) diagonally using a torque wrench. When doing this, the screw may only be tightened through a maximum of ¼ of a turn. Repeat this operation until all of the the screws are tightened with the specified torque using a torque wrench. When doing this, comply with the specified torques. Then check that the motor runs true.

Shaft height	150	200	280
Torque / Nm	127	127	210

4. Then check the gap between the tapered sleeve (1) and tapered ring (2) and between the tapered sleeve (1) and the forcing-off screws (4). There must be a minimum gap of 0.1 mm around the complete circumference. If this minimum gap does not exist, then there is a risk that the clamping element will not fulfill its function (excessively low joint interference and therefore inadequate torque transmission).
   Causes could be for hollow shaft extension:
   - excessively low wall thickness, or
   - excessively low diameter of the clamping seat

The clamping elements have been mounted.

❒

Options to optimize the smooth running characteristics of the mounting

You can check that the system runs true during procedures 2 and 3. You align the motor by specifically tightening the screws (3). If the clamping screw (3) is over-proportionally tightened, then at this position the motor is lifted off from the shaft extension.

If, after tightening to the final torque, the true running check indicates an excessively high deviation, then release all of the clamping screws (3) and repeat tightening procedures 2 and 3 - checking the true running and tightening the clamping screws as required (3).

Removing

Procedure

If, when removing the clamping element, after removing the clamping screws (3) the tapered ring (2) cannot be released, then proceed as follows:

1. Release the lock nut (5) and turn this until it comes into contact with the head of the forcing-off screw (4).
2. Rotate the forcing-off screws (4) in the tapered ring (2) until they are in contact with the tapered sleeve (1).
3. Screw in the forcing-off screws (4) one after the another through ¼ of a turn until the tapered ring is released.

The tapered ring has been released.

❒

If the motor cannot be released from the shaft extension, for an appropriate shaft extension design, use the forcing-off screws to press the tapered ring until it comes into contact with the shaft shoulder. The motor is pressed from the shaft extension by turning the forcing-off screws further (4).

When reusing the clamping element, turn the forcing-off screws back and secure them using the lock nuts (5).

When certain requirements exist, e.g.

- different diameter
- restricted mounting space
- thermal insulation
- electrical isolation

regarding the shaft-side connection of the motor, RINGSPANN GmbH can provide support when selecting a suitable clamping system for your particular application. Contact:

RINGSPANN GmbH	Phone +49 (0) 6172 275 0
Schaberberg 30-34	Internet: http://www.ringspann.de
D-61348 Bad Homburg	

Plug-on shaft with option +Q30

Available for motors 1FW315☐, 1FW320☐ and 1FW328☐ with plug-on shaft (15th position in the Article No. = S)

Support at the DE with the seat integrated in order to facilitate centered mounting.

When the shaft journal is implemented according to dimension drawings 510.31315.01/510.33320.01/510.31396.01, then it is also possible to disassemble using forcing-off screws.

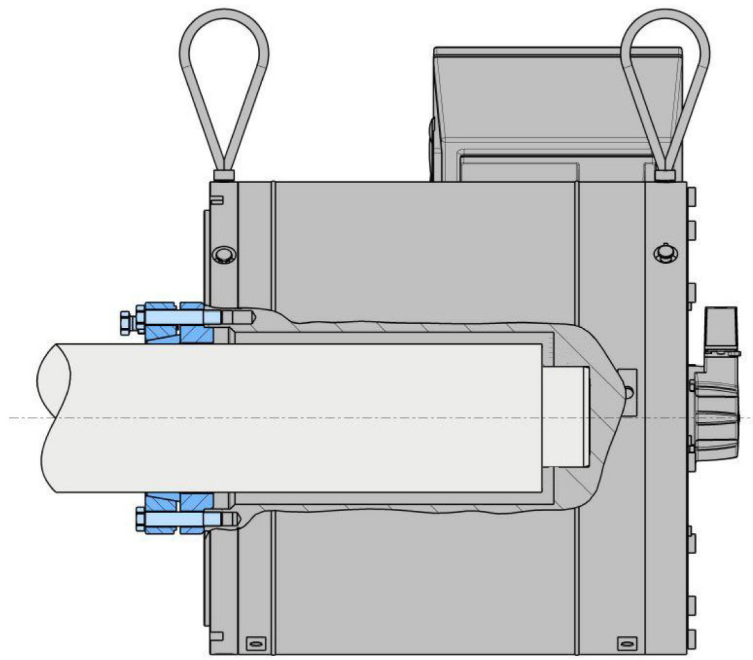


Figure 5-23 Plug-on shaft clamping element

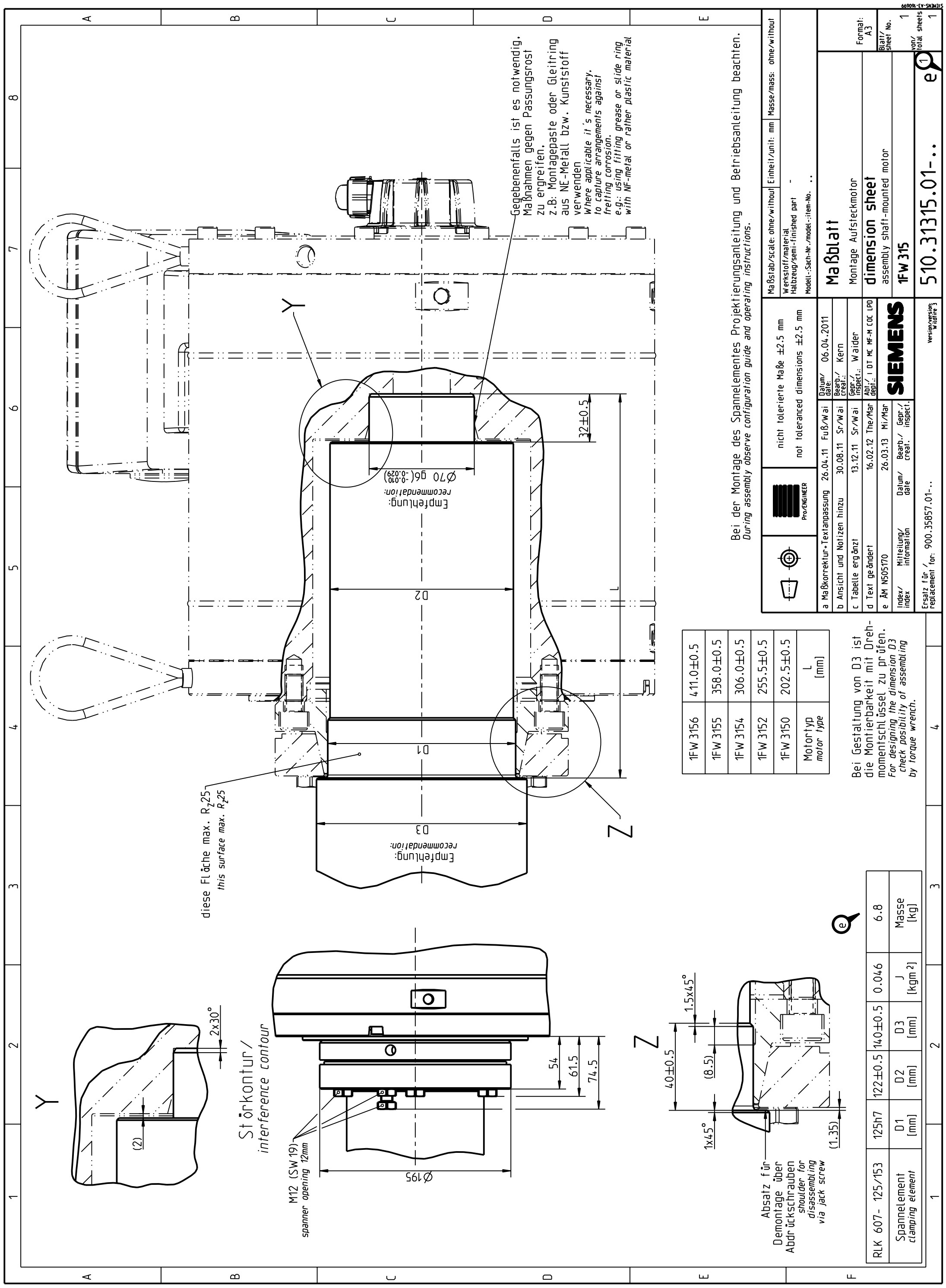


Figure 5-24 Dimension drawing, mounting plug-on motor 1FW315

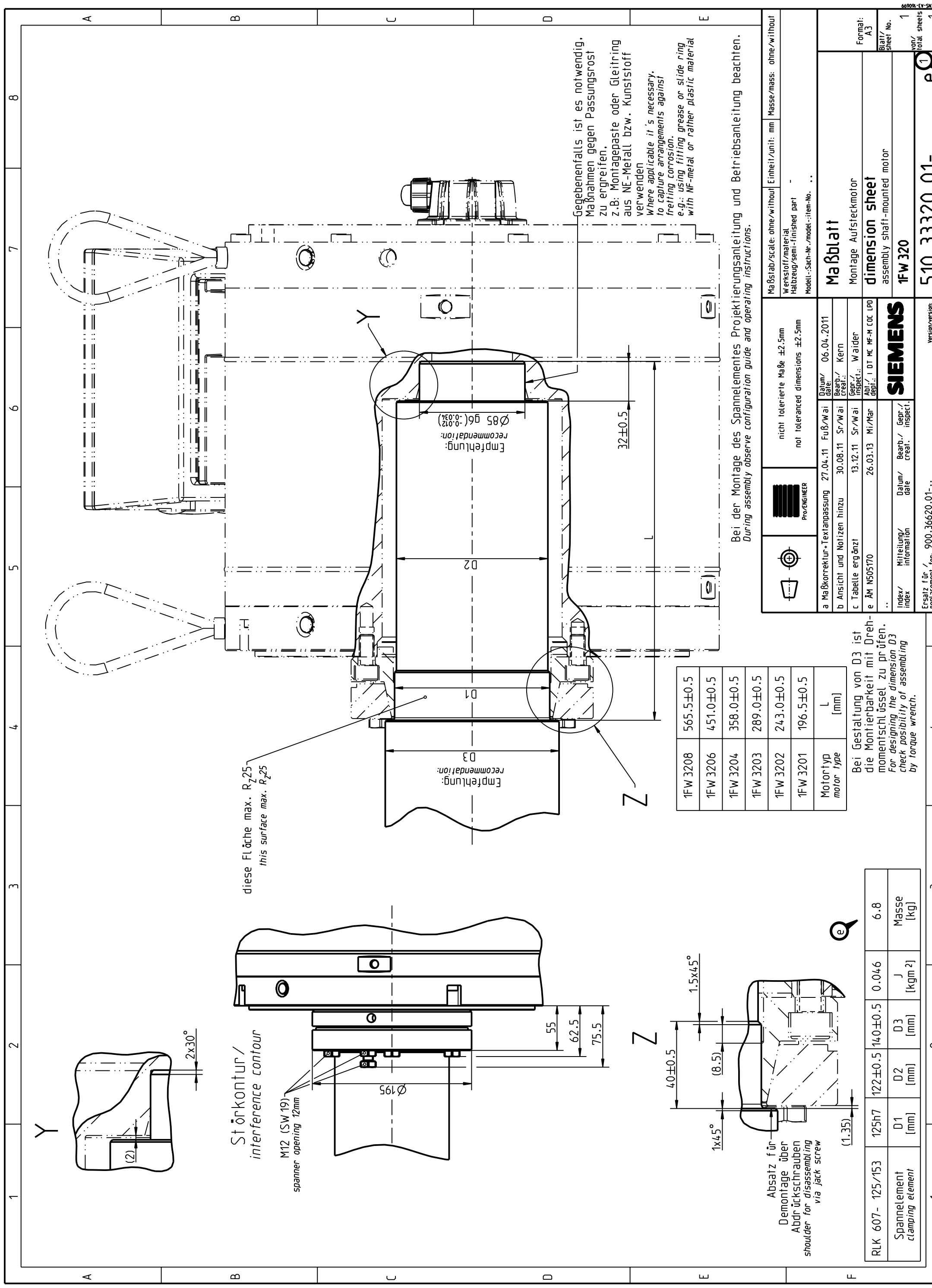


Figure 5-25 Dimension drawing, mounting plug-on motor 1FW320

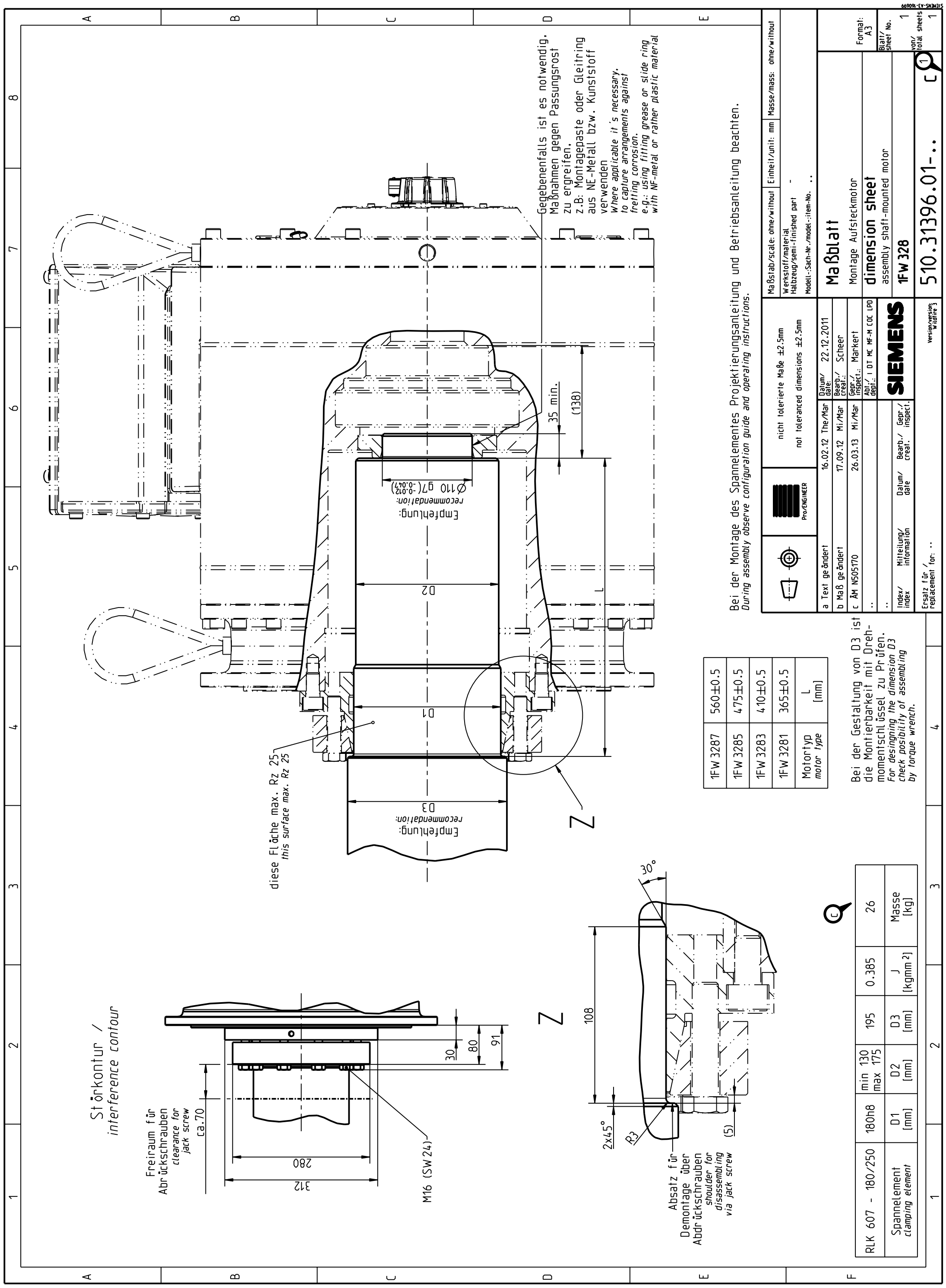


Figure 5-26 Dimension drawing, mounting plug-on motor 1FW328

Hollow shaft with option +Q30

1FW315□-□□□□□-□□A□
1FW320□-□□□□□-□□A□

- Harmonized clamping system
- For hollow shafts through which hot or cold media are routed
- Axial mounting space is required at the DE
- Mounted only from the DE or alternatively, in two parts from DE/NDE
- Torque transmission to the customer shaft (h8 fit) via a flanged clamping element at the DE
- Supported at the NDE using an aluminum ring to guarantee centered mounting and to prevent any inadmissible wobbling motion.

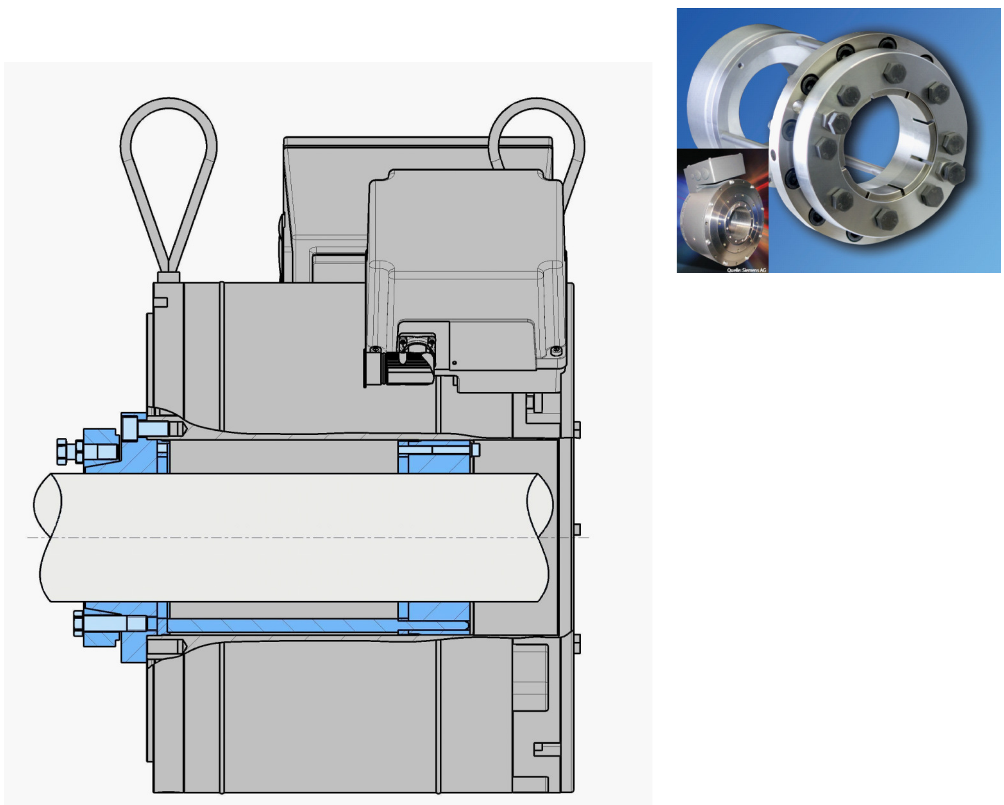


Figure 5-27 Outer clamping system

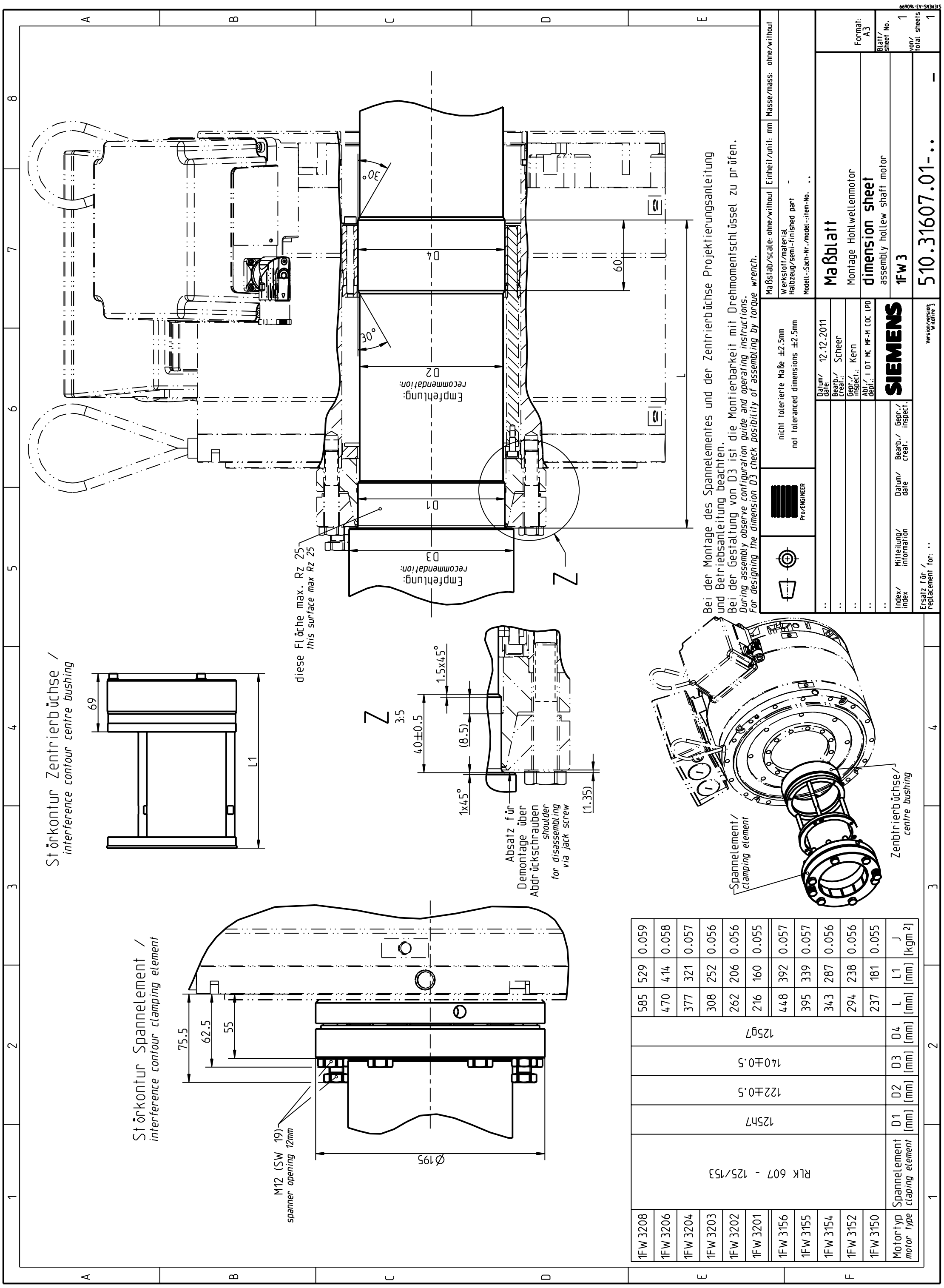


Figure 5-28 Dimension drawing hollow shaft with clamping element

Hollow shaft, inner clamping element

1FW315□-□□□□□-□□C□
1FW320□-□□□□□-□□C□

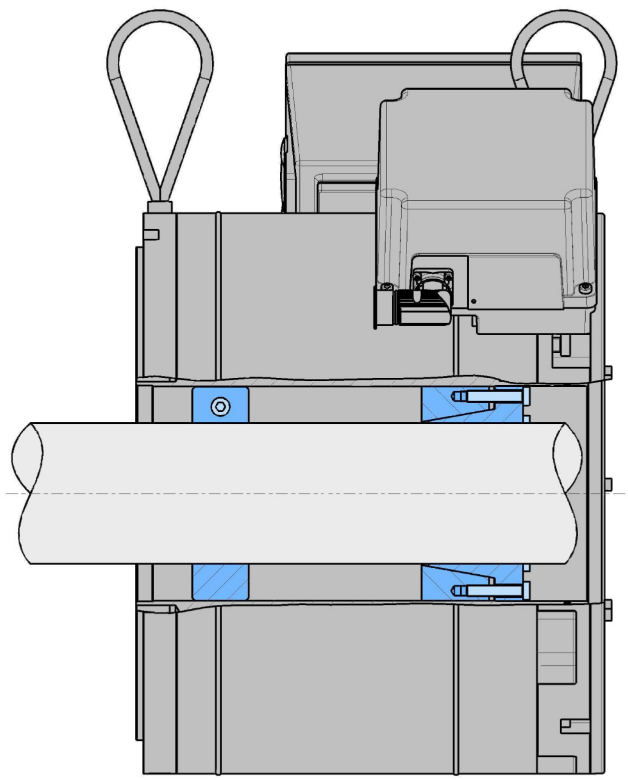
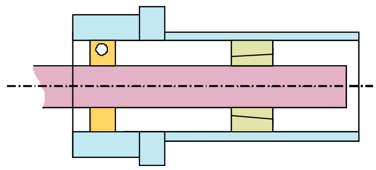


Figure 5-29 Inner clamping system

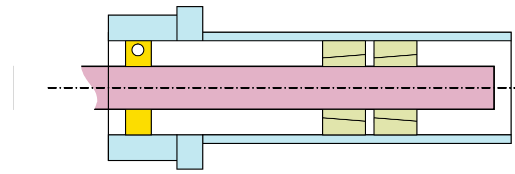
- Available for 1FW315□ and 1FW320□ with special shaft (15th position in the Article No. = C)
- RINGSPANN RTM 134.1
- Torque transmission to the customer shaft (h8 fit) via the clamping element located in the hollow shaft NDE
- Supported at the DE using an aluminum ring to guarantee centered mounting and to prevent any inadmissible wobbling motion
- Compact mounting at the machine is possible as no axial mounting space is required at the DE and the device is completely mounted from the NDE.

Table 5-8 Clamping sets required to transmit the torque

1FW3150....1FW3155	1FW3156
1FW3201....1FW3204	1FW3206....1FW3208



One clamping set is sufficient



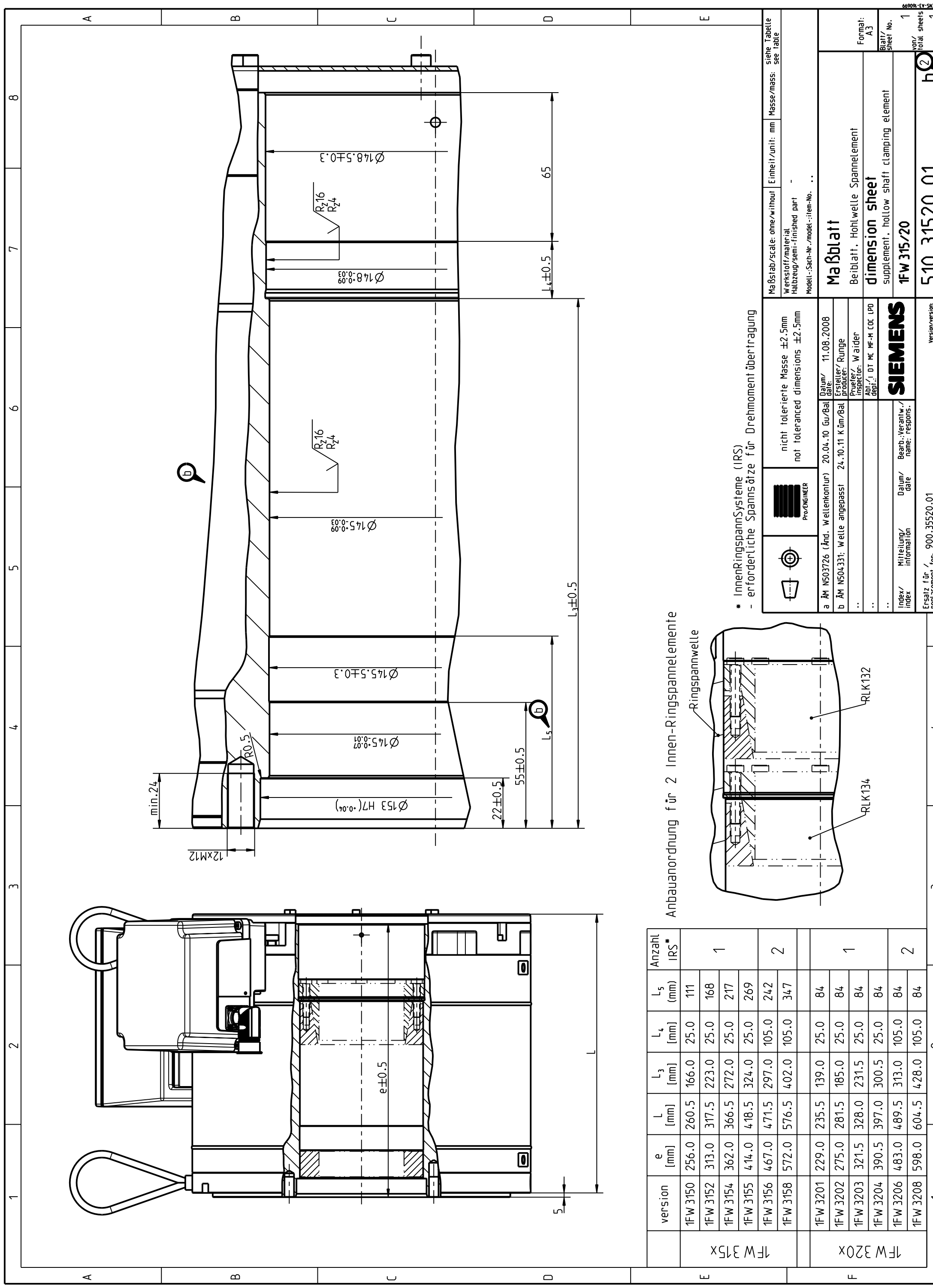
Two clamping sets are required to transmit the torque

Technical Support RINGSPANN GmbH

RINGSPANN GmbH can support you when selecting a suitable clamping system for your application.

RINGSPANN GmbH
Schaberberg 30-34
D-61348 Bad Homburg

Phone +49 (0) 6172 275 0
Internet: http://www.ringspann.de



version	e [mm]	L [mm]	L_3 [mm]	L_4 [mm]	L_5 (mm)	Anzahl IRS*
1FW 315x: 1FW3150	256.0	260.5	166.0	25.0	111	1
1FW3152	313.0	317.5	223.0	25.0	168	1
1FW3154	362.0	366.5	272.0	25.0	217	1
1FW3155	414.0	418.5	324.0	25.0	269	1
1FW3156	467.0	471.5	297.0	105.0	242	2
1FW3158	572.0	576.5	402.0	105.0	347	2
1FW 320x: 1FW3201	229.0	235.5	139.0	25.0	84	1
1FW3202	275.0	281.5	185.0	25.0	84	1
1FW3203	321.5	328.0	231.5	25.0	84	1
1FW3204	390.5	397.0	300.5	25.0	84	1
1FW3206	483.0	489.5	313.0	105.0	84	2
1FW3208	598.0	604.5	428.0	105.0	84	2

Figure 5-30 Dimension drawing hollow shaft clamping element

5.4.4 Coupling mounting

Advantage: Simple design, a standard motor can be used.

Disadvantage: As a result of its function, a coupling must be flexible and therefore has a negative impact on the positive characteristics and features of a directly driven load. The coupling reduces the drive train stiffness.

NOTICE
Premature bearing damage Bearings can be prematurely damaged, if force transmission elements apply too much load to the shaft end as a result of radial forces. • When using mechanical transmission elements, ensure that the maximum limit values specified in the radial force diagrams are not exceeded.

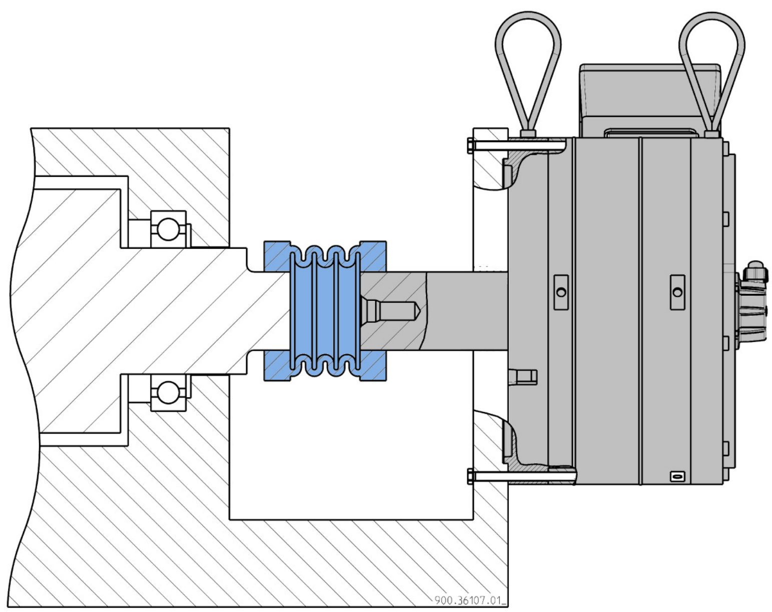


Figure 5-31 Decoupling the machine shaft from the motor shaft using a coupling

5.4.5 No bearings at the DE

Option "No DE bearings" is designated with a "3" at the 16th position of the article number.

1FW3□□□-□□□□□-□□□**3**

Properties

- Stiff rotor and stator mounting for the "hollow shaft" and "plug-on shaft" versions
- Only a few mounting components are required
- Provides the possibility of mounting bearing modules to absorb increased process forces
- Not available for solid shaft versions (15th position in the Article No.: "H" and "M")

Note

- Avoid any radial overdetermination of the remaining bearing at the NDE; this must be verified by making the appropriate calculation.
- Comply with the mounting conditions, see dimension drawing 609.30284.01, no DE bearings.
- Limit the axial temperature expansion of the machine shaft as specified in dimension drawing 609.30284.01, DE without bearings
- Dimension drawing 609.30284.01, DE without bearings refers to the mounted state. Dimension "L" in the dimension drawing can be higher at a motor when originally shipped
- The motor shaft creates a radial force as a result of this bearing type. Take into account the radial force in the customer's machine design, see the following table.
- Only operate the motor when it is mounted.

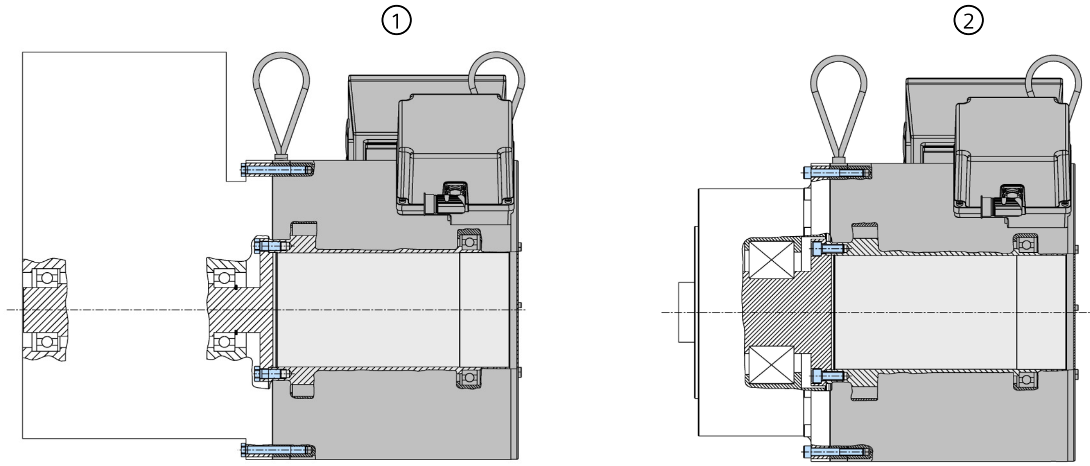
Frame size	Radial force / N
1FW315☐	800
1FW320☐	2000
1FW328☐	4100

Note

Torque motors shall not be used without bearings and/or similar mountings. By installing/usage of option 1FW3xxx-xxxxx-xxx3 (motor without bearing) Customer bears the full responsibility to comply with the aforesaid precondition. In connection with option 1FW3xxx-xxxxx-xxx3 (motor without bearing) Siemens does not grant any warranty and shall not be liable with respect to any claims arising out of or relating to the combination with or incorporation into the motor with any other product, component or machine; customer shall hold Siemens harmless against any third party claim thereof.

If you have any questions regarding the general conditions, contact the Siemens Service Center.

Mounting examples



1 Siemens must be consulted (regarding overdetermination)

2 For bearing module with increased radial/axial force load

Figure 5-32 Mounting examples for motors with no bearings at the DE

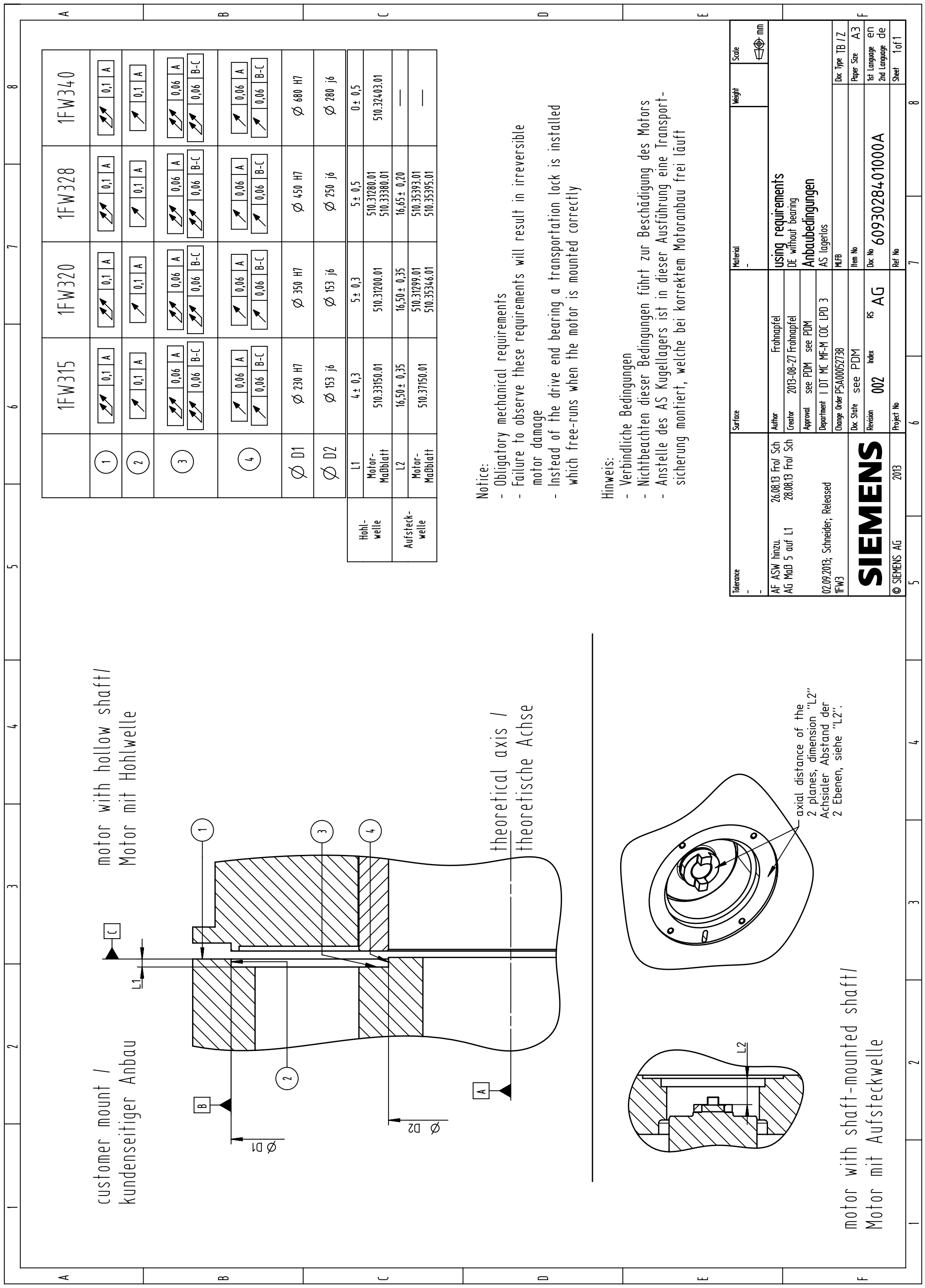
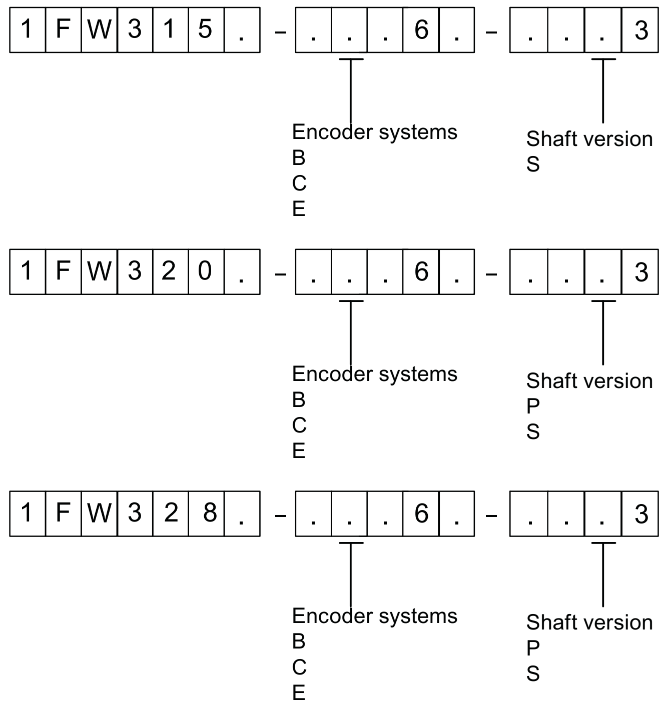


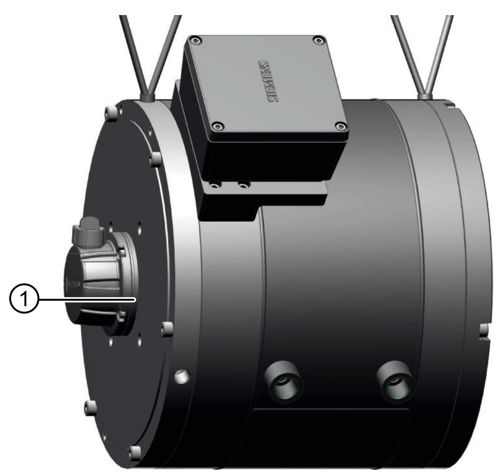
Figure 5-33 Dimension drawing, no bearings at the DE

5.4.6 Plug-on shaft and DE without bearings



Mounting instructions

The motor is shipped with a transport ring at the NDE. The transport ring is located between the encoder and the bearing shield. This prevents the motor shaft from coming into contact with the encoder. See the diagram below.



1 Transport ring

Figure 5-34 Transport ring for motors without bearing

Before mounting, remove the encoder including the transport ring according to the following description "Removing/mounting the encoder".

Note

Comply with the mounting conditions

In order that the motor operates correctly, already when designing the machine or the system, it is absolutely mandatory that the mounting conditions are complied with according to dimension drawing 609.30284.01. The sum of all of the tolerances of the mounting must not exceed the tolerances listed under L_2.
This includes, for example:

- Positioning the motor shaft when mounting
- Shifting the customers shaft
- Thermal expansion of the customer's shaft

5.4.7 Removing/mounting the encoder

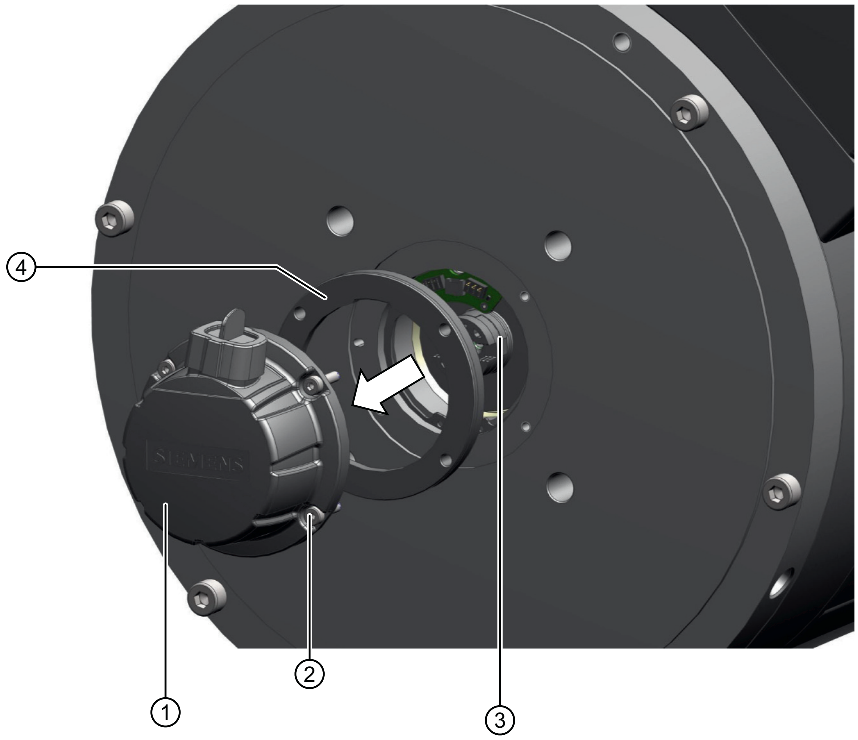
NOTICE
Destruction of components sensitive to electrostatic discharge Electronic modules contain components that can be destroyed by electrostatic discharge. These components can be damaged or destroyed if they are not handled properly. • Carefully observe the instructions in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

Procedure

Proceed the following to remove and mount the encoder:

1 Removing

1. Bring the motor into a no-voltage condition.
2. Withdraw the encoder cable.

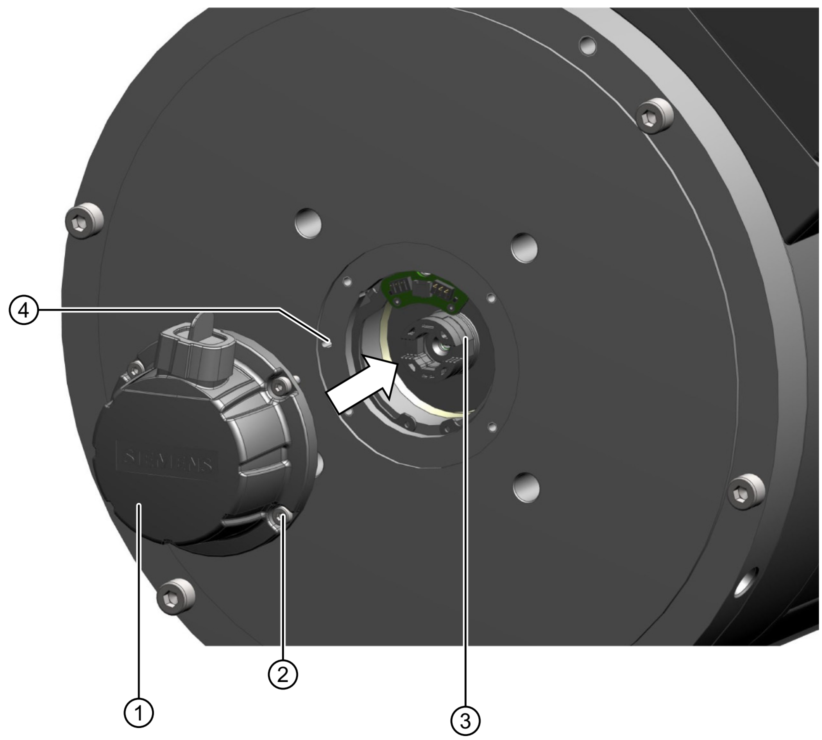


1	Encoder
2	Four fixing screws
3	Coupling element
4	Transport ring

3. Release the four fastening screws for the encoder.
4. Remove the encoder, the transport ring and the coupling element.

2 Mounting

1. Attach the coupling element to the coupling hub of the motor shaft.
2. Align the coupling hub at the encoder to the couplings element in the motor. The encoder with coupling hub can only be inserted at a specific position.



1	Encoder
2	Four fixing screws
3	Coupling element
4	Elongated hole to position the encoder

3. Insert the encoder at this position. Inserting the coupling involves blind assembly.
4. Rotate the inserted encoder, so that the positioning pin of the encoder latches into the elongated hole in the bearing shield.
5. Fasten the encoder using the four fastening screws provided (tightening torque: 2 to 3 Nm).

3 Absolute adjustment

Note

Only absolute encoders need to be adjusted.

When you adjust an absolute encoder (referencing), its actual value is compared once with the machine zero point and then set to valid.

The actual adjustment status of an absolute encoder is shown in the following machine data:

For SINUMERIK	For SINAMICS
MD34210 §MA_ENC_REFP_STATE (absolute encoder status)	p2507 (absolute encoder adjustment status)

- Adjust the encoder as described in the instructions in the associated Function Manual.

The motor is now ready for operation again.

❒

For detailed information about replacing an encoder, see Chapter "Maintenance and service intervals (Page 74)".

5.4.8 Natural frequency when mounted

The motor is an oscillating system with a design-dependent natural frequency, which is higher than the specified maximum speed.

When the motor is mounted onto a machine, a new system, which is capable of vibration, is created with modified natural frequencies. These can lie within the motor speed range.

This can result in undesirable vibrations in the mechanical drive transmission.

Note

Motors must be carefully mounted on adequately stiff foundations or bedplates. Additional elasticities of the foundation/bedplates can cause resonance effects of the natural frequency at the operating speed and, therefore, result in inadmissibly high vibration values.

The magnitude of the natural frequency when the motor is mounted depends on various factors and can be influenced by the following points:

- Mechanical transmission elements (gearboxes, belts, couplings, pinions, etc.)
- Stiffness of the machine design to which the motor is mounted
- Stiffness of the motor in the area around the foot or customer flange
- Motor weight
- Machine weight and the weight of the mechanical system in the vicinity of the motor
- Damping properties of the motor and the driven machine
- Installation type/position (IM B14, IM V18/19, IM B35)
- Motor weight distribution, i.e. length, shaft height

5.4.9 Vibration resistance

The following factors influence the system vibrational behavior at the site of installation:

- Output elements
- Mounting situation
- Alignment and installation
- Effects of external vibration

As a consequence, motor vibration values can increase.

It may be necessary that you completely balance the rotor together with the output element.

Observe the specified vibration values at the specified motor measuring points. In this way you guarantee perfect function and long service life of the motor.

Table 5-9 Maximum permissible radial vibration values, based on ISO 10816 [1)]

Vibration frequency	Vibration values
< 6.3 Hz	Vibration displacement s ≤ 0.16 mm
6.3 - 250 Hz	Vibration velocity v_{rms} ≤ 4.5 mm/s
> 250 Hz	Vibration acceleration a ≤ 10 m/s²

Table 5-10 Max. permissible axial vibration values[1)]

Vibration velocity	Vibration acceleration
v_{rms} = 4.5 mm/s	a_{peak} = 2.25 m/s²

1) Both values must be maintained simultaneously.

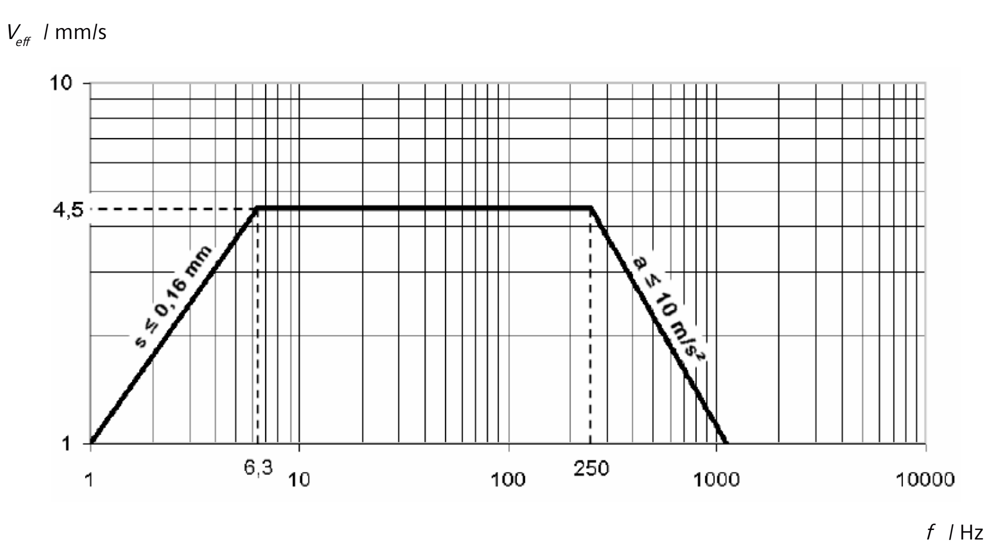


Figure 5-35 Max. permissible vibration velocity, taking into account the vibration displacement and vibration acceleration

To evaluate the vibration velocity, the measuring equipment must meet the requirements of ISO 2954. Evaluate the vibration acceleration as a peak value in the time domain in a frequency band extending from 10 up to 2000 Hz.

Appropriately adapt the measuring range if it is expected that noticeable vibration levels are excited above 2000 Hz (e.g. as a result of gear tooth meshing frequencies). This does not alter the maximum permissible values.

5.4.10 Mounting vibration sensors (Z-option G50)

The end shield and the adapters of the motors are equipped with M8 sensor boreholes for screwing in vibration sensors.

Depending on the motor type, adapters are supplied for the M8 sensor connection. For this and further information, see the following figure "Position and dimensions of the sensor boreholes for the vibration sensors".

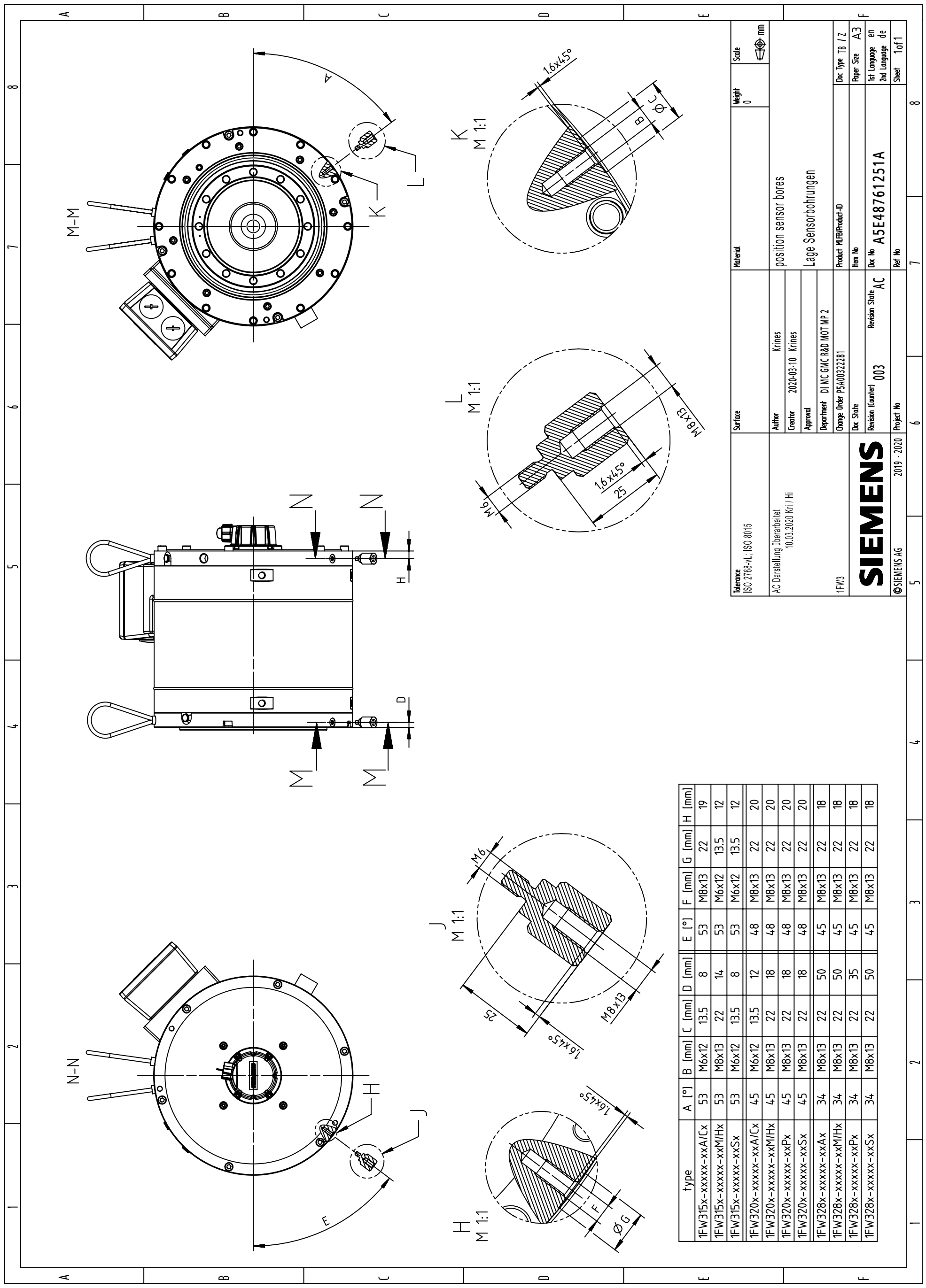
The adapters are fastened in pairs on the lifting eye. Where applicable, mount the adapter on the motor.

Remove the screw plugs before mounting the adapters.

You do not always need both adapters. Dispose of unnecessary adapters and screws in the proper manner.

Observe a maximum permissible tightening torque of 3 Nm when screwing the vibration sensors into the adapter.

The adapters protrude beyond the mounting flange of the motor and produce geometric interference. If geometric interference occurs, remove the adapters and use the M6 sensor holes.



type	A [°]	B [mm]	C [mm]	D [mm]	E [°]	F [mm]	G [mm]	H [mm]
1FW315x-xxxxx-xxA/Cx	53	M6x12	13.5	8	53	M8x13	22	19
1FW315x-xxxxx-xxM/Hx	53	M8x13	22	14	53	M6x12	13.5	12
1FW315x-xxxxx-xxSx	53	M6x12	13.5	8	53	M6x12	13.5	12
1FW320x-xxxxx-xxA/Cx	45	M6x12	13.5	12	48	M8x13	22	20
1FW320x-xxxxx-xxM/Hx	45	M8x13	22	18	48	M8x13	22	20
1FW320x-xxxxx-xxPx	45	M8x13	22	18	48	M8x13	22	20
1FW320x-xxxxx-xxSx	45	M8x13	22	18	48	M8x13	22	20
1FW328x-xxxxx-xxAx	34	M8x13	22	50	45	M8x13	22	18
1FW328x-xxxxx-xxM/Hx	34	M8x13	22	50	45	M8x13	22	18
1FW328x-xxxxx-xxPx	34	M8x13	22	35	45	M8x13	22	18
1FW328x-xxxxx-xxSx	34	M8x13	22	50	45	M8x13	22	18

Figure 5-36 Position and dimensions of the sensor holes for the vibration sensors

5.4.11 Heavy Duty (Z option L03)

Mounting

A flange is used for mounting.

Table 5-11 Flange mounting

	Description for SH 200	Description for SH 280
Bolt ISO 898-1[1)]	M12	M16
Washer ISO 7092	ISO 7092-12-300 HV	ISO 7092-16-300 HV (d2 = 30)
Tightening torque	120 Nm	300 Nm

1) Use screws of property class 10.9

Note

Screw locking

You must secure all screws as a result of the vibration and shock load.

Shaft adaptation

- A rigid connection between the motor and customer shaft is not permissible.
- Avoid distortion or overdetermining the bearings by precisely aligning the motor.
  Axial and radial forces are not allowed.
- In operation, avoid any additional axial shock load to the motor shaft.
- Design the shaft adaptation so that there are no axial and radial forces (straight gearing with splined shaft) and the appropriate play.
  Axial and radial forces are not allowed.

5.5 Data on efficiency

If necessary, you can calculate the efficiency yourself with the TST configuration tool and then read off efficiency data at an operating point. You will find the link to the TST configuration tool in chapter "TIA Selection Tool - TST (Page 93)".

If, for example, you require detailed efficiency characteristics or values at specific operating points you can contact Technical Support. You can find the link to Technical Support in chapter "Introduction".

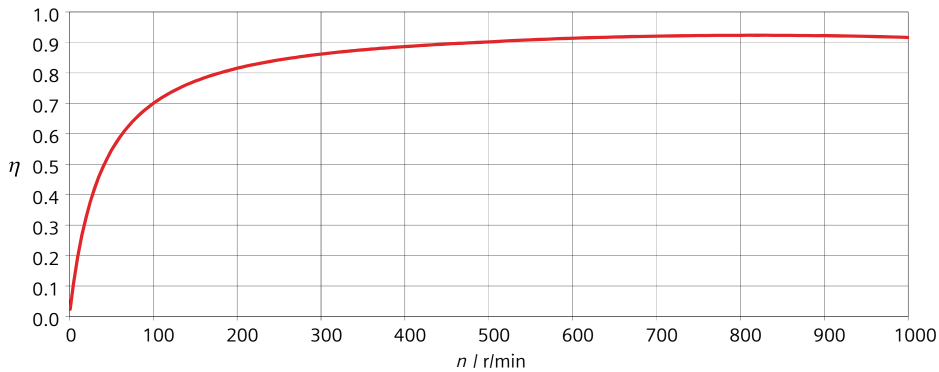


Figure 5-37 Example diagram: Efficiency as a function of speed

You can refer to catalog "D21.4 SINAMICS S120 and SIMOTICS" for the optimum efficiency in continuous operation.

Technical data and characteristics 6

6.1 Explanations

Permissible operating range

The permissible operating range is limited by thermal, mechanical, and electromagnetic boundaries.

Permissible winding temperature range

The temperature rise of the motor is caused by the losses generated in the motor (current-dependent losses, no-load losses, friction losses). Utilizing the insulation system according to temperature class 155 (F) has a limiting effect.

Torque characteristics of motor

The maximum permissible torque depends on the permissible winding overtemperature (100 K) and, in turn, on the mode. To adhere to the temperature limits, the torque must be reduced as the speed increases, starting from static torque M_0.

The characteristics are specified for uninterrupted duty S1 (100 K).

NOTICE
Thermal destruction of the motor
The motor can be thermally destroyed if you operate the it continuously in the area above the S1 characteristic. • Continuous duty in the area above the S1 characteristic curve is not thermally permitted for the motor.

The speed range is affected by:

- The maximum permissible speed (mechanical) $n_{max\ mech}$ (centrifugal forces on the rotor, bearing lifetime), or
- The maximum permissible speed on the converter $n_{max\ Inv}$ (output frequency, voltage strength of the converter and/or motor)

Winding versions

A number of winding versions (armature circuit versions) for different rated speeds n_N are possible within one motor frame size.

Table 6-1 Code letter for the winding version

Rated speed n_N in r/min	Winding version (10th position in the Article No.)
150	E
250	G
300	H
400	J
500	L
600	M
750	P for SH 150
800	P for SH 200 and SH 280
1200	S

Converter output voltages

The converter output voltages differ according to the converter type and supply voltage.

Table 6-2 Converter output voltages

Converter type	Infeed module	Supply voltage	DC link voltage	Output voltage
		V_{line}	$V_{DC\ link}$	V_{mot}
SINAMICS S120 3AC 380 - 480 V	ALM	400 V	600 V	425 V
	ALM	480 V	720 V	510 V
	SLM	400 V	528 V	380 V
	SLM	480 V	634 V	460 V

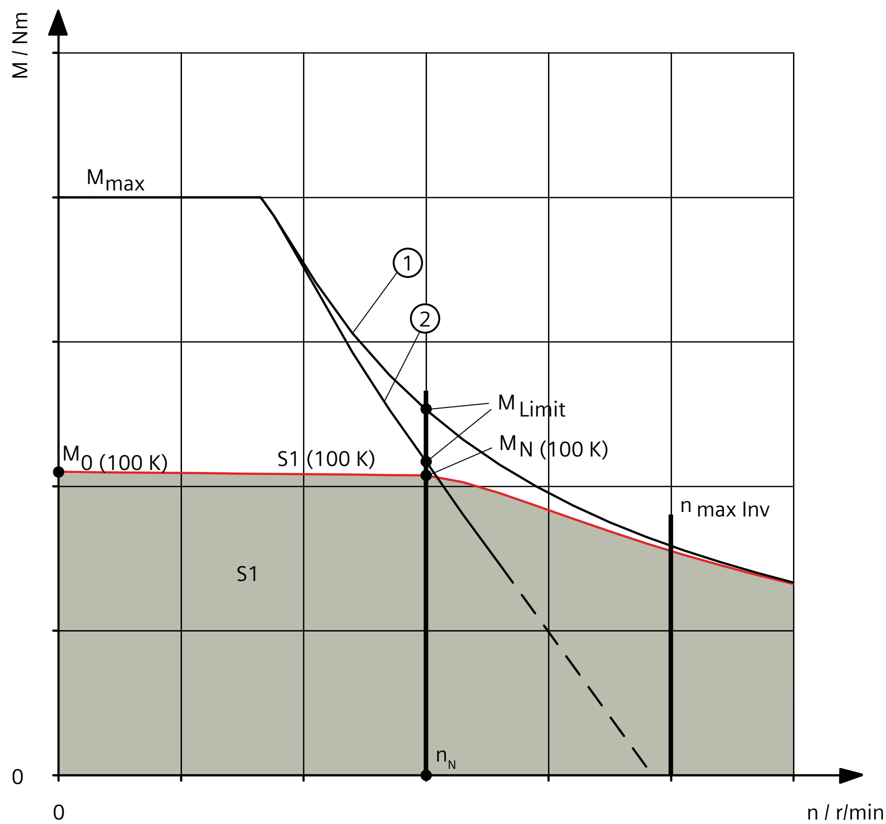
Torque limit when operating on a SINAMICS S120 with field weakening

The SINAMICS S120 converter injects a field weakening current, which means that the motor can operate above the voltage limiting characteristic. The method used by the converter to inject the field weakening current has a significant influence on the curve characteristic.

The characteristics shown apply to operation on a SINAMICS S120 converter.

Field weakening operation is always active for a SINAMICS S120 converter.

The shape of the characteristics in field weakening mode depends on the position of the voltage limiting characteristic. Therefore, an appropriate torque-speed characteristic is assigned in the field-weakening range for each converter output voltage.



① Voltage limit characteristic: Field weakening

② Voltage limit characteristic: Limit by the DC link voltage

M_{Limit} Limit torque

S1 Continuous operation

Figure 6-1 Torque characteristic of a synchronous motor operating on a SINAMICS drive system with field weakening (example characteristic)

The permissible speed range has been limited to $n_{max\ Inv}$.

Torque limit when operating on a SINAMICS S120 without field weakening

It is possible to deactivate the field weakening function with the SINAMICS S120 drive system. This therefore reduces the operating range that is available.

The shape of the voltage limiting characteristic is determined by the winding version and the magnitude of the converter output voltage.

The voltage induced in the motor winding increases as the speed increases. The difference between the DC link voltage of the converter and the induced motor voltage can be used to apply the current.

For converters **without field weakening option**, this limits the magnitude of the current that can be impressed. This causes the torque to drop off quickly at high speeds. All operating points that can be achieved with the motor lie to the left of the voltage limiting characteristic that is shown in the diagram.

The characteristic curve is plotted for each winding version in a separate data sheet (see Chapter "Data sheets and characteristics (Page 163)"). The speed-torque characteristics for different converter output voltages are then assigned to each data sheet.

Note

The voltage limit characteristic of a motor with 600 r/min rated speed lies far above that of the same motor type with 200 r/min. However, for the same torque, this motor requires a significantly higher current.

For this reason, you should select the rated speed such that it does not lie too far above the maximum speed required for the application.

The size (rating) of the converter module (output current) can be minimized in this fashion

Offset of the voltage limit characteristic

Note

A offset of the voltage limiting characteristic can only used in the case of approximately linear limiting characteristic curves. The voltage limiting characteristic can be offset only if the condition $U_{Mot, new} > U_{iN}$ is fulfilled.

The induced voltage U_{iN} can be taken from the motor rating plate or calculated according to the following formula: $U_{iN} = k_E \cdot n_N / 1000$

In order to identify the limits of the motor for a converter output voltage (U_{Mot}) other than 380 V, 425 V, 460 V or 510 V, the relevant voltage limiting characteristic curve must be shifted (offset) for the particular new output voltage ($U_{Mot, new}$).

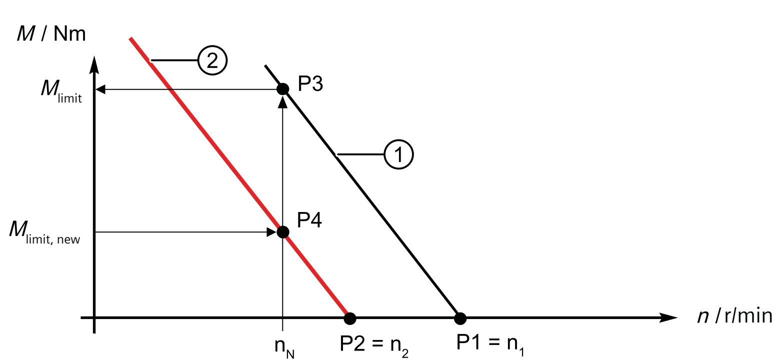
The degree of offset is obtained as follows:

For an output voltage of $U_{Mot, new}$, an offset is obtained along the X axis (speed) by a factor of:

$$\frac{U_{Mot,new}}{U_{Mot}}$$

$U_{Mot, new}$	=	new converter output voltage
U_{Mot}	=	drive converter output voltage from the characteristic curve for 380 V, 425 V, 460 V or 510 V

Calculating the new limit torque with the new limiting characteristic



① Voltage limit characteristic for U_{Mot}

② New voltage limit characteristic for $U_{Mot, new}$

P1 Intersection of the voltage limiting characteristic on the x axis; calculate speed n_1 in r/min.

$$n_1 = \frac{U_{Mot}}{k_E} \cdot 1000$$

P2 Intersection of the new voltage limiting characteristic on the x axis; calculate speed n_2 in r/min.

$$n_2 = n_1 \cdot \frac{U_{Mot,new}}{U_{Mot}}$$

P3 At n_N draw a line vertically upwards, up to the voltage limiting characteristic. This point of intersection is P3. On the left-hand side, read off M_{limit}.

P4 In order to determine P4, $M_{limit, new}$ must first be calculated.

$$M_{limit, new} = \frac{U_{Mot,new} - U_{iN}}{U_{Mot} - U_{iN}} \cdot M_{limit}$$

P4 is the intersection of $M_{limit, new}$ and n_N. The new voltage limiting characteristic is obtained by connecting P2 and P4.

Example of offset of voltage limiting characteristic curve without field weakening

Motor 1FW3201-1❑L

n_N = 500 r/min

k_E = 520 V/1000 r/min

$U_{Mot, new}$ should be 290 V; in the example, the calculation is made with U_{Mot} = 425 V

It first must be checked as to whether the condition $U_{Mot, new} > U_{iN}$ is fulfilled.

$U_{iN} = k_E \cdot n_N/1000$; $U_{iN} = 520 \cdot 500/1000 = 260$ V → condition $U_{Mot, new} > U_{iN}$ is fulfilled.

Calculation P1: $n_1 = \frac{425}{520} \cdot 1000 = 817$ r/min

Calculation P2: $n_2 = \frac{290}{425} \cdot 817 = 557$ r/min

Calculation P3: Read off M_{limit} at n_N = 500 r/min and 425 V: approx. 330 Nm

Calculation P4: $M_{limit, new} = \frac{290 - 260}{425 - 260} \cdot 330 = 60$ Nm

Enter and connect points P2 and P4. This line is the new voltage limiting characteristic for $U_{Mot, new}$ = 290 V.

Tolerance data

The characteristic data listed in the data sheets are nominal values that are subject to natural scatter.

Table 6-3 Tolerance data in the motor list data

Motor list data		Typ. value	Guaranteed value
Stall current	I_0	± 3 %	± 7,5 %
Electrical time constant	T_{el}	± 5 %	± 10 %
Torque constant	k_T	± 3 %	± 7,5 %
Voltage constant	k_E	± 3 %	± 7,5 %
Winding resistance	R_{ph}	± 5 %	± 10 %
Moment of inertia	J_{mot}	± 2 %	± 10 %

Effects of temperature and parameter scatter on the characteristic

The torque-speed characteristics specified in the following chapter relate to the nominal values at operating temperature.

Speed limits $n_{max\ Inv}$

The maximum permissible speed is limited by the mechanical speed limit $n_{max\ mech}$ (centrifugal forces at the rotor, bearing service life) or the electrical limit speed $n_{max\ Inv}$.

NOTICE

Converter destroyed due to overvoltage

When the machine is operational (when motoring or separately driven) at speeds higher than $n_{max\ Inv}$, a voltage can be induced in the winding that exceeds the maximum permissible converter voltage. This can cause irreparable damage to the converter.

- Operation is not permissible above the speed $n_{max\ Inv}$ without protective measures or other additional measures. Siemens AG accepts no liability for any damage occurring as a result of failing to observe the danger warning.

Converter type	Max. permissible voltage at the converter $U_{Perm\ Inv}$
SINAMICS S120, 3AC 380-480 V	820 V

The following formula can be used to determine the maximum permissible speed $n_{max\ Inv}$ up to which the system can be operated without restrictions.

$$n_{max\ Inv} = \frac{U_{Perm\ Inv} \cdot 1000}{k_E \cdot \sqrt{2}}$$

$n_{max\ Inv}$ in r/min

$U_{Perm\ Inv}$ in V

k_E in V/1000 r/min, k_E = voltage constant (see Chapter "Data sheets and characteristics (Page 163)").

The SINAMICS S120 drive system calculates this value automatically.

When the converter is functioning properly, the voltage that occurs at the motor terminals in field-weakening mode can be limited by generating a voltage in phase opposition to the induced voltage.

6.2 Slot ripple and accuracy

The values in the table "slot ripple and accuracy" apply under the following conditions:

- Synchronous motor on SINAMICS S with servo control
- Type of construction: booksize or chassis
- Default setting: Pulse frequency 4 kHz or 2 kHz
- Torque control

Table 6-4 Slot ripple and accuracy

Shaft height	Slot ripple	Torque accuracy
1FW315□-1□□□□	1.2%	± 2.5%
1FW320□-1□□□□	1.5%	± 2.5%
1FW320□-3□□□□	1.3%	± 2.5%
1FW328□-2□□□□	1.0%	± 2.5%
1FW328□-3□□□□	1.0%	± 2.5%

Notes on torque accuracy

- Applicable for 1FW3 with encoder with/without belts
- Measurement with motor identification and friction compensation
- In torque operating range up to ± M_0
- Speed operating range 1:10 up to rated speed
- Note: external influences, e.g. motor temperature, can cause an additional long-term inaccuracy (constancy) of approx. ± 2.5%
- Approx. ± 1% less accurate in field-weakening range

Ripple

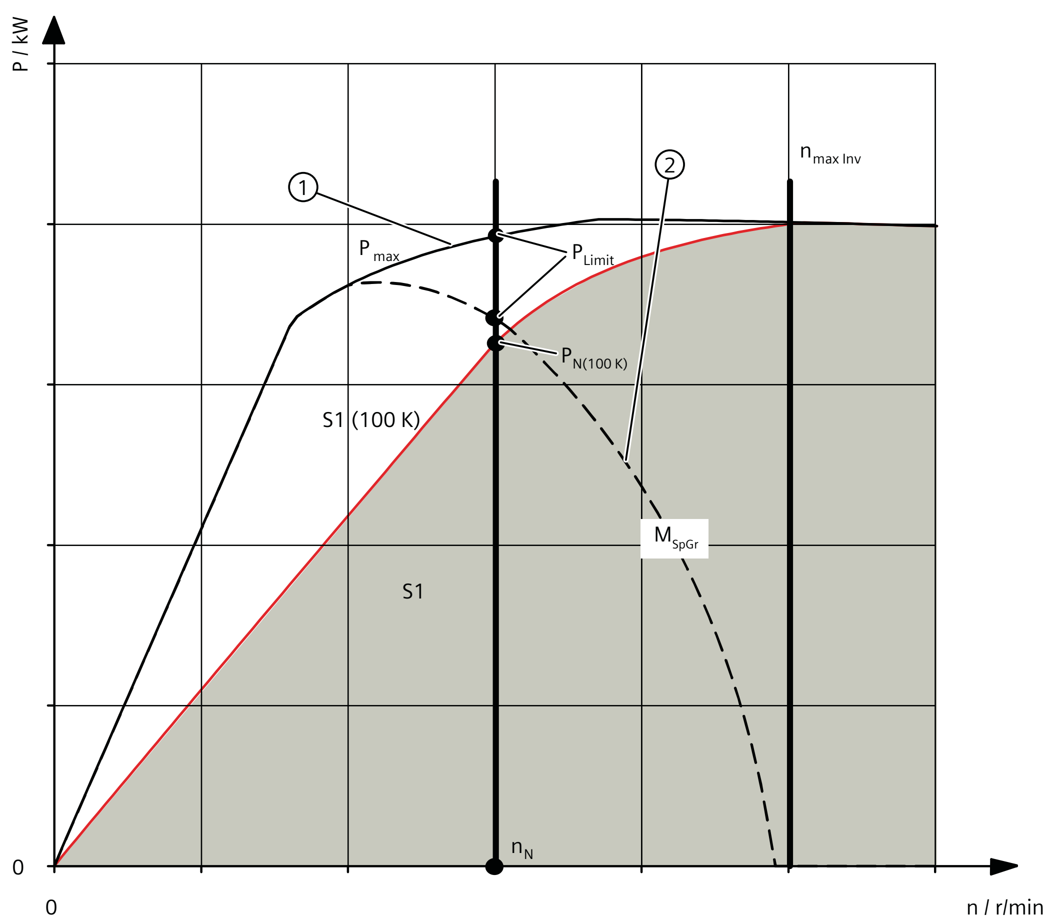
The ripple is the unwanted characteristic of the actual value that overlies the mean value (useful signal). With regard to torques, this is also referred to as harmonic torque. Typical harmonic torques arise through the slot ripple of the motor, the limited resolution of the encoder, or through the limited resolution of the voltage setting of the IGBT power unit. The ripple in the torque is reflected in the ripple in inverse proportional to the mass inertia of the drive.

Accuracy

The accuracy defines the magnitude of the average, repeatable deviation between the actual value and the specified setpoint under rated operating conditions. Deviations between the actual value and setpoint are caused by internal inaccuracies in the measuring and control systems. External disturbances, such as temperature or speed, are not included in the accuracy assessment. The closed-loop and open-loop controls must be optimized with respect to the relevant variable.

6.3 Schematic performance characteristics

The following diagram shows the schematic performance characteristics depending on the speed and on the voltage limit characteristics.



① Voltage limit characteristic: Field weakening
② Voltage limit characteristic: Limit by the DC link voltage
S1 Continuous operation

Figure 6-2 Schema power characteristics

6.4 Data sheets and characteristics

The voltages and currents specified in the data sheets are rms values. Other rated speeds on request.

The specified rated data refer to $V_{line\ rms}$ = 400 V, Active Line Module, DC link voltage, 600 V DC.

Note

Operation without water cooling

Complete torque motors 1FW3 can be operated without water cooling if the torque is appropriately reduced and the thermal losses can be adequately dissipated. The reduction factor depends on the shaft height, length and speed and can be provided when requested. Characteristics for motors without water cooling are availabel in the engineering tool TST.

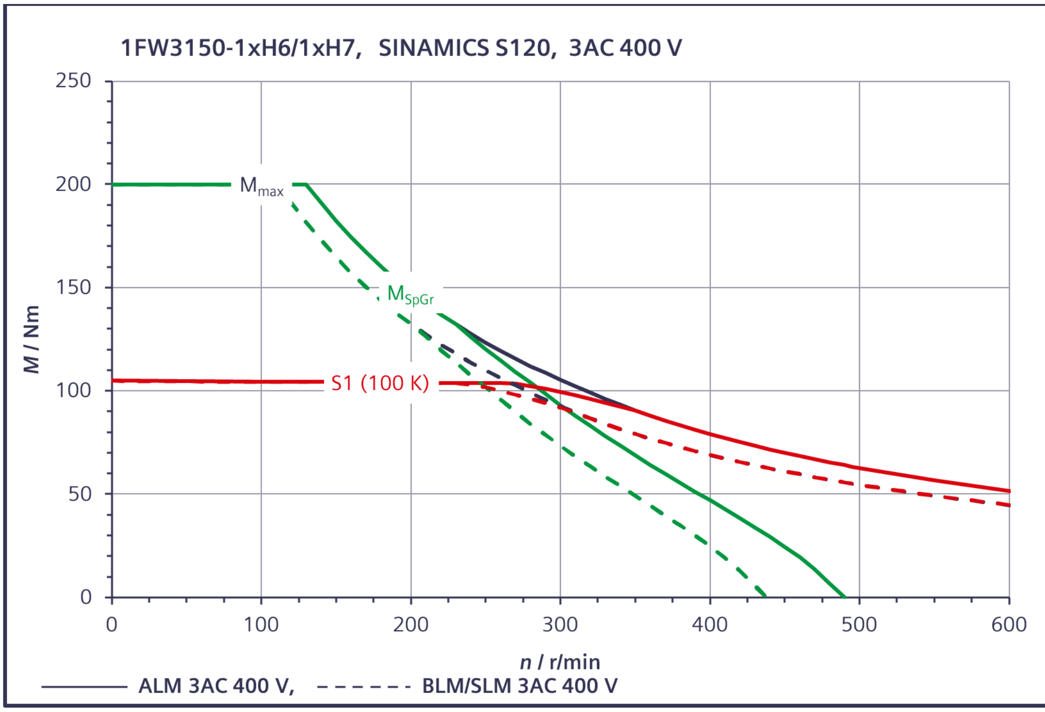
6.4.1 Shaft height 150

Table 6-5 1FW3150, rated speed 300 r/min

Engineering data	Code	Unit	1FW3150-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	100
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	3.1
Rated current (100 K)	$I_{N\ (100\ K)}$	A	8.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	105
Stall current (100 K)	$I_{0\ (100\ K)}$	A	7.3
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	630
Maximum torque	M_{max}	Nm	200
Maximum current	I_{max}	A	17.0
Motor data			
Number of poles	2p	--	14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	k_T	Nm/A	14.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	915
Winding resistance (at 20 °C)	R_{ph}	Ω	3.95
Rotating field inductance	L_D	mH	110
Electrical time constant	T_{el}	ms	27.5
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	6.8
Moment of inertia	J_{mot}	kgm^2	0.12
Shaft torsional stiffness	c_t	Nm/rad	3.13E+07
Weight	m	kg	87
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	3.4
Moment of inertia	J_{mot}	kgm^2	0.06
Shaft torsional stiffness	c_t	Nm/rad	1.13E+06
Weight	m	kg	102
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	8.0
Moment of inertia	J_{mot}	kgm^2	0.14
Shaft torsional stiffness	c_t	Nm/rad	4.17E+07
Weight	m	kg	102

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



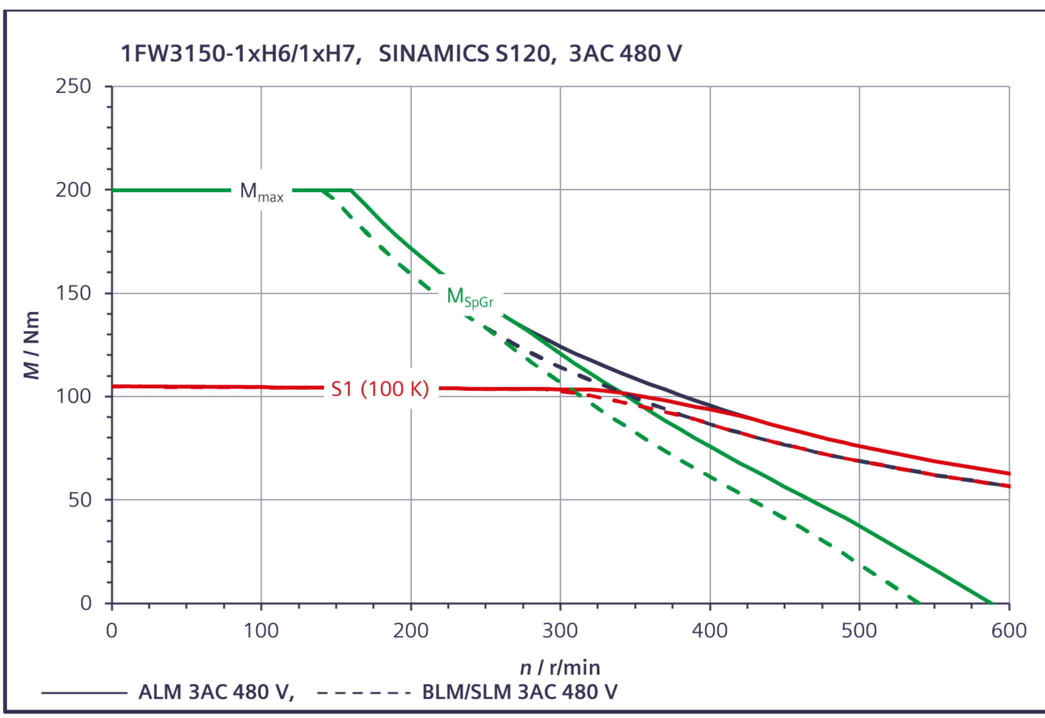
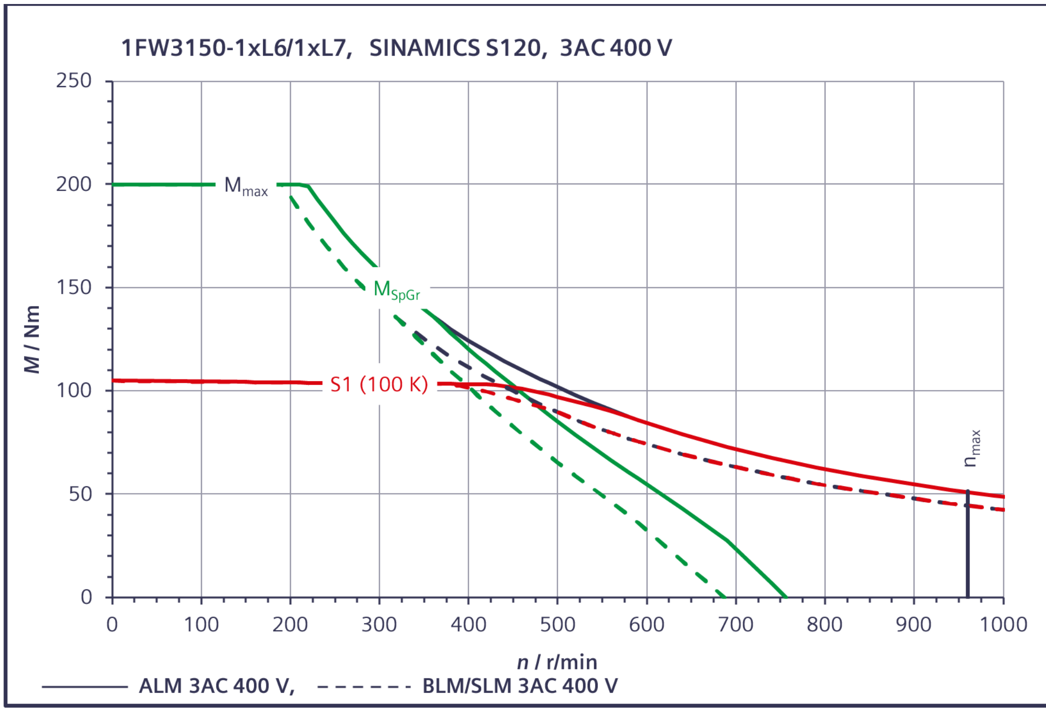


Table 6-6 1FW3150, rated speed 500 r/min

Engineering data	Code	Unit	1FW3150-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	100
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	5.2
Rated current (100 K)	$I_{N\ (100\ K)}$	A	12.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	105
Stall current (100 K)	$I_{0\ (100\ K)}$	A	11.5
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	960
Maximum torque	M_{max}	Nm	200
Maximum current	I_{max}	A	26.0
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	k_T	Nm/A	9.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	600
Winding resistance (at 20 °C)	R_{ph}	Ω	1.68
Rotating field inductance	L_D	mH	47
Electrical time constant	T_{el}	ms	28.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	6.8
Moment of inertia	J_{mot}	kgm^2	0.12
Shaft torsional stiffness	c_t	Nm/rad	3.13E+07
Weight	m	kg	87
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	3.4
Moment of inertia	J_{mot}	kgm^2	0.06
Shaft torsional stiffness	c_t	Nm/rad	1.13E+06
Weight	m	kg	102
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	8.0
Moment of inertia	J_{mot}	kgm^2	0.14
Shaft torsional stiffness	c_t	Nm/rad	4.17E+07
Weight	m	kg	102

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



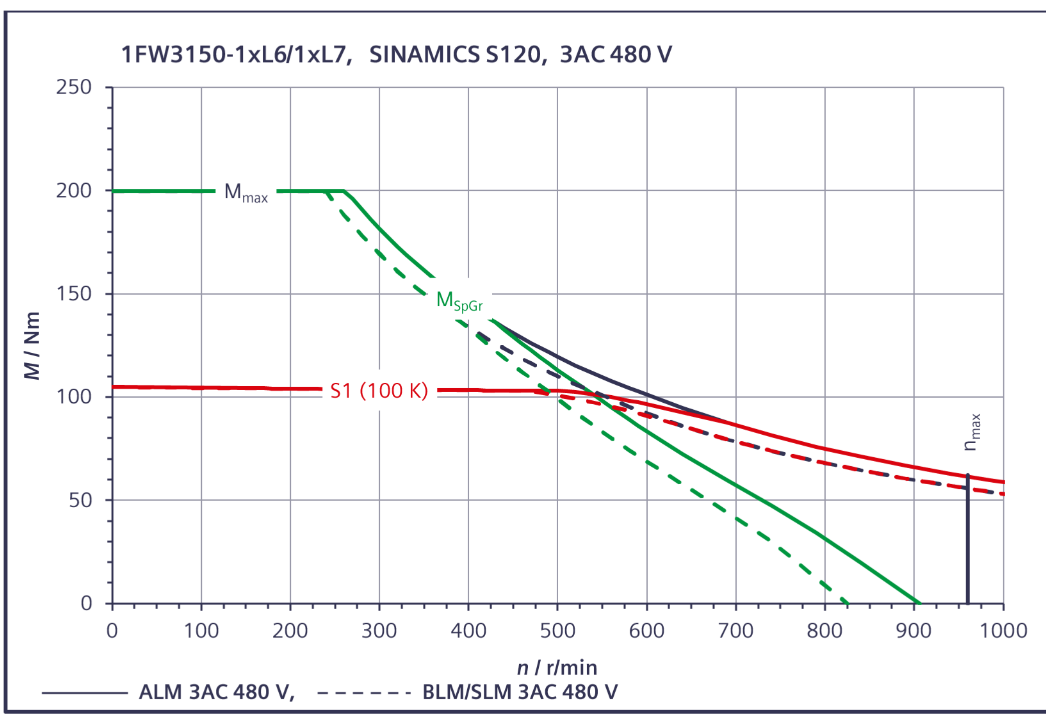
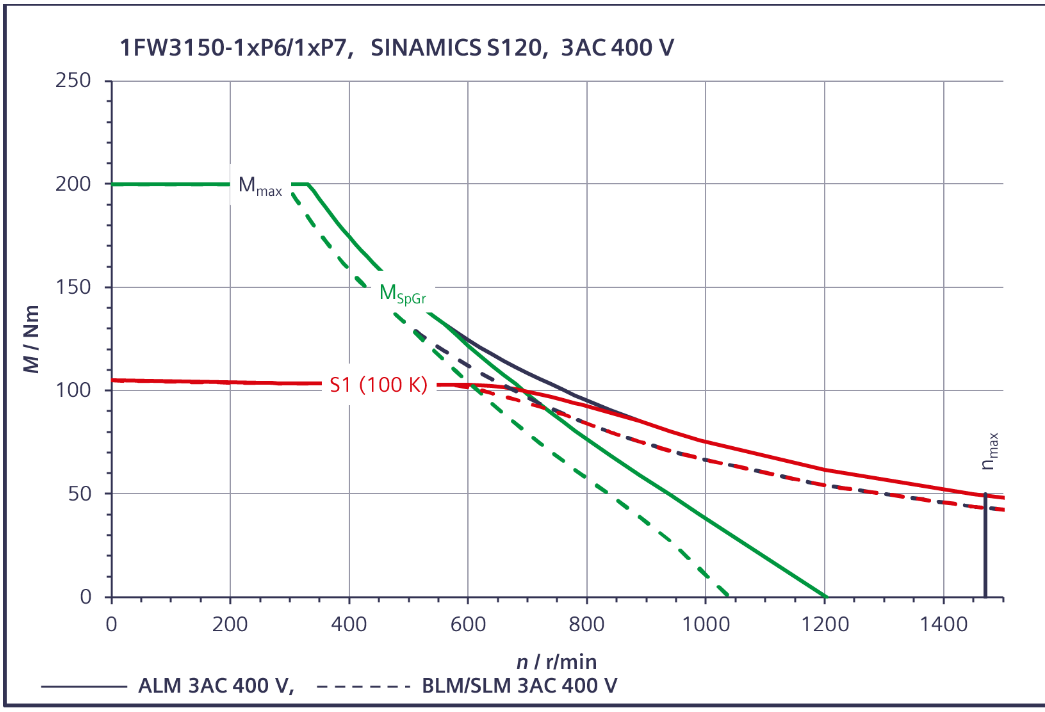


Table 6-7 1FW3150, rated speed 750 r/min

Engineering data	Code	Unit	1FW3150-1☐P
Rated speed	n_N	r/min	750
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	100
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	7.9
Rated current (100 K)	$I_{N\ (100\ K)}$	A	18.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	105
Stall current (100 K)	$I_{0\ (100\ K)}$	A	17.5
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1470
Maximum torque	M_{max}	Nm	200
Maximum current	I_{max}	A	41.0
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant	k_T	Nm/A	6.1
Voltage constant (at 20 °C)	k_E	V/1000 r/min	393
Winding resistance (at 20 °C)	R_{ph}	Ω	0.75
Rotating field inductance	L_D	mH	21
Electrical time constant	T_{el}	ms	28.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	7.3
Moment of inertia	J_{mot}	kgm^2	0.12
Shaft torsional stiffness	c_t	Nm/rad	3.13E+07
Weight	m	kg	87
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	3.6
Moment of inertia	J_{mot}	kgm^2	0.06
Shaft torsional stiffness	c_t	Nm/rad	1.13E+06
Weight	m	kg	102
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	8.5
Moment of inertia	J_{mot}	kgm^2	0.14
Shaft torsional stiffness	c_t	Nm/rad	3.14E+07
Weight	m	kg	102

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



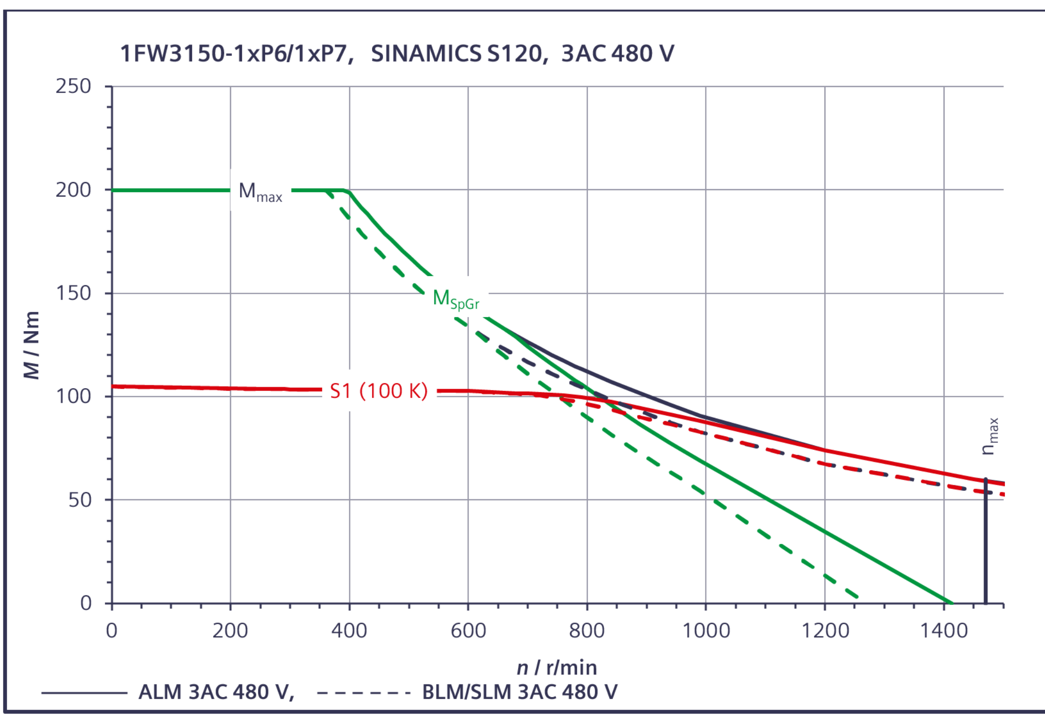
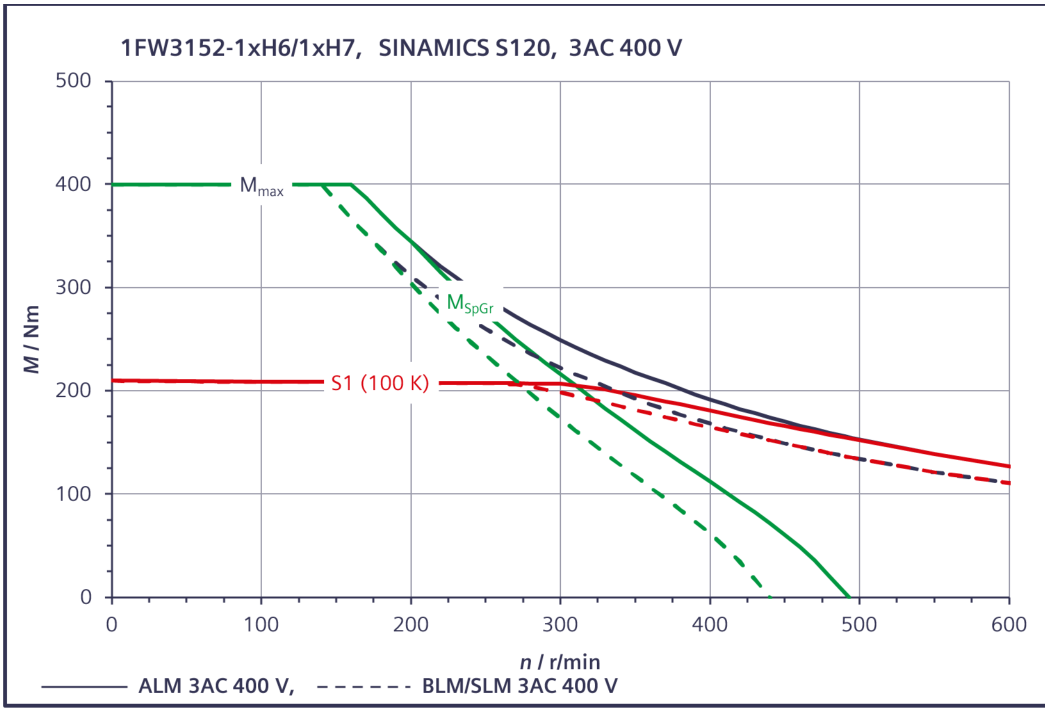


Table 6-8 1FW3152, rated speed 300 r/min

Engineering data	Code	Unit	1FW3152-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	200
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	6.3
Rated current (100 K)	$I_{N\ (100\ K)}$	A	14
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	210
Stall current (100 K)	$I_{0\ (100\ K)}$	A	15.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	630
Maximum torque	M_{max}	Nm	400
Maximum current	I_{max}	A	35.0
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T\ (100\ K)}$	Nm/A	14.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	915
Winding resistance (at 20 °C)	R_{ph}	Ω	1.47
Rotating field inductance	L_D	mH	49
Electrical time constant	T_{el}	ms	33.5
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.4
Moment of inertia	J_{mot}	kgm^2	0.16
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	108
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.09
Shaft torsional stiffness	c_t	Nm/rad	1.1E+06
Weight	m	kg	121
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	4.3
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	2.92E+07
Weight	m	kg	124

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



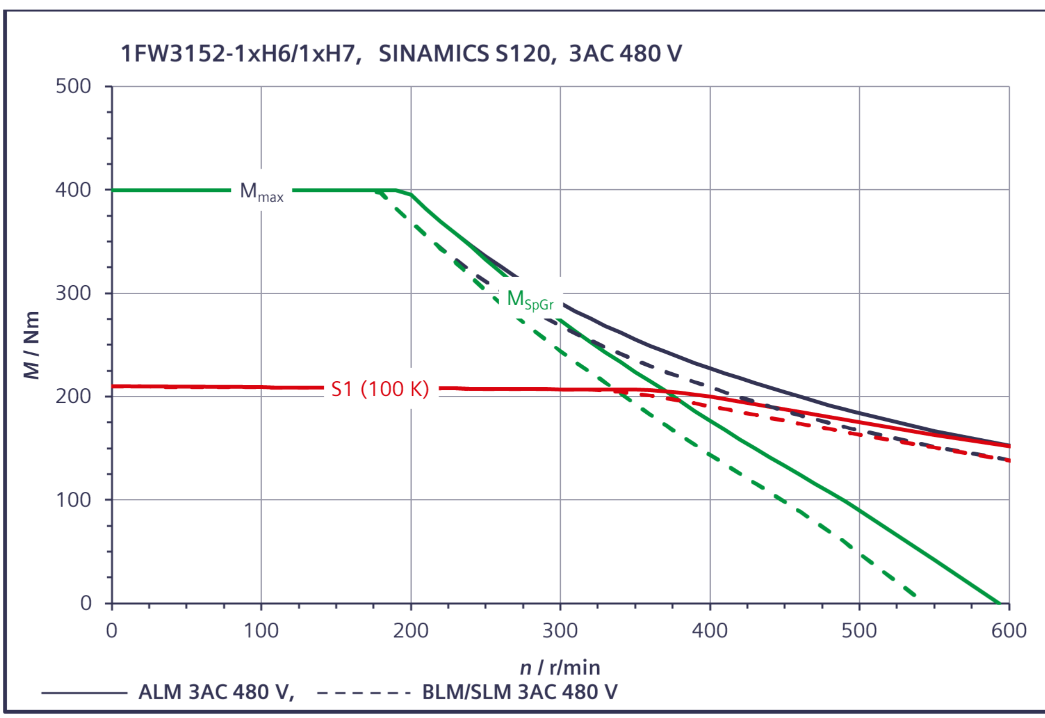
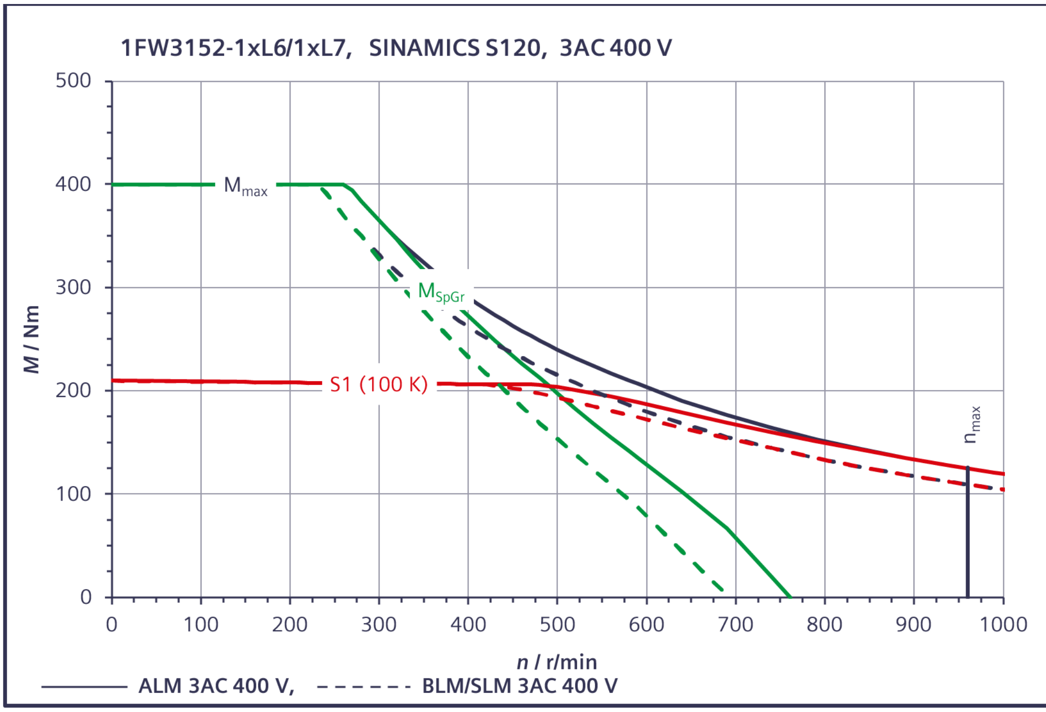


Table 6-9 1FW3152, rated speed 500 r/min

Engineering data	Code	Unit	1FW3152-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	200
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	10.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	22.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	210
Stall current (100 K)	$I_{0\ (100\ K)}$	A	22.5
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	960
Maximum torque	M_{max}	Nm	400
Maximum current	I_{max}	A	53
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T\ (100\ K)}$	Nm/A	9.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	600
Winding resistance (at 20 °C)	R_{ph}	Ω	0.62
Rotating field inductance	L_D	mH	21
Electrical time constant	T_{el}	ms	34.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.4
Moment of inertia	J_{mot}	kgm^2	0.16
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	108
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.09
Shaft torsional stiffness	c_t	Nm/rad	1.1E+06
Weight	m	kg	121
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	4.2
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	2.92E+07
Weight	m	kg	124

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



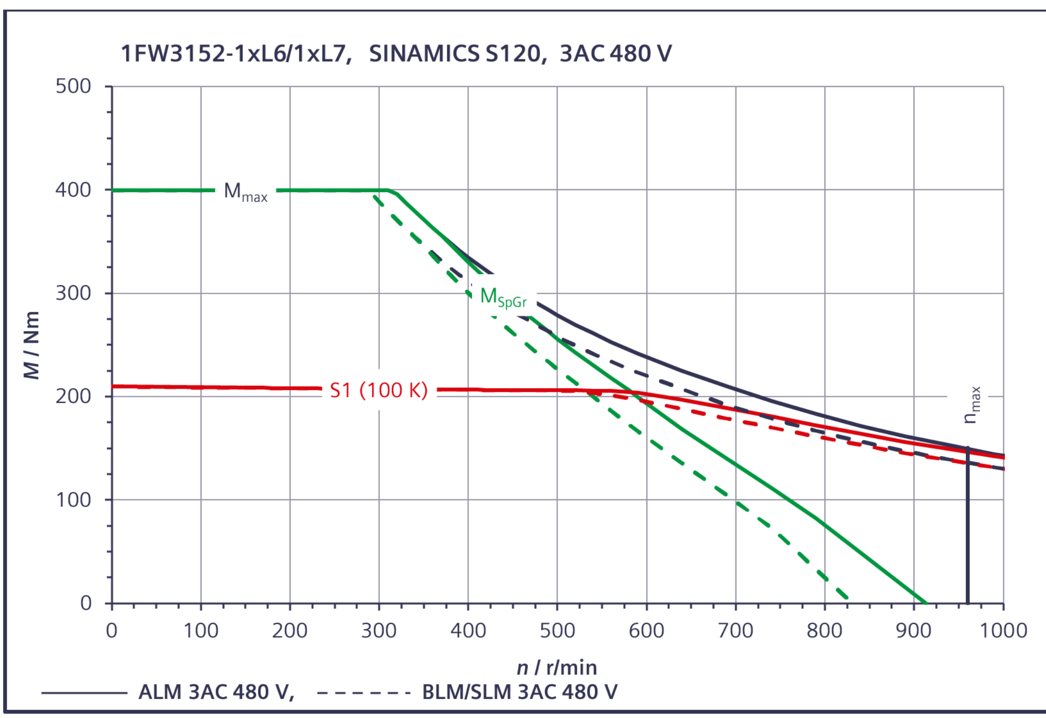
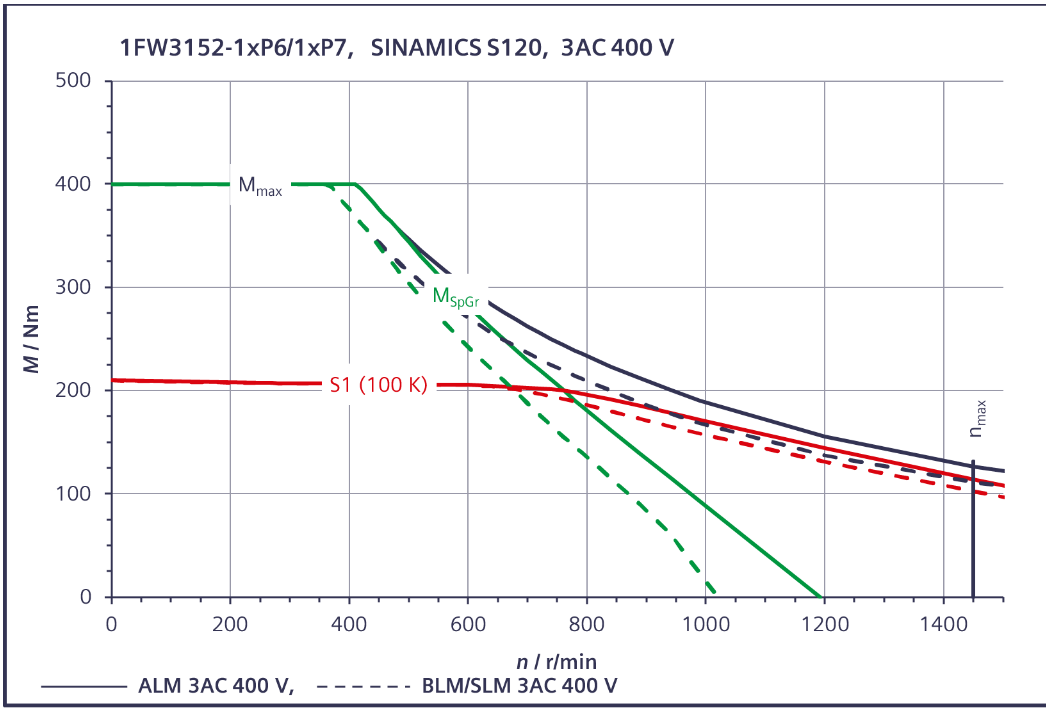


Table 6-10 1FW3152, rated speed 750 r/min

Engineering data	Code	Unit	1FW3152-1☐P
Rated speed	n_N	r/min	750
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	200
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	15.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	32.5
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	210
Stall current (100 K)	$I_{0\ (100\ K)}$	A	33.5
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1450
Maximum torque	M_{max}	Nm	400
Maximum current	I_{max}	A	79
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T\ (100\ K)}$	Nm/A	6.3
Voltage constant (at 20 °C)	k_E	V/1000 r/min	399
Winding resistance (at 20 °C)	R_{ph}	Ω	0.28
Rotating field inductance	L_D	mH	9.5
Electrical time constant	T_{el}	ms	33.5
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.4
Moment of inertia	J_{mot}	kgm^2	0.16
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	108
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.09
Shaft torsional stiffness	c_t	Nm/rad	1.1E+06
Weight	m	kg	121
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	4.2
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	2.92E+07
Weight	m	kg	124

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



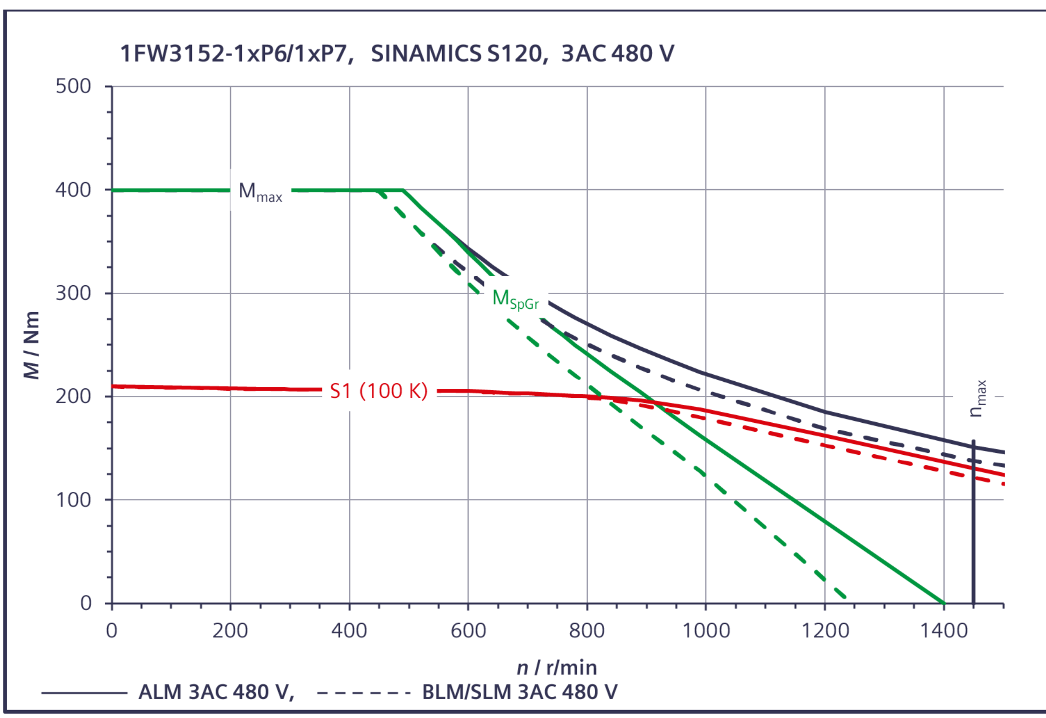
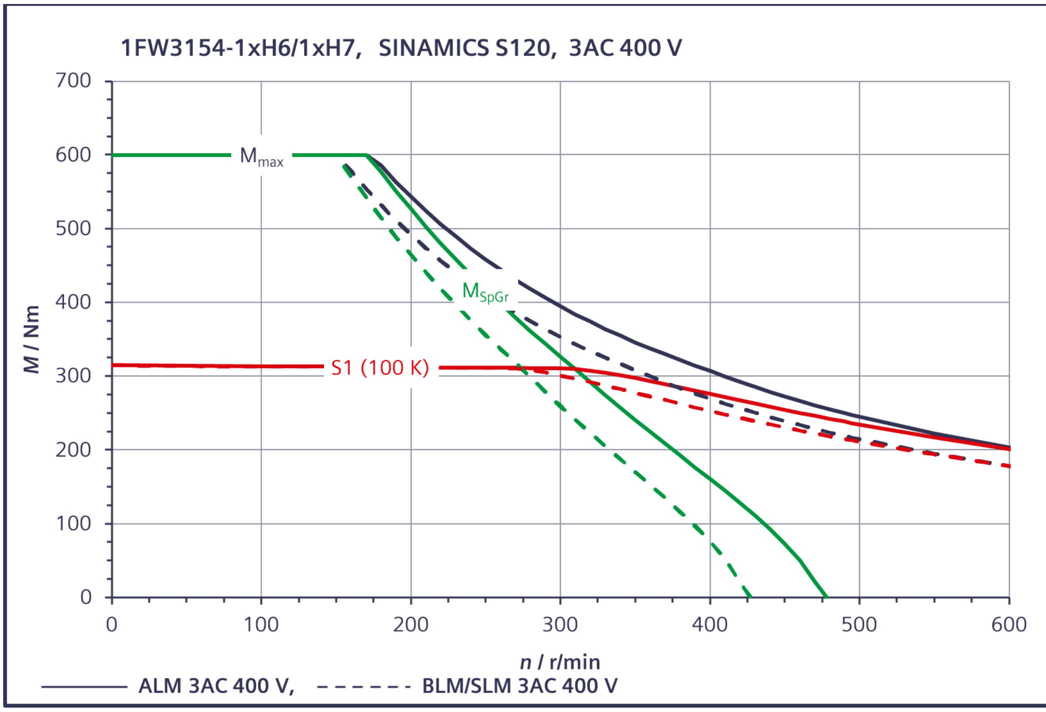


Table 6-11 1FW3154, rated speed 300 r/min

Engineering data	Code	Unit	1FW3154-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	300
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	9.4
Rated current (100 K)	$I_{N\ (100\ K)}$	A	20.5
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	315
Stall current (100 K)	$I_{0\ (100\ K)}$	A	21.5
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	610
Maximum torque	M_{max}	Nm	600
Maximum current	I_{max}	A	49.0
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	14.8
Voltage constant (at 20 °C)	k_E	V/1000 r/min	945
Winding resistance (at 20 °C)	R_{ph}	Ω	0.92
Rotating field inductance	L_D	mH	33
Electrical time constant	T_{el}	ms	36.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm²	0.2
Shaft torsional stiffness	c_t	Nm/rad	1.66E+07
Weight	m	kg	129
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm²	0.13
Shaft torsional stiffness	c_t	Nm/rad	9.10E+05
Weight	m	kg	143
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.2
Moment of inertia	J_{mot}	kgm²	0.25
Shaft torsional stiffness	c_t	Nm/rad	2.24E+07
Weight	m	kg	143

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



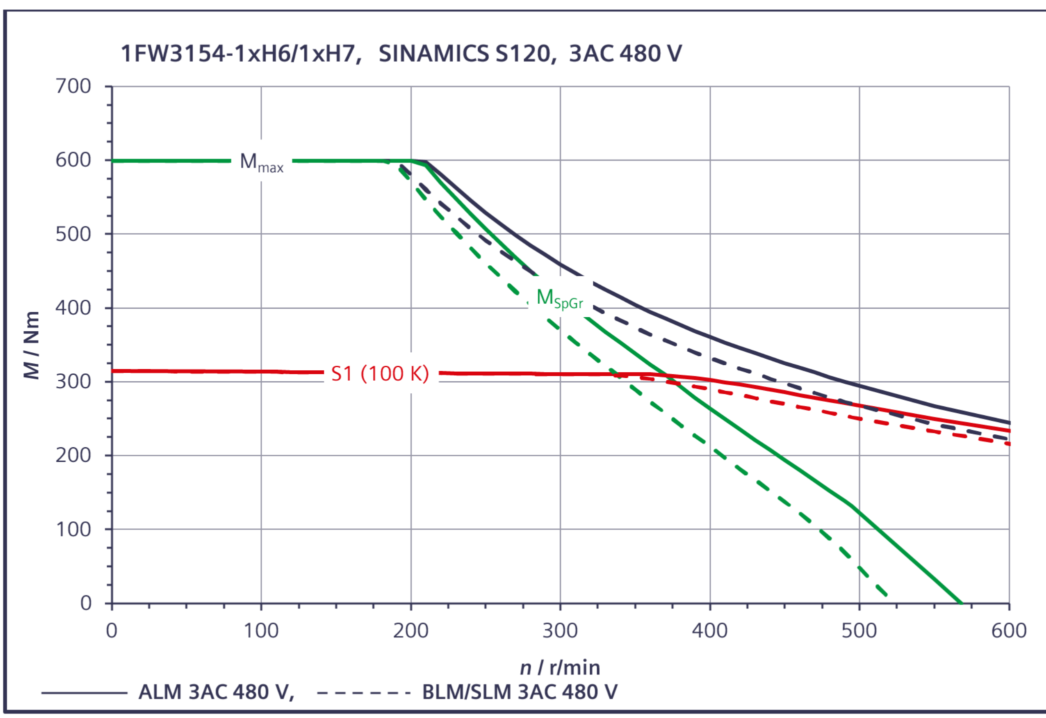
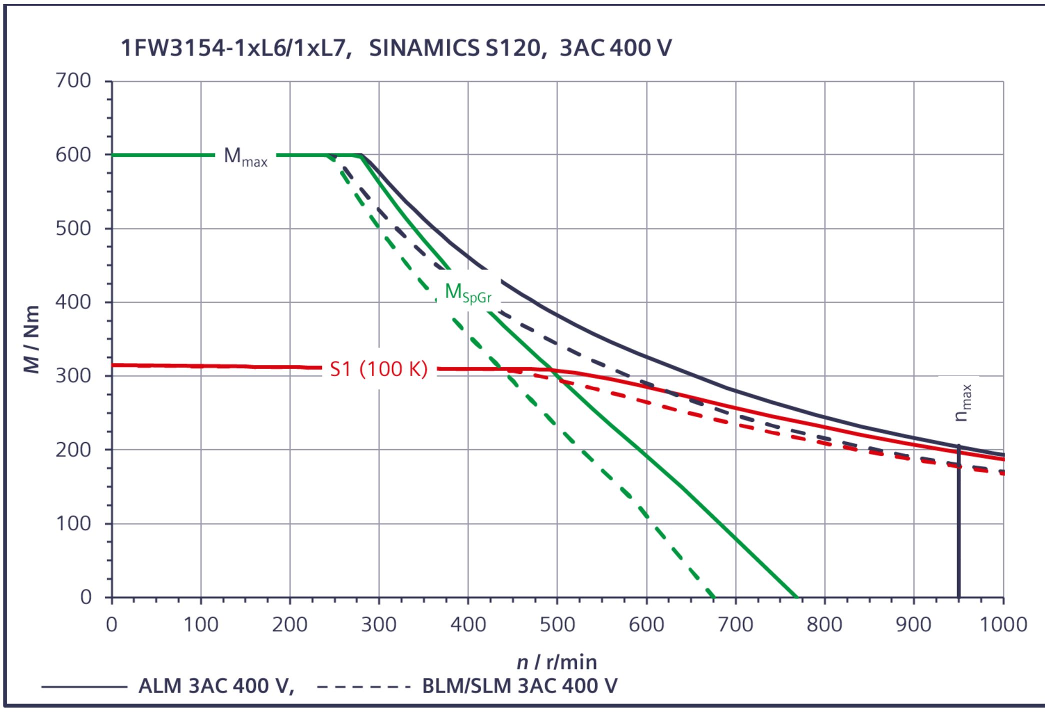


Table 6-12 1FW3154, rated speed 500 r/min

Engineering data	Code	Unit	1FW3154-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	300
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	15.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	32.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	315
Stall current (100 K)	$I_{0\ (100\ K)}$	A	33.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	950
Maximum torque	M_{max}	Nm	600
Maximum current	I_{max}	A	75
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	9.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	610
Winding resistance (at 20 °C)	R_{ph}	Ω	0.39
Rotating field inductance	L_D	mH	14.0
Electrical time constant	T_{el}	ms	36.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	1.66E+07
Weight	m	kg	129
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.13
Shaft torsional stiffness	c_t	Nm/rad	9.10E+05
Weight	m	kg	143
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.2
Moment of inertia	J_{mot}	kgm^2	0.25
Shaft torsional stiffness	c_t	Nm/rad	2.24E+07
Weight	m	kg	143

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



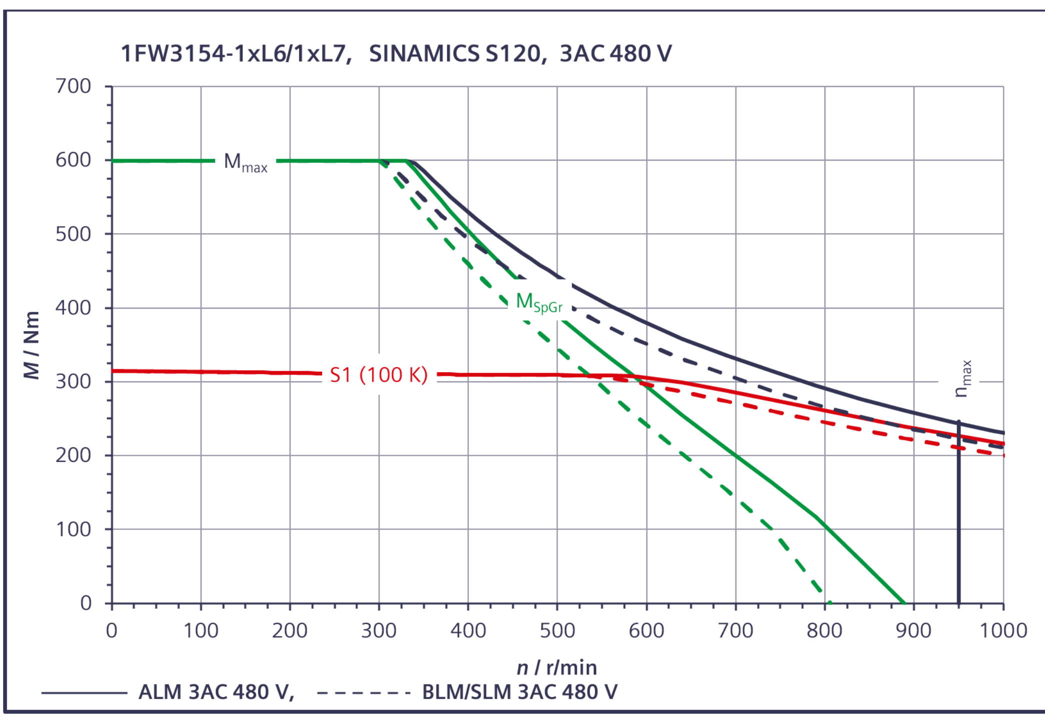
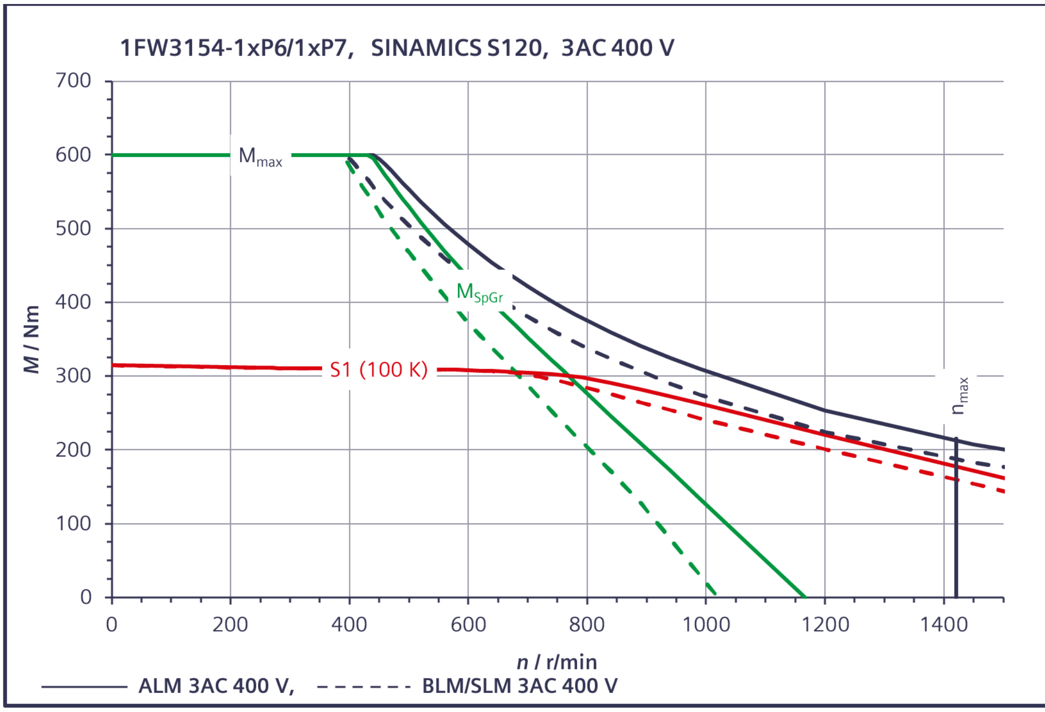


Table 6-13 1FW3154, rated speed 750 r/min

Engineering data	Code	Unit	1FW3154-1☐P
Rated speed	n_N	r/min	750
Rated torque (100 K)	$M_{N (100 K)}$	Nm	300
Rated power (100 K)	$P_{N (100 K)}$	kW	23.5
Rated current (100 K)	$I_{N (100 K)}$	A	47.5
Static torque (100 K)	$M_{0 (100 K)}$	Nm	315
Stall current (100 K)	$I_{0 (100 K)}$	A	49.0
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max Inv}$	r/min	1420
Maximum torque	M_{max}	Nm	600
Maximum current	I_{max}	A	113
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	6.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	407
Winding resistance (at 20 °C)	R_{ph}	Ω	0.171
Rotating field inductance	L_D	mH	6.0
Electrical time constant	T_{el}	ms	35.5
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	1.66E+07
Weight	m	kg	129
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.13
Shaft torsional stiffness	c_t	Nm/rad	9.10E+05
Weight	m	kg	143
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.2
Moment of inertia	J_{mot}	kgm^2	0.25
Shaft torsional stiffness	c_t	Nm/rad	2.24E+07
Weight	m	kg	143

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



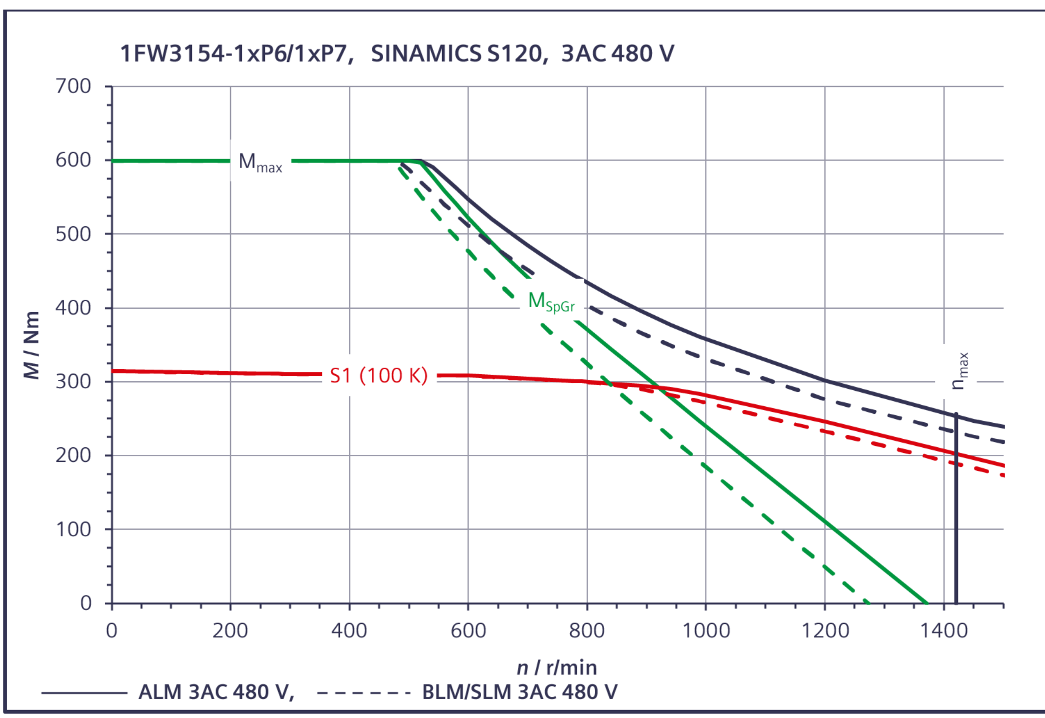
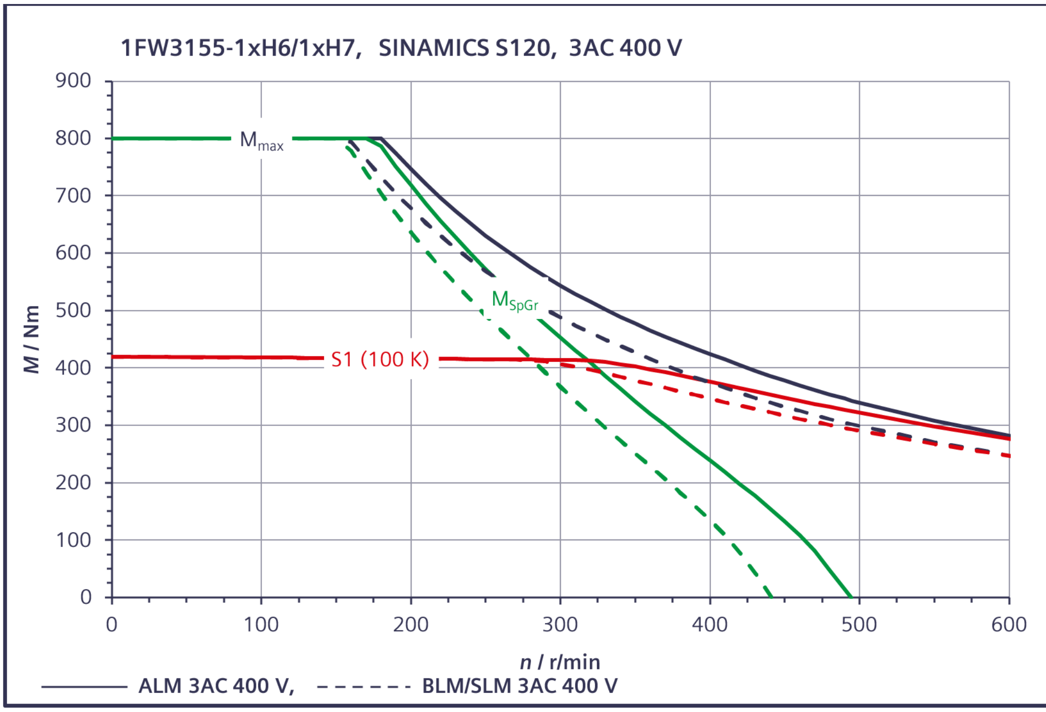


Table 6-14 1FW3155, rated speed 300 r/min

Engineering data	Code	Unit	1FW3155-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	12.6
Rated current (100 K)	$I_{N\ (100\ K)}$	A	28.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	420
Stall current (100 K)	$I_{0\ (100\ K)}$	A	29.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	630
Maximum torque	M_{max}	Nm	800
Maximum current	I_{max}	A	67
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	k_T	Nm/A	14.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	915
Winding resistance (at 20 °C)	R_{ph}	Ω	0.61
Rotating field inductance	L_D	mH	24
Electrical time constant	T_{el}	ms	39.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.1
Moment of inertia	J_{mot}	kgm^2	0.24
Shaft torsional stiffness	c_t	Nm/rad	1.40E+07
Weight	m	kg	150
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.17
Shaft torsional stiffness	c_t	Nm/rad	8.30E+05
Weight	m	kg	164
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	0.29
Shaft torsional stiffness	c_t	Nm/rad	1.84E+07
Weight	m	kg	163

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



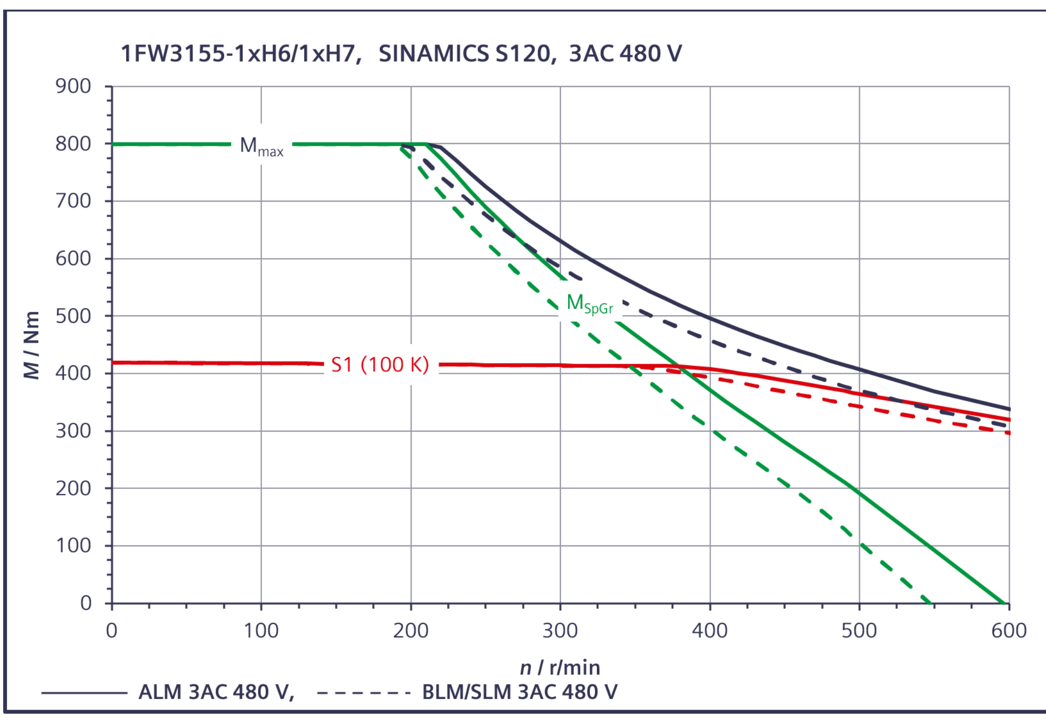
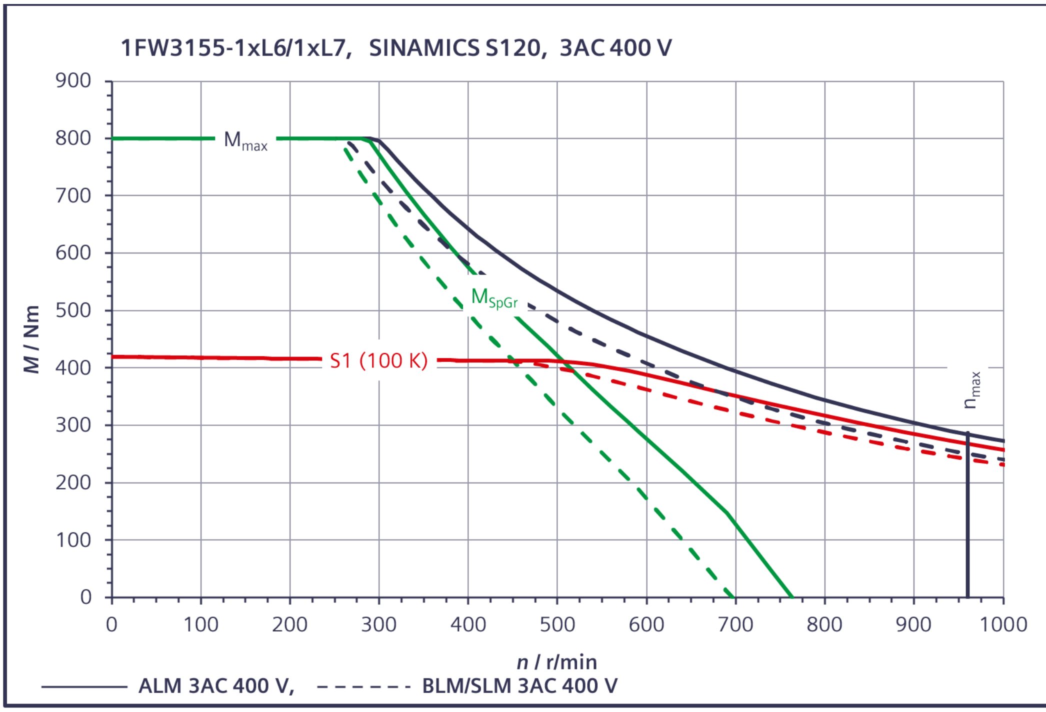


Table 6-15 1FW3155, rated speed 500 r/min

Engineering data	Code	Unit	1FW3155-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	21.0
Rated current (100 K)	$I_{N\ (100\ K)}$	A	43.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	420
Stall current (100 K)	$I_{0\ (100\ K)}$	A	45.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	960
Maximum torque	M_{max}	Nm	800
Maximum current	I_{max}	A	103
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	k_T	Nm/A	9.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	600
Winding resistance (at 20 °C)	R_{ph}	Ω	0.265
Rotating field inductance	L_D	mH	10.0
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.2
Moment of inertia	J_{mot}	kgm^2	0.24
Shaft torsional stiffness	c_t	Nm/rad	1.40E+07
Weight	m	kg	150
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.17
Shaft torsional stiffness	c_t	Nm/rad	8.30E+05
Weight	m	kg	164
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	0.29
Shaft torsional stiffness	c_t	Nm/rad	1.84E+07
Weight	m	kg	163

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



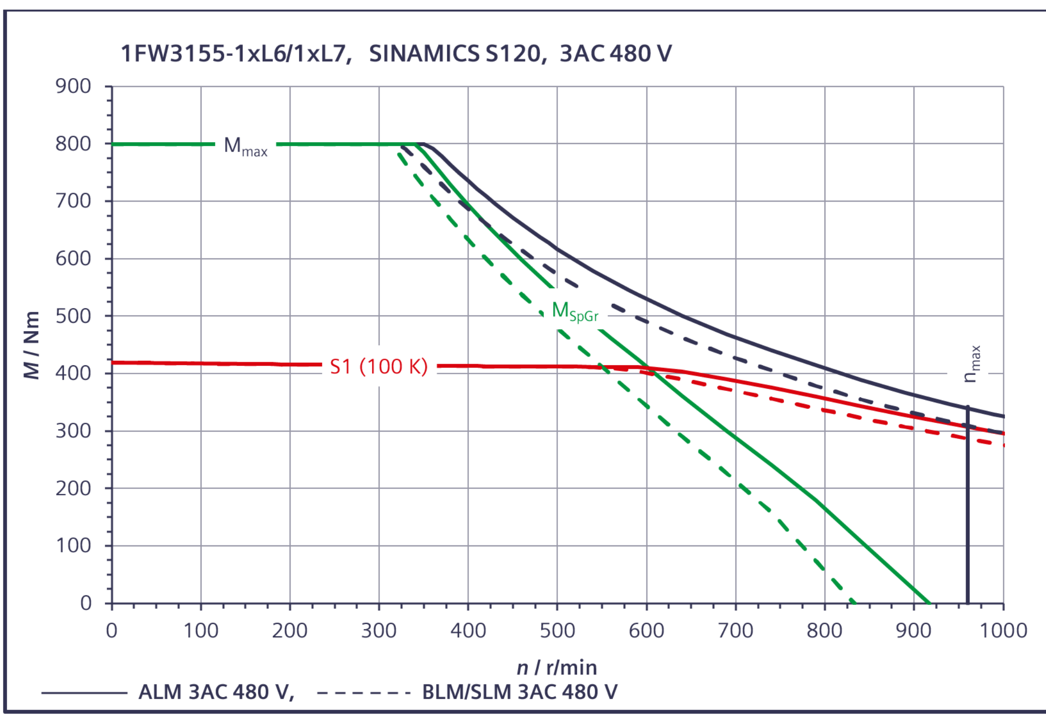
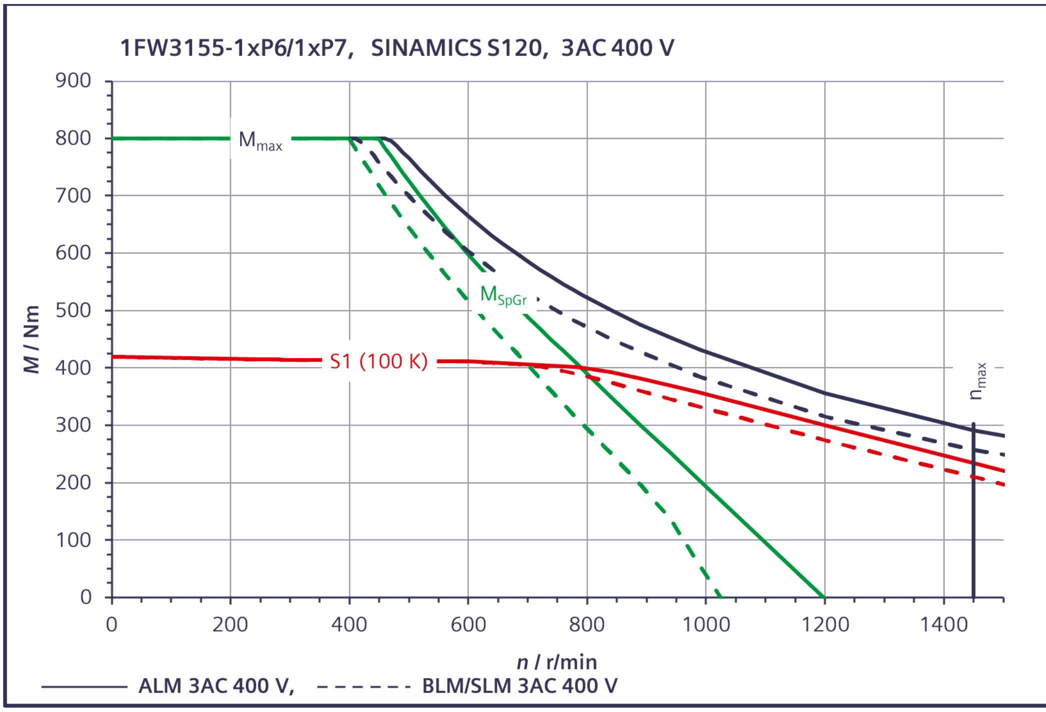


Table 6-16 1FW3155, rated speed 750 r/min

Engineering data	Code	Unit	1FW3155-1☐P
Rated speed	n_N	r/min	750
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	31.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	64
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	420
Stall current (100 K)	$I_{0\ (100\ K)}$	A	67
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1450
Maximum torque	M_{max}	Nm	800
Maximum current	I_{max}	A	153
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	k_T	Nm/A	6.3
Voltage constant (at 20 °C)	k_E	V/1000 r/min	399
Winding resistance (at 20 °C)	R_{ph}	Ω	0.112
Rotating field inductance	L_D	mH	4.4
Electrical time constant	T_{el}	ms	39.5
Thermal time constant	T_{th}	min	4.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	0.24
Shaft torsional stiffness	c_t	Nm/rad	1.40E+07
Weight	m	kg	150
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.17
Shaft torsional stiffness	c_t	Nm/rad	8.30E+05
Weight	m	kg	164
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	0.29
Shaft torsional stiffness	c_t	Nm/rad	1.84E+07
Weight	m	kg	163

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



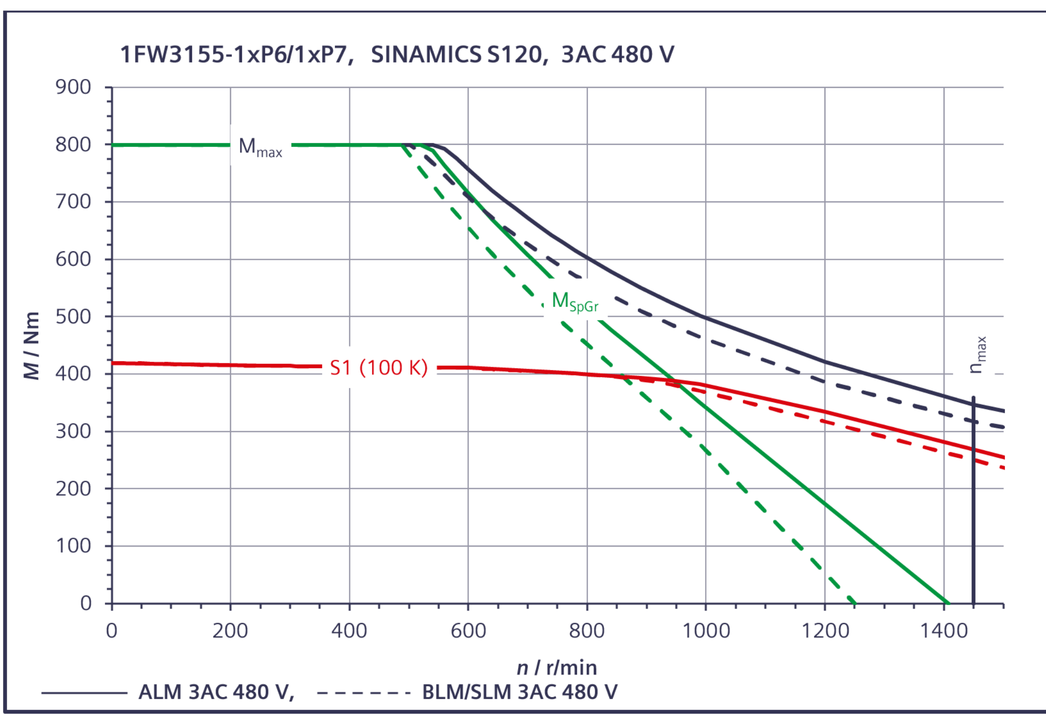
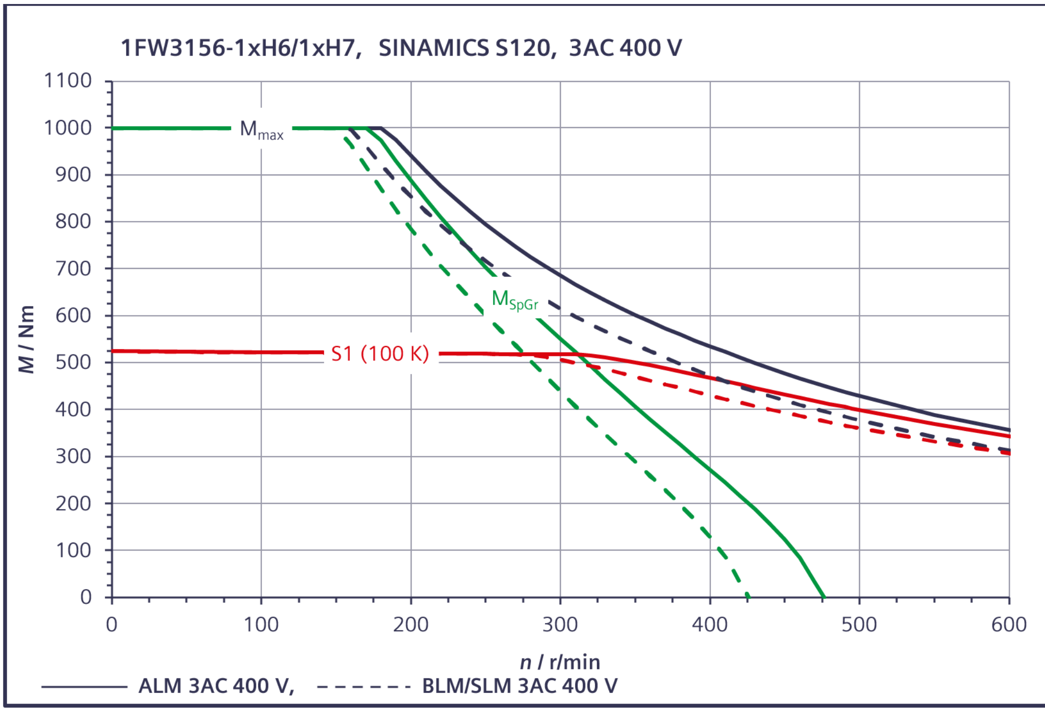


Table 6-17 1FW3156, rated speed 300 r/min

Engineering data	Code	Unit	1FW3156-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	15.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	34.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	35.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	610
Maximum torque	M_{max}	Nm	1000
Maximum current	I_{max}	A	81
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	14.9
Voltage constant (at 20 °C)	k_E	V/1000 r/min	945
Winding resistance (at 20 °C)	R_{ph}	Ω	0.5
Rotating field inductance	L_D	mH	20
Electrical time constant	T_{el}	ms	39.5
Thermal time constant	T_{th}	min	5.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.28
Shaft torsional stiffness	c_t	Nm/rad	1.13E+07
Weight	m	kg	171
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	7.60E+05
Weight	m	kg	187
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	0.34
Shaft torsional stiffness	c_t	Nm/rad	1.55E+07
Weight	m	kg	184

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



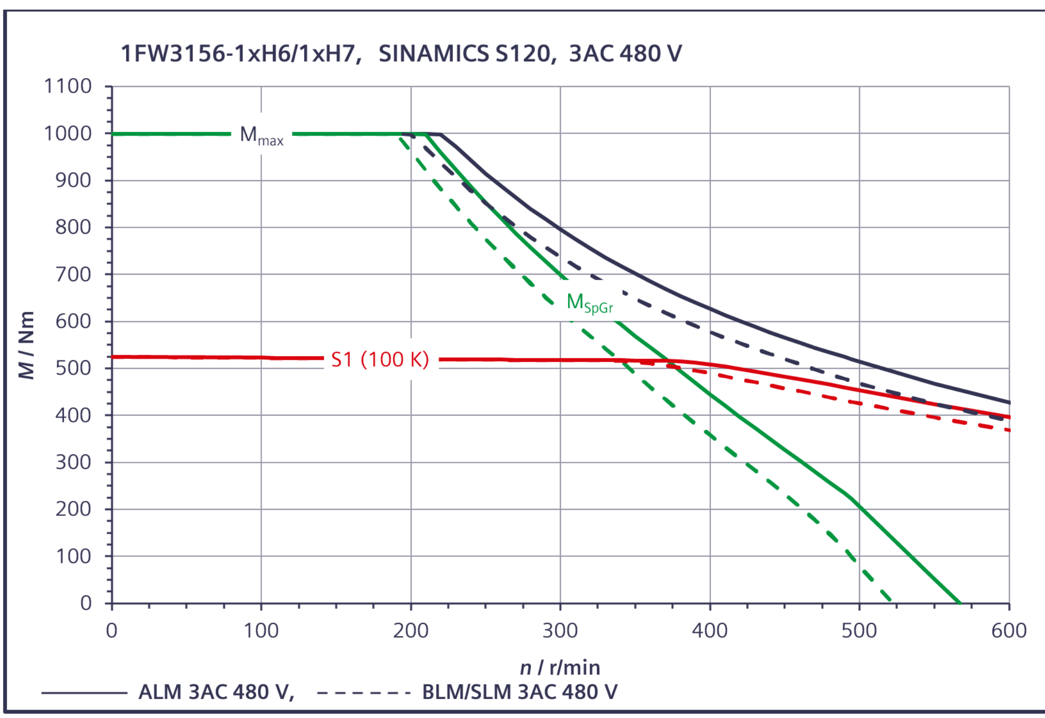
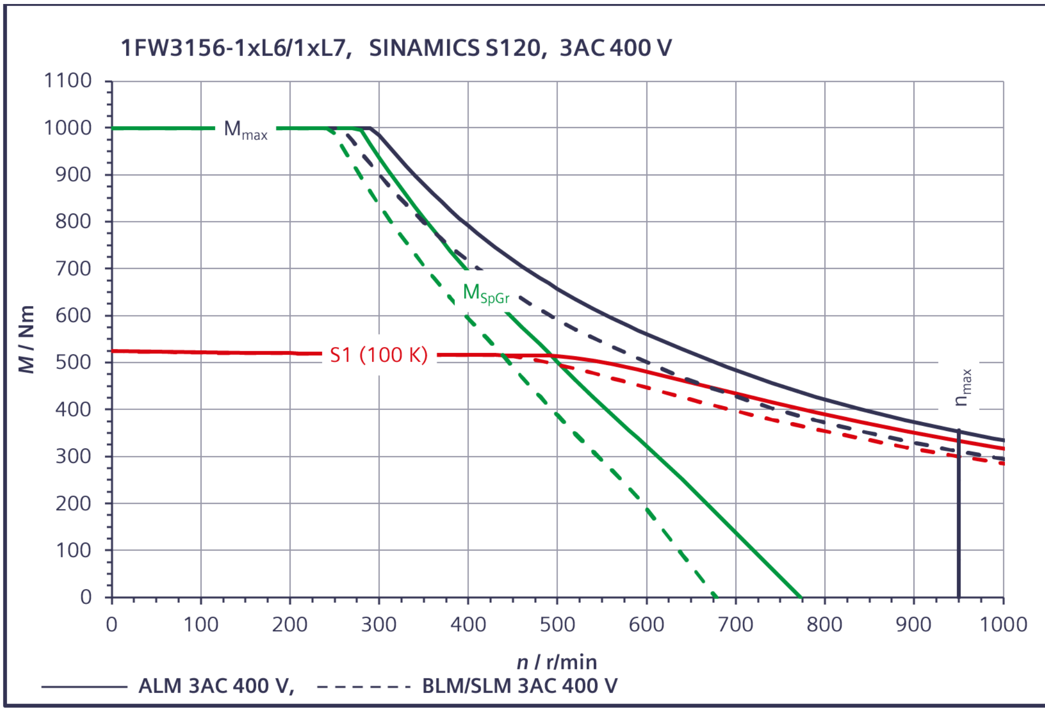


Table 6-18 1FW3156, rated speed 500 r/min

Engineering data	Code	Unit	1FW3156-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	26.0
Rated current (100 K)	$I_{N\ (100\ K)}$	A	53
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	55
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	950
Maximum torque	M_{max}	Nm	1000
Maximum current	I_{max}	A	126
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	9.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	610
Winding resistance (at 20 °C)	R_{ph}	Ω	0.215
Rotating field inductance	L_D	mH	8.5
Electrical time constant	T_{el}	ms	40.0
Thermal time constant	T_{th}	min	5.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.28
Shaft torsional stiffness	c_t	Nm/rad	1.13E+07
Weight	m	kg	171
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	7.60E+05
Weight	m	kg	187
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	0.34
Shaft torsional stiffness	c_t	Nm/rad	1.55E+07
Weight	m	kg	184

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



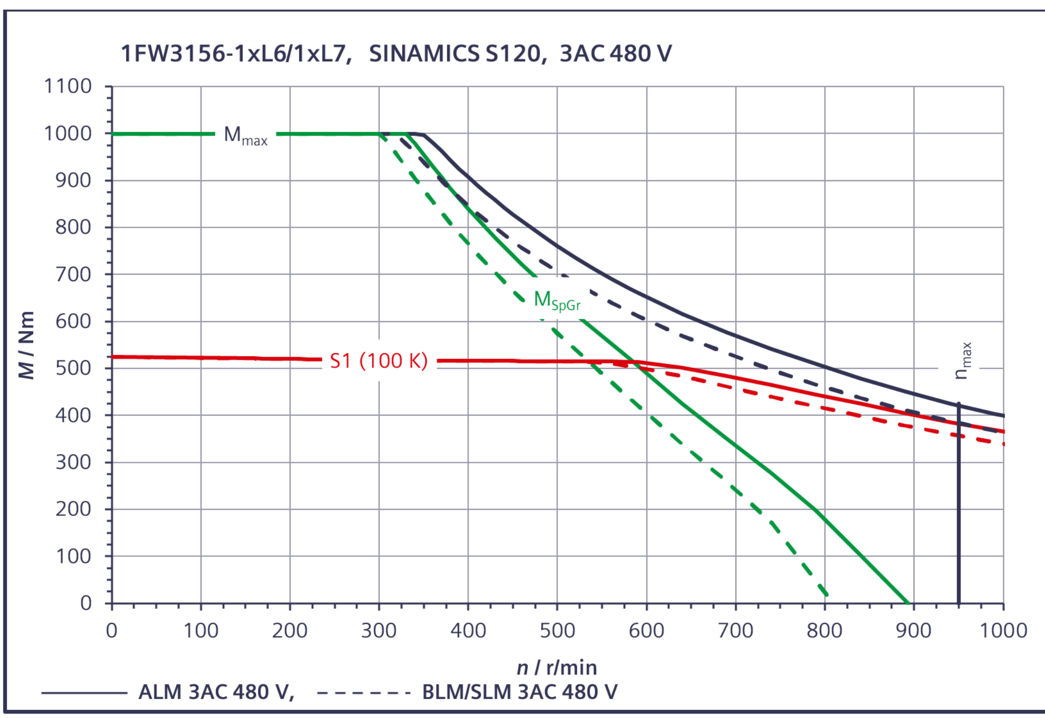
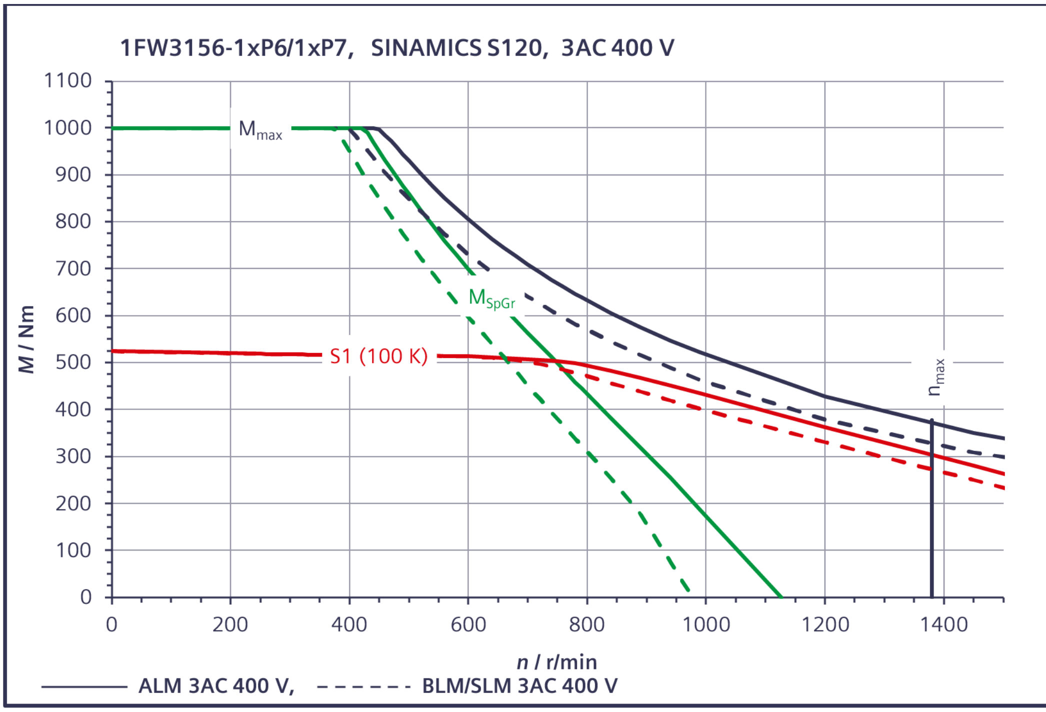


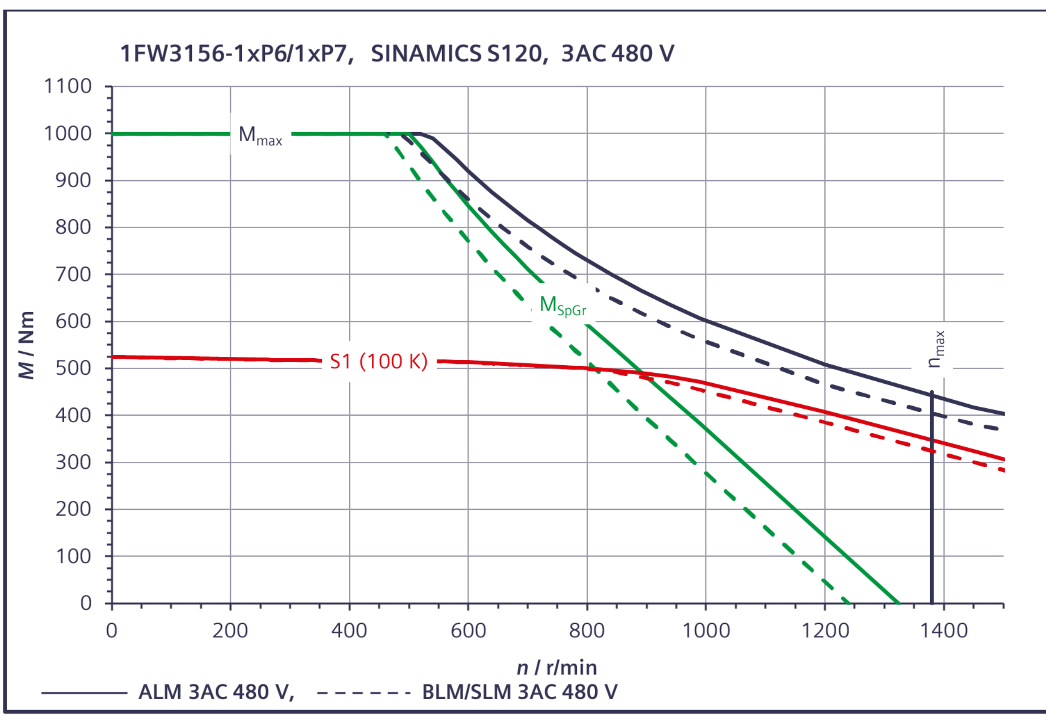
Table 6-19 1FW3156, rated speed 750 r/min

Engineering data	Code	Unit	1FW3156-1☐P
Rated speed	n_N	r/min	750
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	39.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	76
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	80
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1700
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1380
Maximum torque	M_{max}	Nm	1000
Maximum current	I_{max}	A	183
Motor data			
Number of poles	2p		14
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	419
Winding resistance (at 20 °C)	R_{ph}	Ω	0.098
Rotating field inductance	L_D	mH	3.9
Electrical time constant	T_{el}	ms	40.0
Thermal time constant	T_{th}	min	5.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.28
Shaft torsional stiffness	c_t	Nm/rad	1.13E+07
Weight	m	kg	171
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.2
Shaft torsional stiffness	c_t	Nm/rad	7.60E+05
Weight	m	kg	187
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	0.34
Shaft torsional stiffness	c_t	Nm/rad	1.55E+07
Weight	m	kg	184

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*





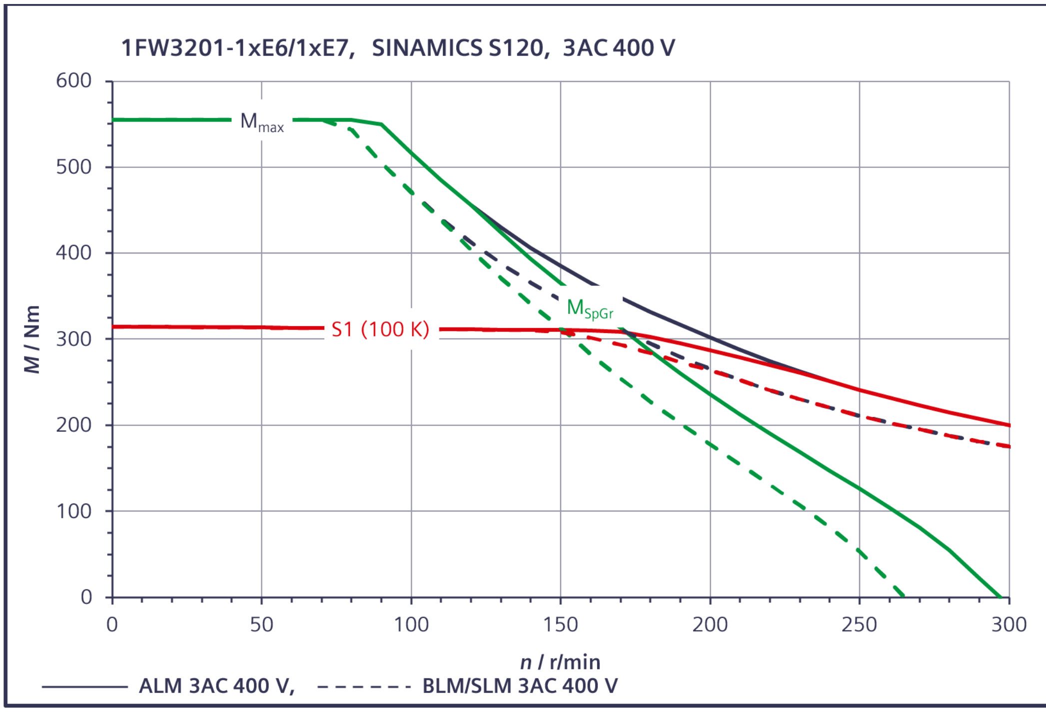
6.4.2 Shaft height 200, Standard

Table 6-20 1FW3201, rated speed 150 r/min

Engineering data	Code	Unit	1FW3201-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	300
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	4.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	13.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	315
Stall current (100 K)	$I_{0\ (100\ K)}$	A	13.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	380
Maximum torque	M_{max}	Nm	555
Maximum current	I_{max}	A	28.0
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	24.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1520
Winding resistance (at 20 °C)	R_{ph}	Ω	1.89
Rotating field inductance	L_D	mH	50
Electrical time constant	T_{el}	ms	27.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.2
Moment of inertia	J_{mot}	kgm^2	0.22
Shaft torsional stiffness	c_t	Nm/rad	3.73E+07
Weight	m	kg	127
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	0.23
Shaft torsional stiffness	c_t	Nm/rad	3.48E+06
Weight	m	kg	176
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.7
Moment of inertia	J_{mot}	kgm^2	0.27
Shaft torsional stiffness	c_t	Nm/rad	4.90E+07
Weight	m	kg	159

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



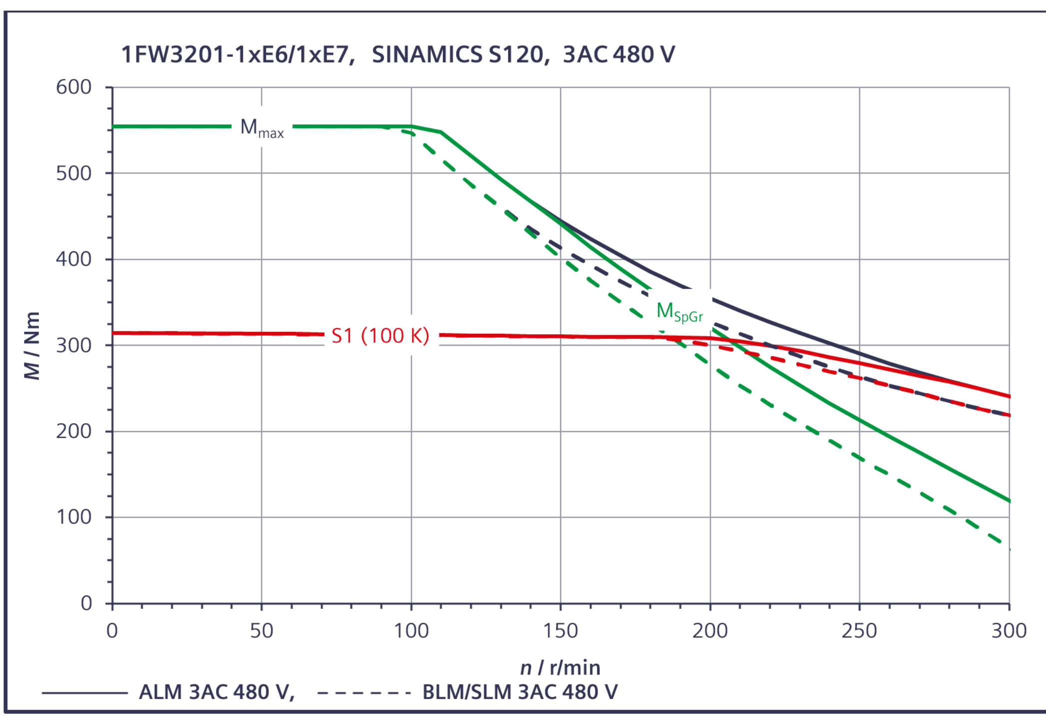
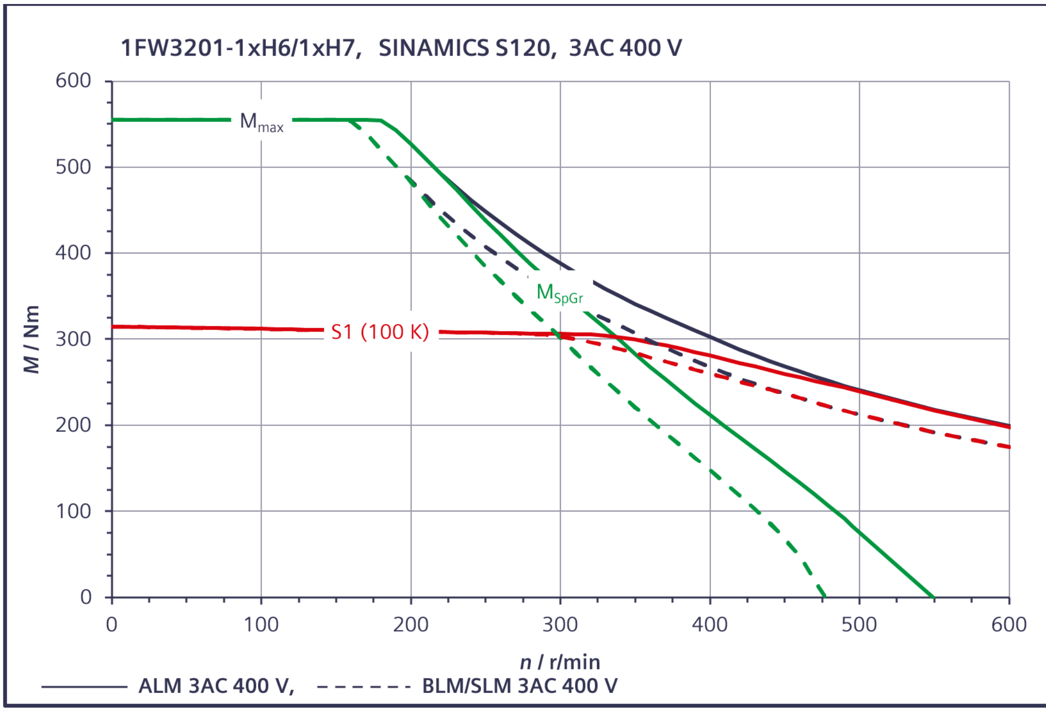


Table 6-21 1FW3201, rated speed 300 r/min

Engineering data	Code	Unit	1FW3201-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	300
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	9.4
Rated current (100 K)	$I_{N\ (100\ K)}$	A	23.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	315
Stall current (100 K)	$I_{0\ (100\ K)}$	A	24.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	680
Maximum torque	M_{max}	Nm	555
Maximum current	I_{max}	A	50
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	13.3
Voltage constant (at 20 °C)	k_E	V/1000 r/min	845
Winding resistance (at 20 °C)	R_{ph}	Ω	0.57
Rotating field inductance	L_D	mH	15.0
Electrical time constant	T_{el}	ms	26.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.1
Moment of inertia	J_{mot}	kgm^2	0.22
Shaft torsional stiffness	c_t	Nm/rad	3.73E+07
Weight	m	kg	127
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.2
Moment of inertia	J_{mot}	kgm^2	0.23
Shaft torsional stiffness	c_t	Nm/rad	3.48E+06
Weight	m	kg	176
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	0.27
Shaft torsional stiffness	c_t	Nm/rad	4.90E+07
Weight	m	kg	159

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



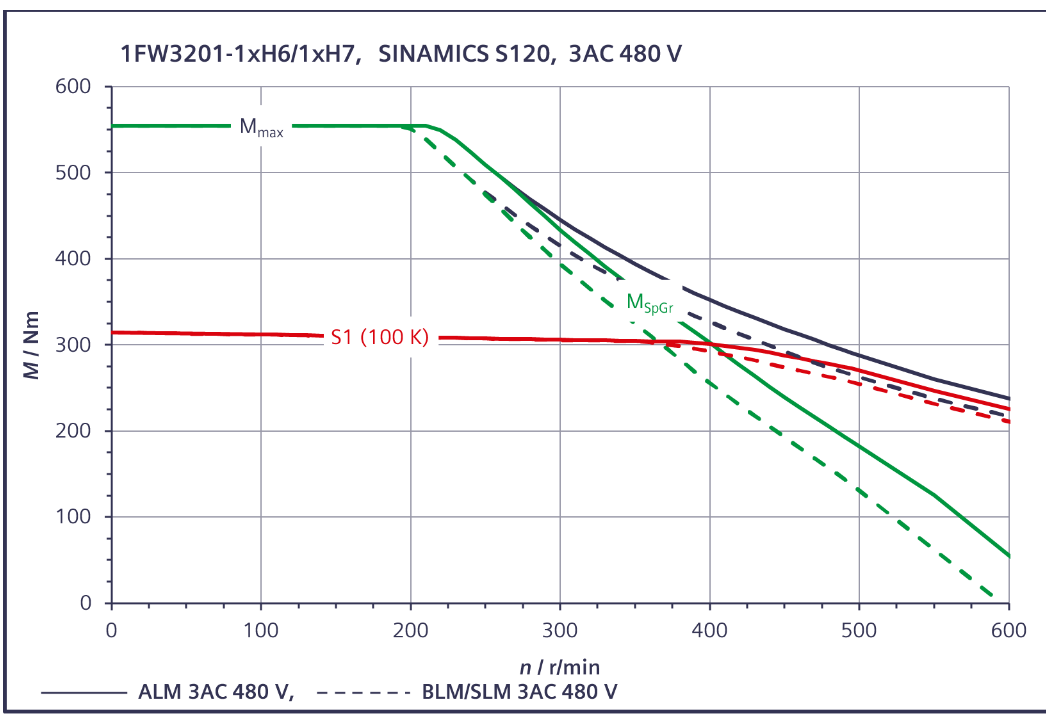
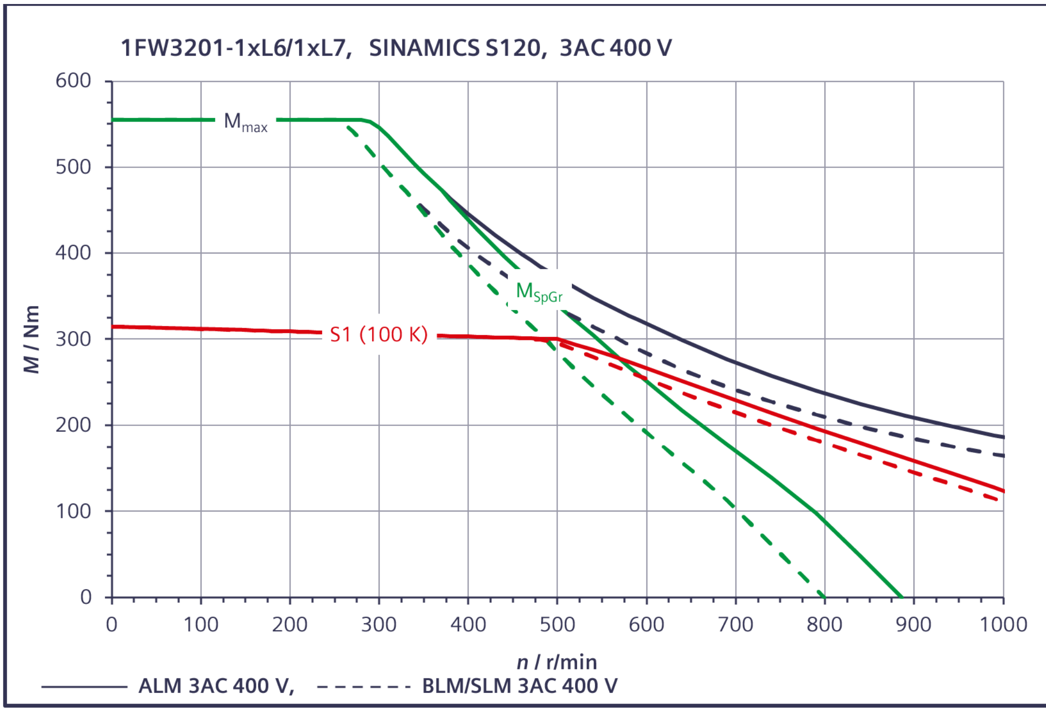


Table 6-22 1FW3201, rated speed 500 r/min

Engineering data	Code	Unit	1FW3201-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N (100 K)}$	Nm	300
Rated power (100 K)	$P_{N (100 K)}$	kW	15.7
Rated current (100 K)	$I_{N (100 K)}$	A	37.0
Static torque (100 K)	$M_{0 (100 K)}$	Nm	315
Stall current (100 K)	$I_{0 (100 K)}$	A	38.0
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	1110
Maximum torque	M_{max}	Nm	555
Maximum current	I_{max}	A	82
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	8.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	520
Winding resistance (at 20 °C)	R_{ph}	Ω	0.225
Rotating field inductance	L_D	mH	6.0
Electrical time constant	T_{el}	ms	26.5
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.2
Moment of inertia	J_{mot}	kgm^2	0.22
Shaft torsional stiffness	c_t	Nm/rad	3.73E+07
Weight	m	kg	127
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	0.23
Shaft torsional stiffness	c_t	Nm/rad	3.48E+06
Weight	m	kg	176
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.7
Moment of inertia	J_{mot}	kgm^2	0.27
Shaft torsional stiffness	c_t	Nm/rad	4.90E+07
Weight	m	kg	159

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



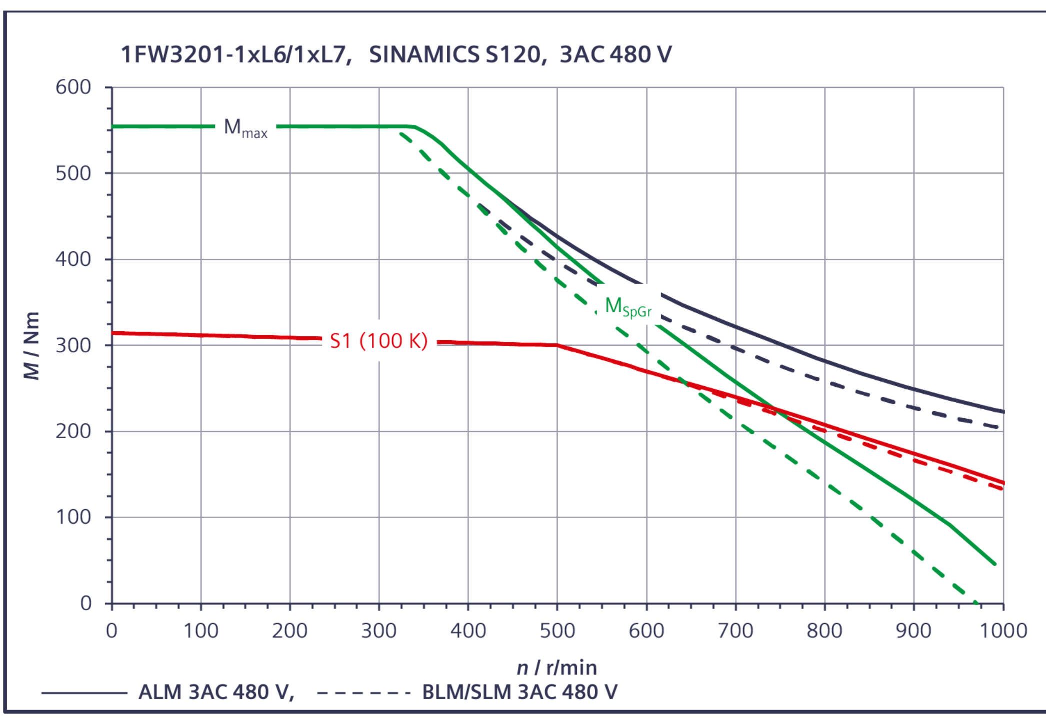
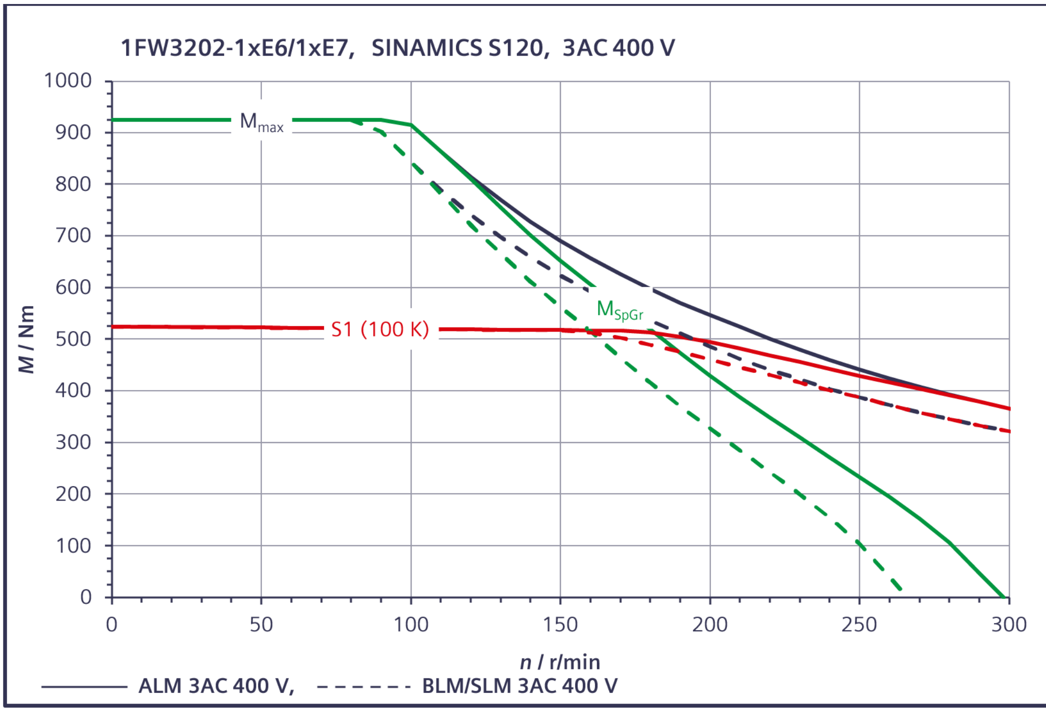


Table 6-23 1FW3202, rated speed 150 r/min

Engineering data	Code	Unit	1FW3202-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	7.9
Rated current (100 K)	$I_{N\ (100\ K)}$	A	21.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	22.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	380
Maximum torque	M_{max}	Nm	925
Maximum current	I_{max}	A	47.0
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	24.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1520
Winding resistance (at 20 °C)	R_{ph}	Ω	0.94
Rotating field inductance	L_D	mH	29
Electrical time constant	T_{el}	ms	31.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm²	0.36
Shaft torsional stiffness	c_t	Nm/rad	2.74E+07
Weight	m	kg	156
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm²	0.35
Shaft torsional stiffness	c_t	Nm/rad	3.28E+06
Weight	m	kg	205
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm²	0.39
Shaft torsional stiffness	c_t	Nm/rad	4.05E+07
Weight	m	kg	188

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



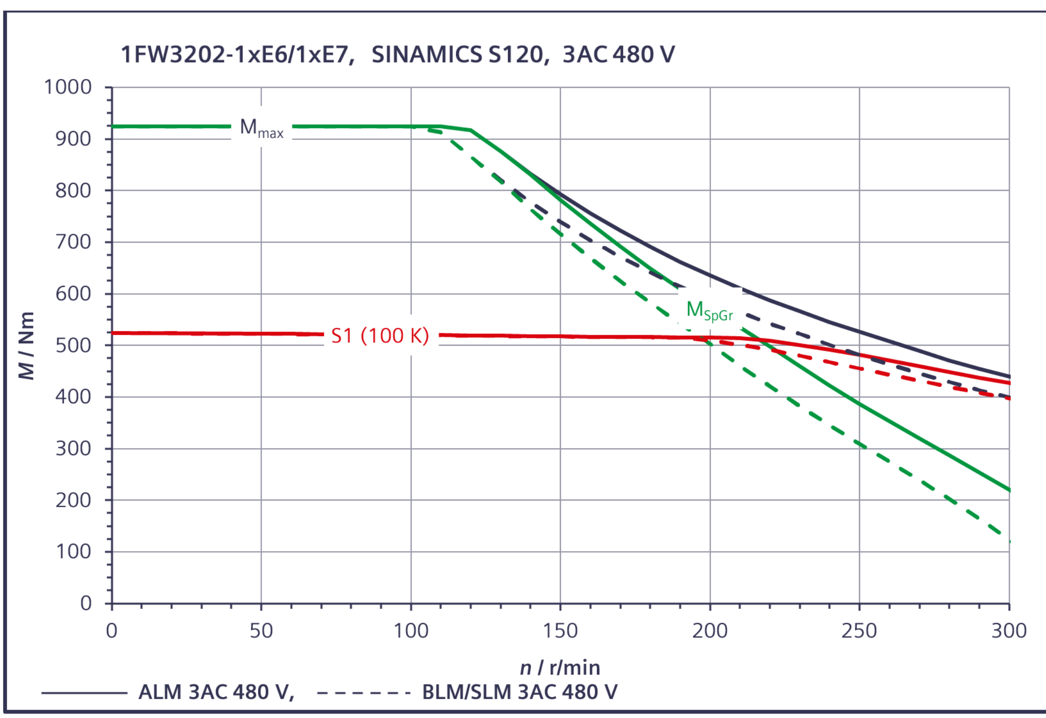
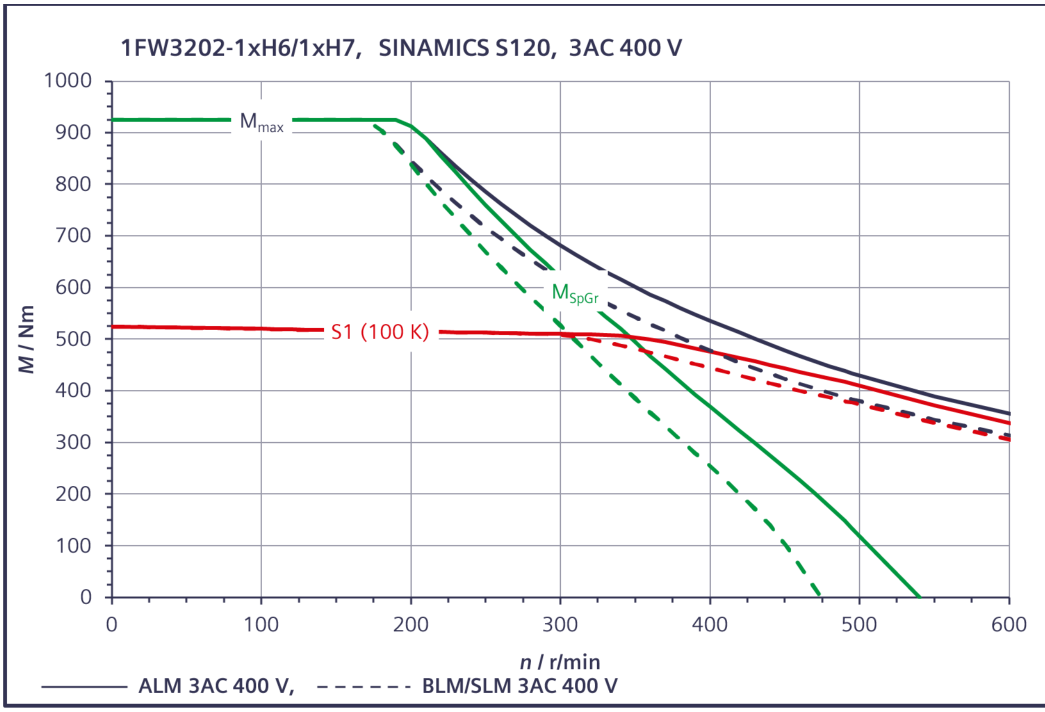


Table 6-24 1FW3202, rated speed 300 r/min

Engineering data	Code	Unit	1FW3202-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	15.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	37.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	39.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	670
Maximum torque	M_{max}	Nm	925
Maximum current	I_{max}	A	81
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	13.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	855
Winding resistance (at 20 °C)	R_{ph}	Ω	0.285
Rotating field inductance	L_D	mH	9.0
Electrical time constant	T_{el}	ms	31.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	0.36
Shaft torsional stiffness	c_t	Nm/rad	2.74E+07
Weight	m	kg	156
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.35
Shaft torsional stiffness	c_t	Nm/rad	3.28E+06
Weight	m	kg	205
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	0.39
Shaft torsional stiffness	c_t	Nm/rad	4.05E+07
Weight	m	kg	188

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



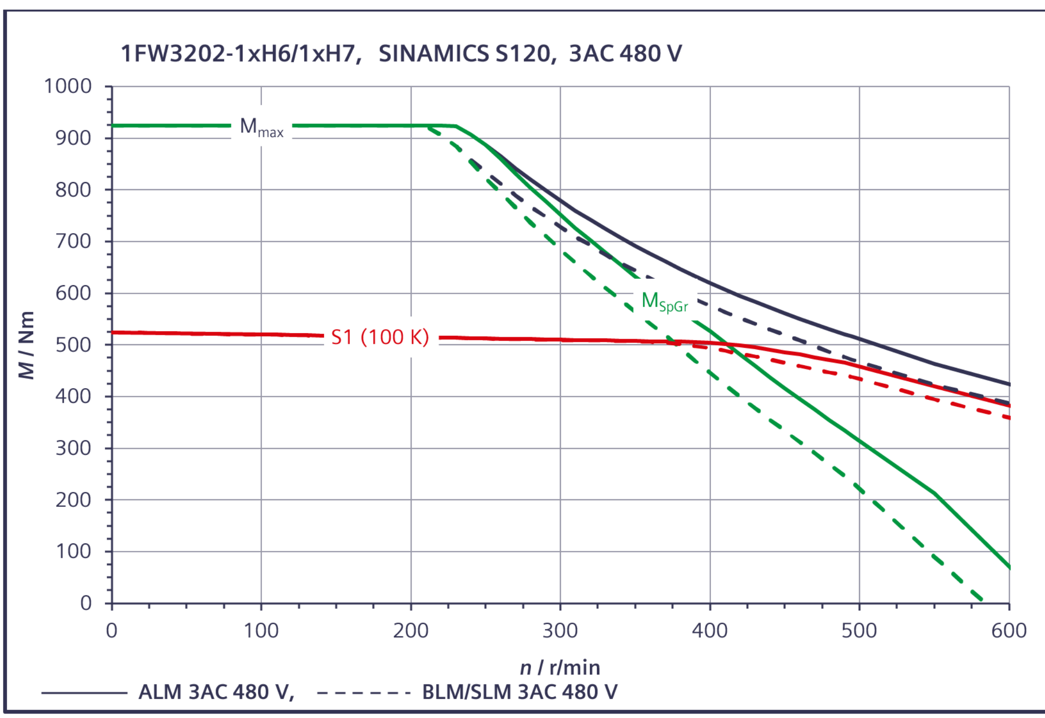
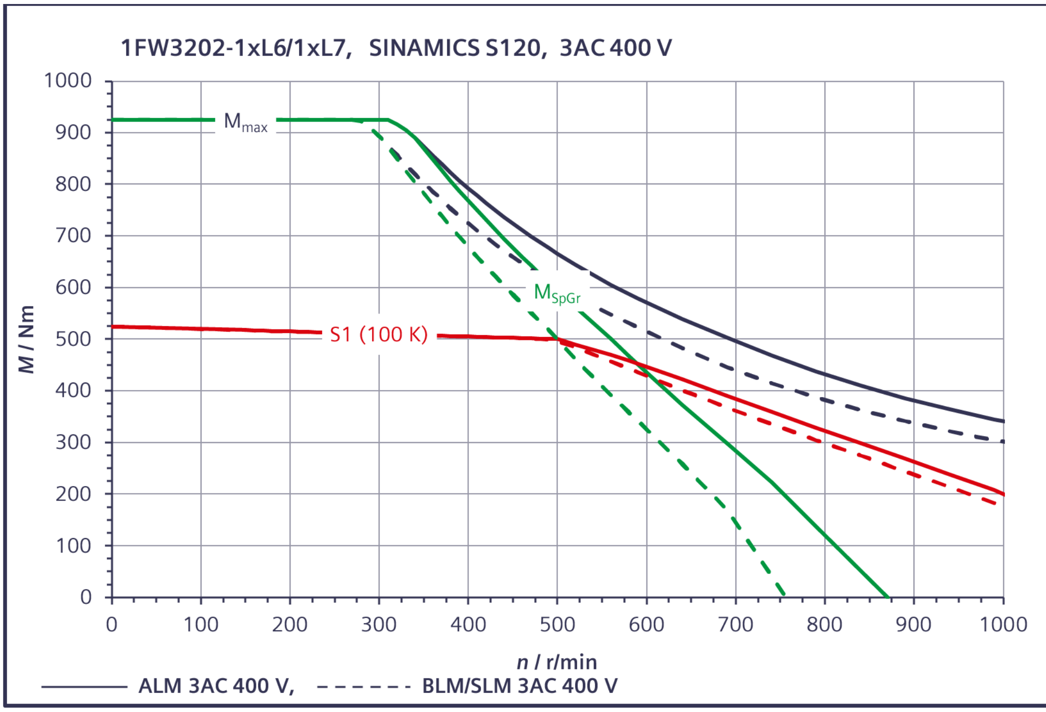


Table 6-25 1FW3202, rated speed 500 r/min

Engineering data	Code	Unit	1FW3202-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	26.0
Rated current (100 K)	$I_{N\ (100\ K)}$	A	59
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	525
Stall current (100 K)	$I_{0\ (100\ K)}$	A	62
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1070
Maximum torque	M_{max}	Nm	925
Maximum current	I_{max}	A	131
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	540
Winding resistance (at 20 °C)	R_{ph}	Ω	0.117
Rotating field inductance	L_D	mH	3.5
Electrical time constant	T_{el}	ms	30.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	0.36
Shaft torsional stiffness	c_t	Nm/rad	2.74E+07
Weight	m	kg	156
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	0.35
Shaft torsional stiffness	c_t	Nm/rad	3.28E+06
Weight	m	kg	205
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	0.39
Shaft torsional stiffness	c_t	Nm/rad	4.05E+07
Weight	m	kg	188

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



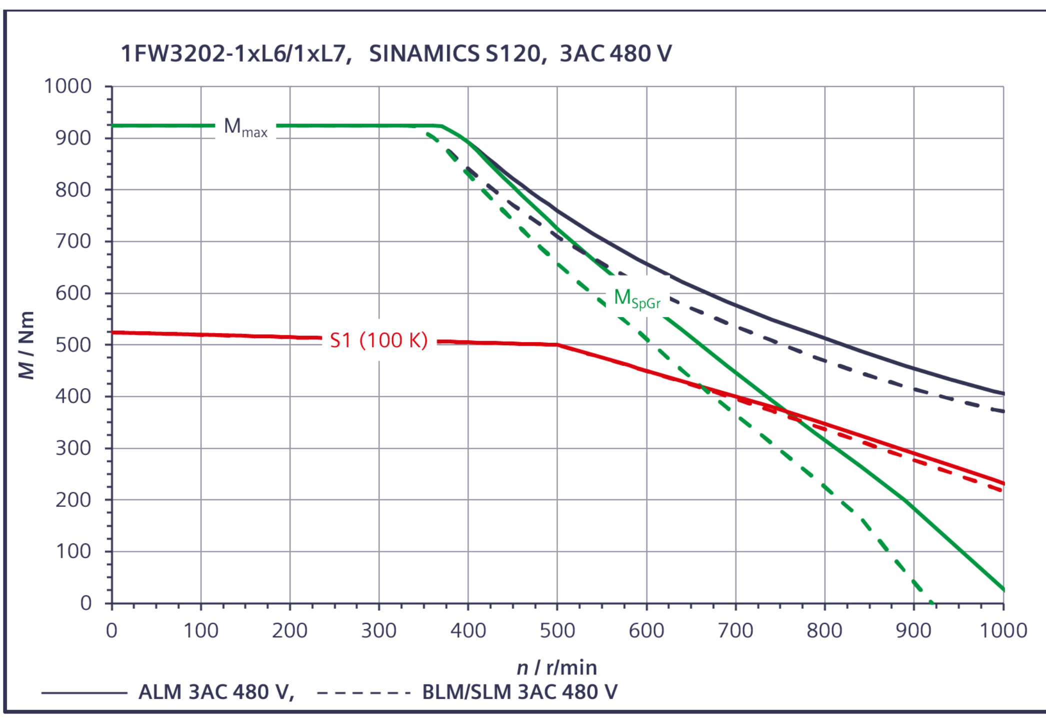
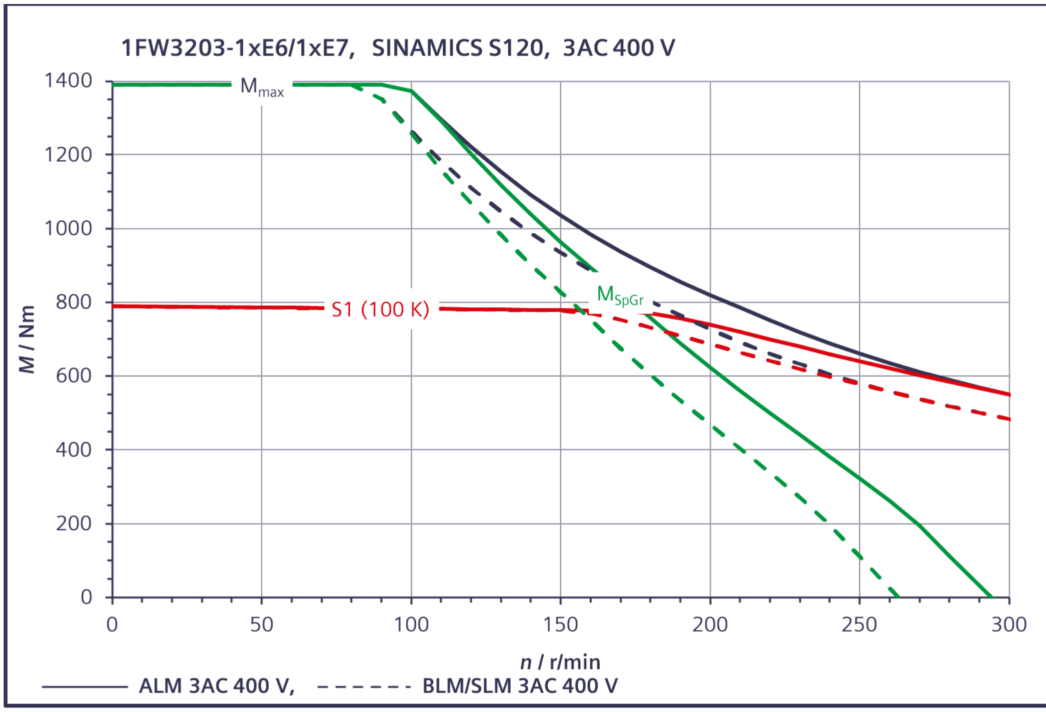


Table 6-26 1FW3203, rated speed 150 r/min

Engineering data	Code	Unit	1FW3203-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	750
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	11.8
Rated current (100 K)	$I_{N\ (100\ K)}$	A	31.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	790
Stall current (100 K)	$I_{0\ (100\ K)}$	A	32.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	370
Maximum torque	M_{max}	Nm	1390
Maximum current	I_{max}	A	69
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	24.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1555
Winding resistance (at 20 °C)	R_{ph}	Ω	0.64
Rotating field inductance	L_D	mH	20
Electrical time constant	T_{el}	ms	31.5
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.49
Shaft torsional stiffness	c_t	Nm/rad	2.16E+07
Weight	m	kg	182
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.46
Shaft torsional stiffness	c_t	Nm/rad	3.11E+06
Weight	m	kg	235
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	0.52
Shaft torsional stiffness	c_t	Nm/rad	3.44E+07
Weight	m	kg	215

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



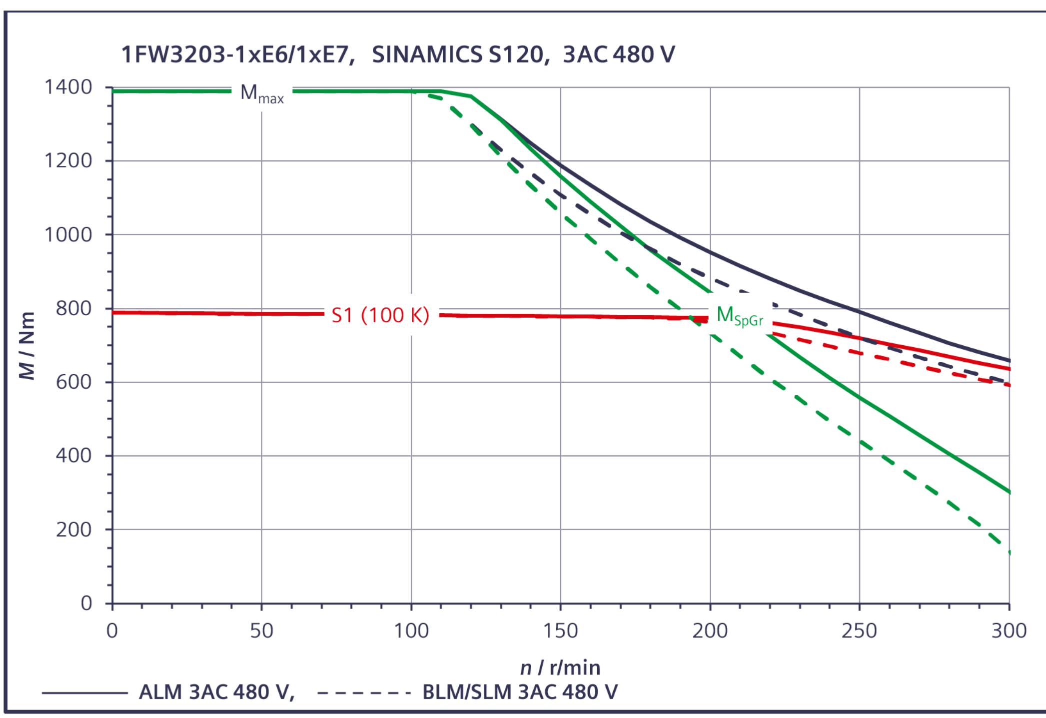
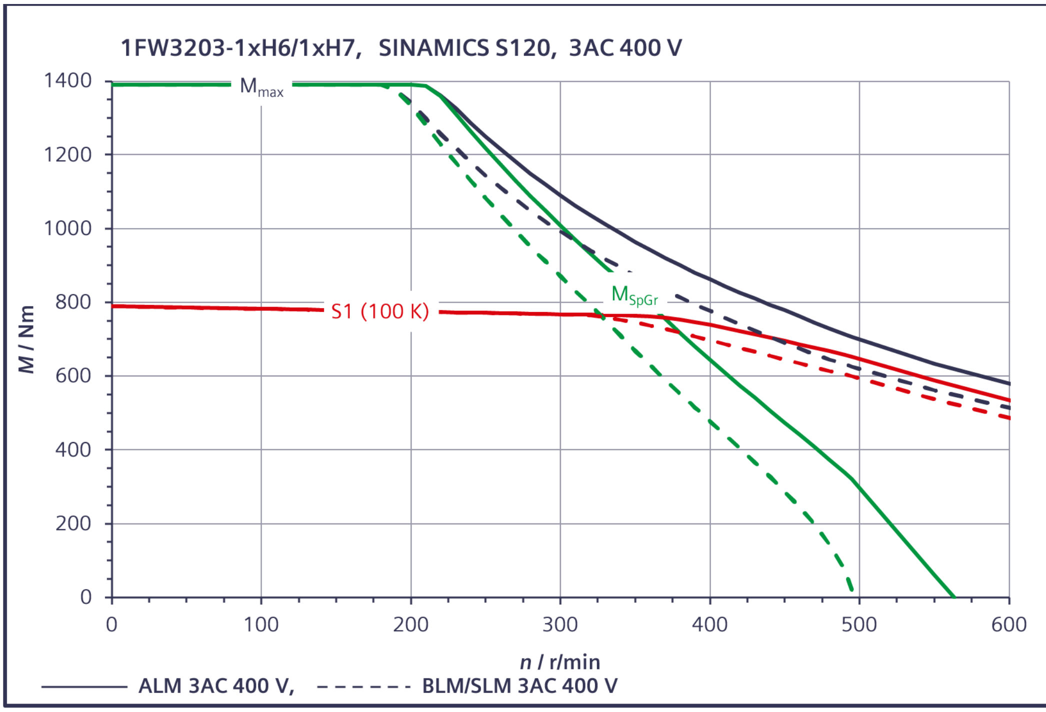


Table 6-27 1FW3203, rated speed 300 r/min

Engineering data	Code	Unit	1FW3203-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N (100 K)}$	Nm	750
Rated power (100 K)	$P_{N (100 K)}$	kW	23.5
Rated current (100 K)	$I_{N (100 K)}$	A	59
Static torque (100 K)	$M_{0 (100 K)}$	Nm	790
Stall current (100 K)	$I_{0 (100 K)}$	A	62
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	710
Maximum torque	M_{max}	Nm	1390
Maximum current	I_{max}	A	132
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	12.7
Voltage constant (at 20 °C)	k_E	V/1000 r/min	810
Winding resistance (at 20 °C)	R_{ph}	Ω	0.162
Rotating field inductance	L_D	mH	5.0
Electrical time constant	T_{el}	ms	32.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.49
Shaft torsional stiffness	c_t	Nm/rad	2.16E+07
Weight	m	kg	182
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.46
Shaft torsional stiffness	c_t	Nm/rad	3.11E+06
Weight	m	kg	235
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.52
Shaft torsional stiffness	c_t	Nm/rad	3.44E+07
Weight	m	kg	215

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



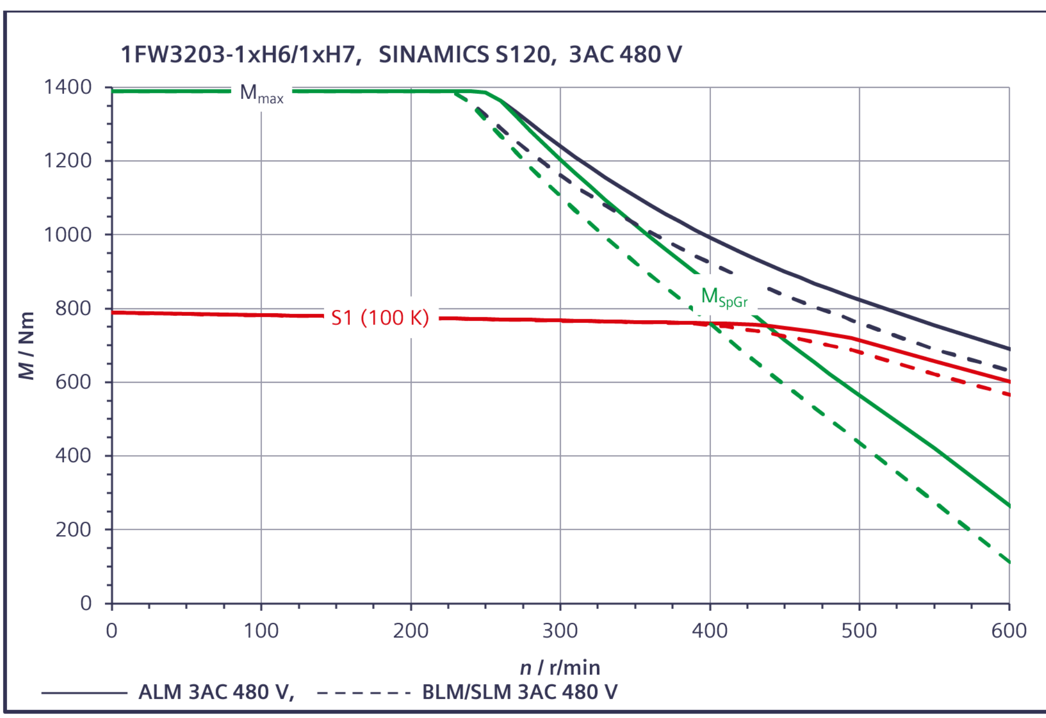
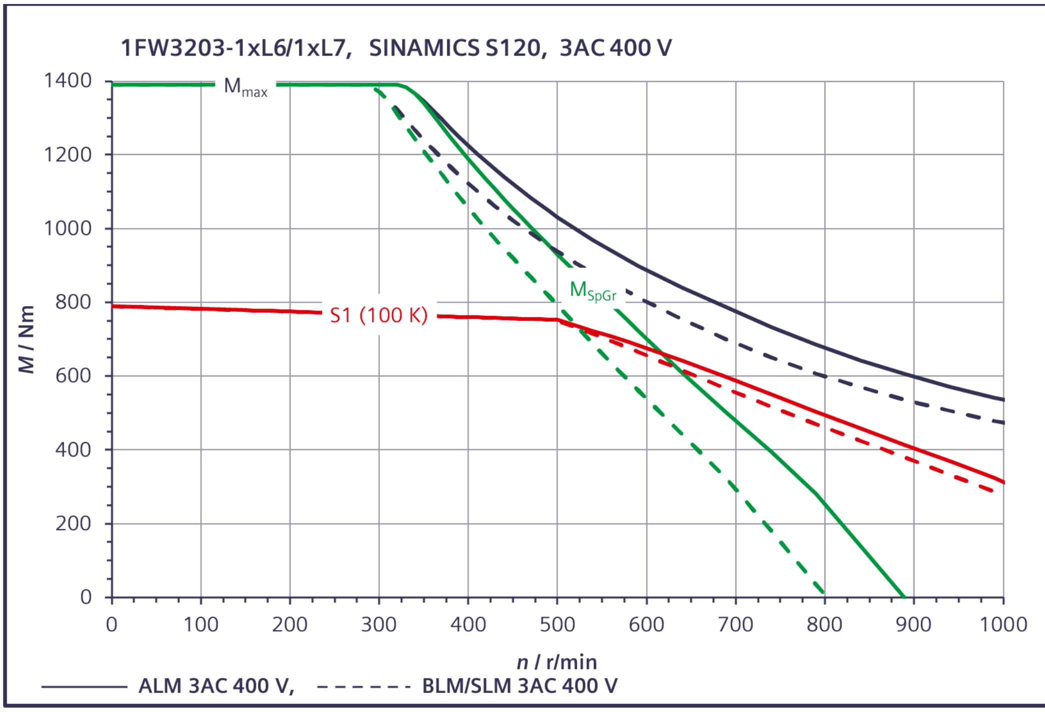


Table 6-28 1FW3203, rated speed 500 r/min

Engineering data	Code	Unit	1FW3203-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N (100 K)}$	Nm	750
Rated power (100 K)	$P_{N (100 K)}$	kW	39.5
Rated current (100 K)	$I_{N (100 K)}$	A	92
Static torque (100 K)	$M_{0 (100 K)}$	Nm	790
Stall current (100 K)	$I_{0 (100 K)}$	A	100
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	1110
Maximum torque	M_{max}	Nm	1390
Maximum current	I_{max}	A	205
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	8.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	520
Winding resistance (at 20 °C)	R_{ph}	Ω	0.07
Rotating field inductance	L_D	mH	2.2
Electrical time constant	T_{el}	ms	31.5
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.49
Shaft torsional stiffness	c_t	Nm/rad	2.16E+07
Weight	m	kg	182
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.46
Shaft torsional stiffness	c_t	Nm/rad	3.11E+06
Weight	m	kg	235
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	0.52
Shaft torsional stiffness	c_t	Nm/rad	3.44E+07
Weight	m	kg	215

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



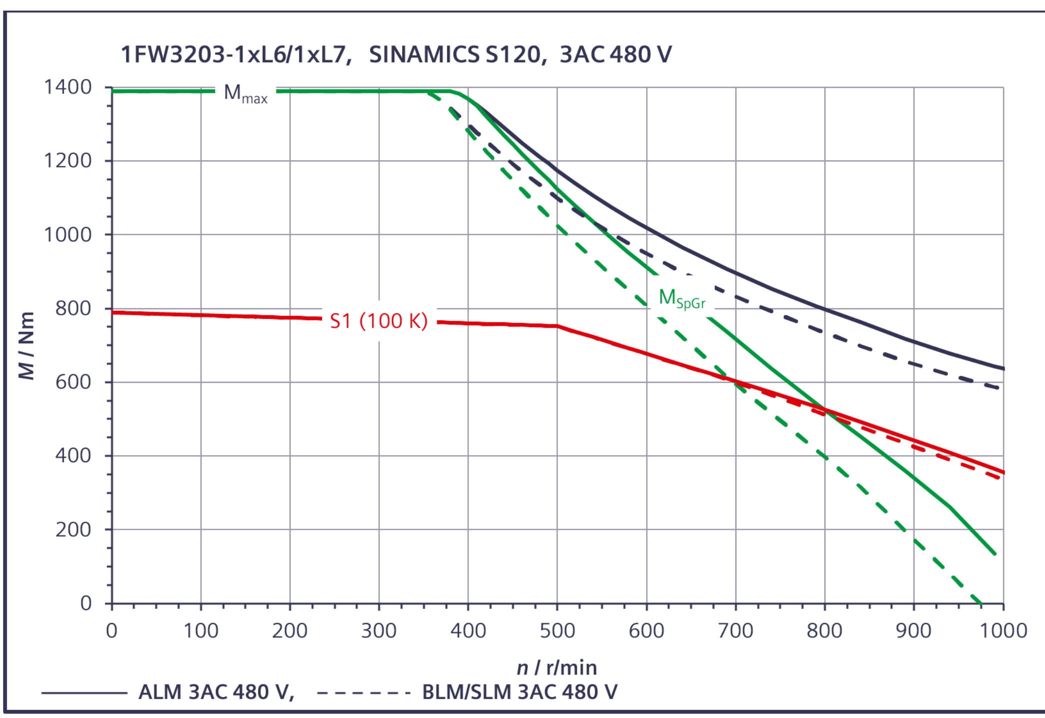
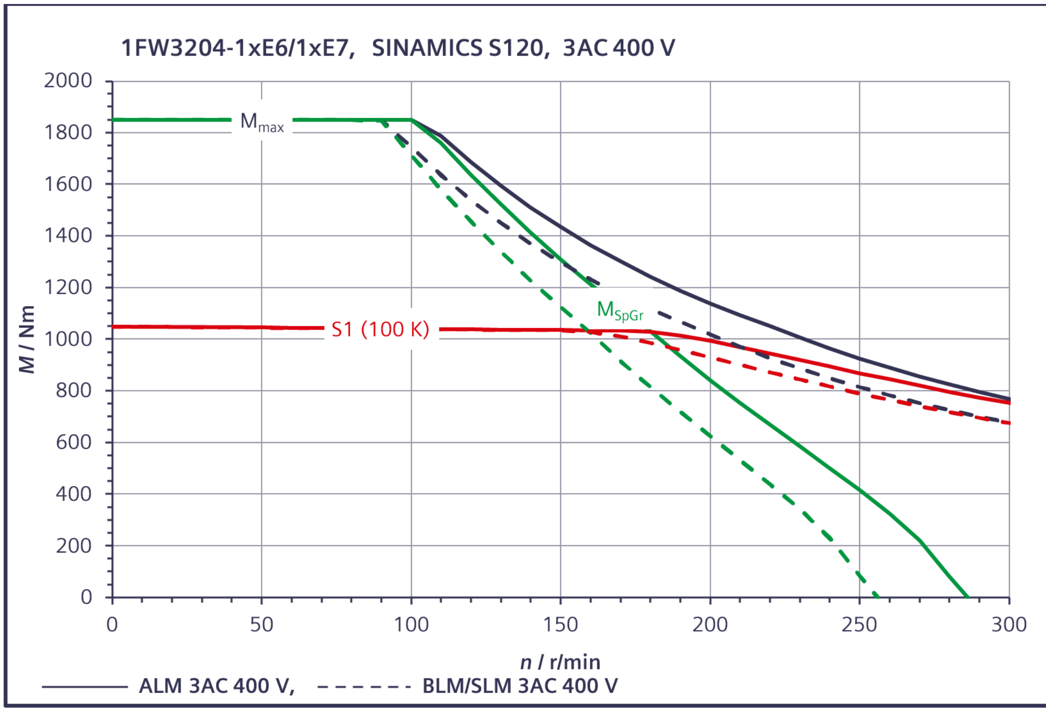


Table 6-29 1FW3204, rated speed 150 r/min

Engineering data	Code	Unit	1FW3204-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1000
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	15.7
Rated current (100 K)	$I_{N\ (100\ K)}$	A	40.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1050
Stall current (100 K)	$I_{0\ (100\ K)}$	A	42.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	360
Maximum torque	M_{max}	Nm	1850
Maximum current	I_{max}	A	90
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	25
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1585
Winding resistance (at 20 °C)	R_{ph}	Ω	0.44
Rotating field inductance	L_D	mH	15.0
Electrical time constant	T_{el}	ms	34.0
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	1.64E+07
Weight	m	kg	225
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.61
Shaft torsional stiffness	c_t	Nm/rad	2.88E+06
Weight	m	kg	285
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	3.00E+07
Weight	m	kg	260

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



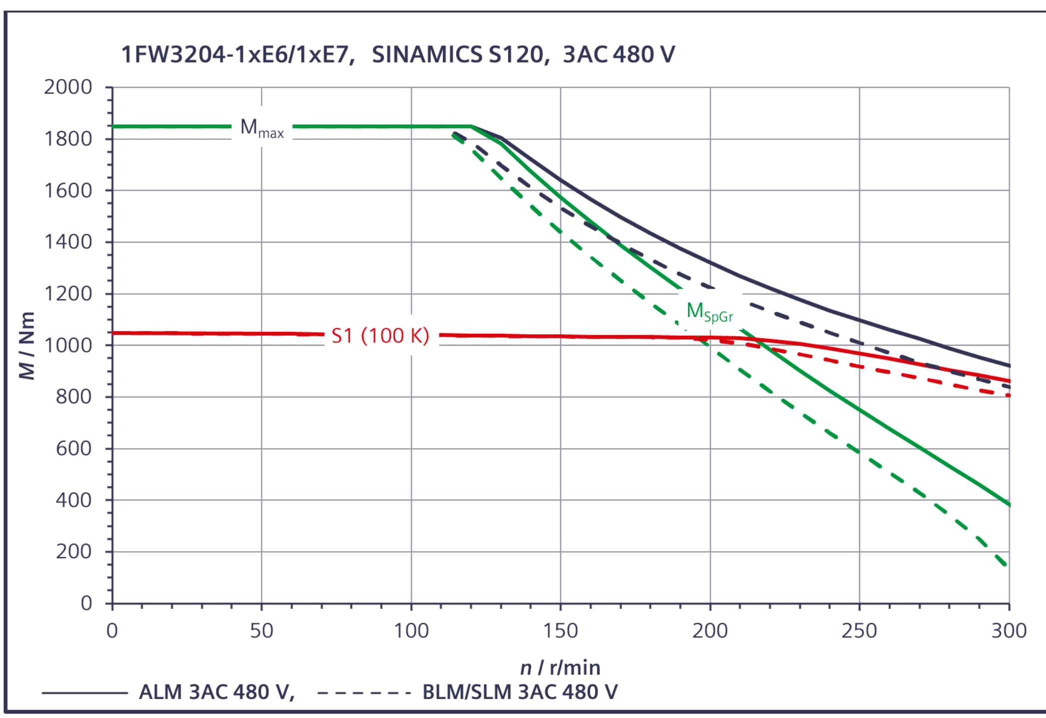
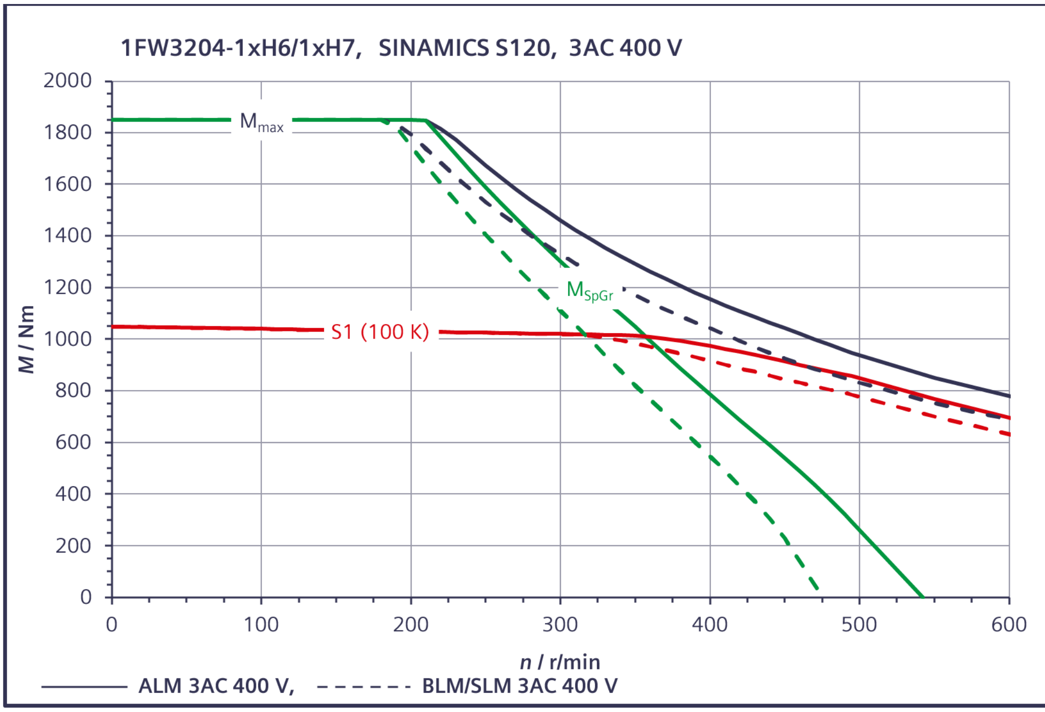


Table 6-30 1FW3204, rated speed 300 r/min

Engineering data	Code	Unit	1FW3204-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1000
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	31.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	74
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1050
Stall current (100 K)	$I_{0\ (100\ K)}$	A	77
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	670
Maximum torque	M_{max}	Nm	1850
Maximum current	I_{max}	A	163
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	13.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	855
Winding resistance (at 20 °C)	R_{ph}	Ω	0.125
Rotating field inductance	L_D	mH	4.2
Electrical time constant	T_{el}	ms	33.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	1.64E+07
Weight	m	kg	225
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.61
Shaft torsional stiffness	c_t	Nm/rad	2.88E+06
Weight	m	kg	285
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	3.00E+07
Weight	m	kg	260

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



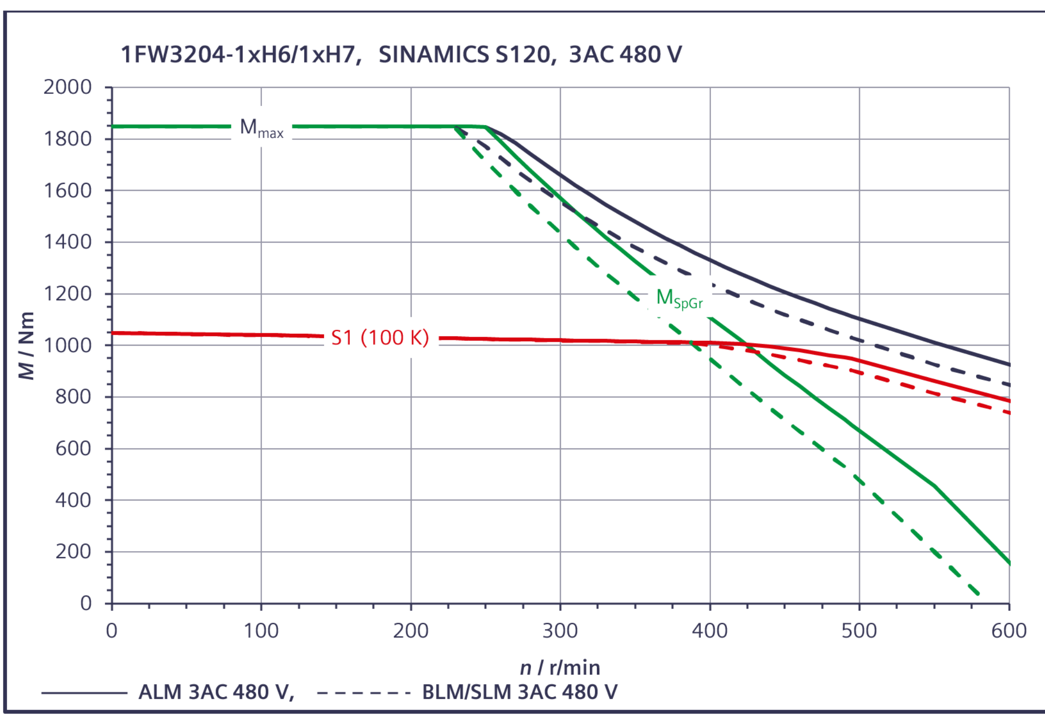
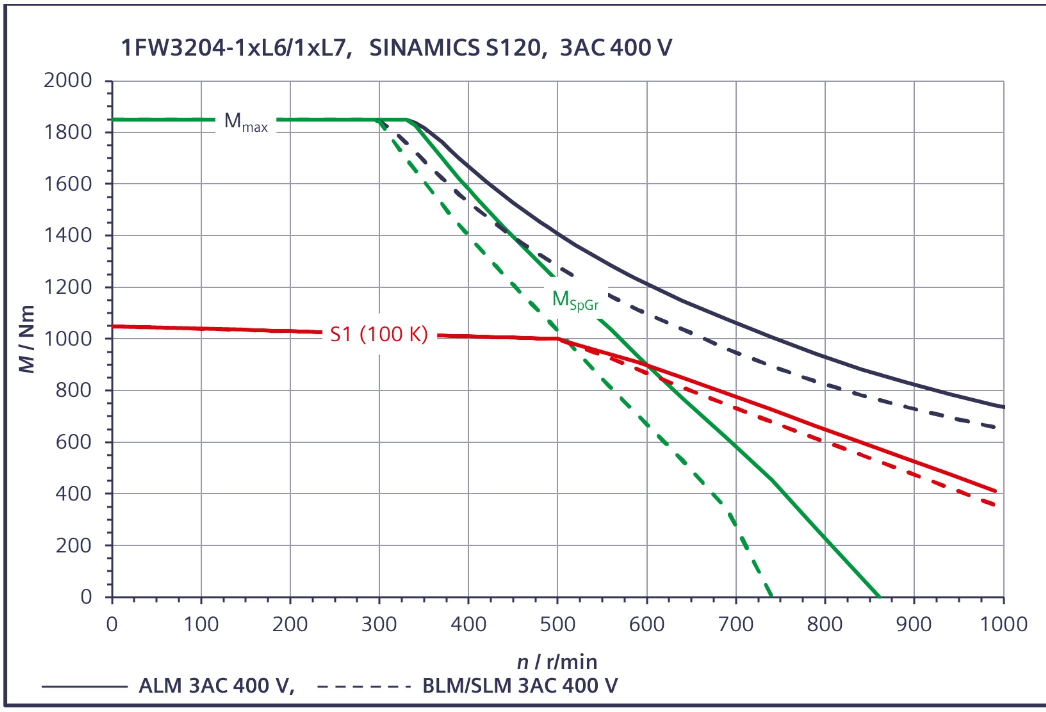


Table 6-31 1FW3204, rated speed 500 r/min

Engineering data	Code	Unit	1FW3204-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N (100 K)}$	Nm	1000
Rated power (100 K)	$P_{N (100 K)}$	kW	52
Rated current (100 K)	$I_{N (100 K)}$	A	118
Static torque (100 K)	$M_{0 (100 K)}$	Nm	1050
Stall current (100 K)	$I_{0 (100 K)}$	A	129
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	1060
Maximum torque	M_{max}	Nm	1850
Maximum current	I_{max}	A	260
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	8.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	545
Winding resistance (at 20 °C)	R_{ph}	Ω	0.049
Rotating field inductance	L_D	mH	1.7
Electrical time constant	T_{el}	ms	34.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	1.64E+07
Weight	m	kg	225
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	0.61
Shaft torsional stiffness	c_t	Nm/rad	2.88E+06
Weight	m	kg	285
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.7
Shaft torsional stiffness	c_t	Nm/rad	3.00E+07
Weight	m	kg	260

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



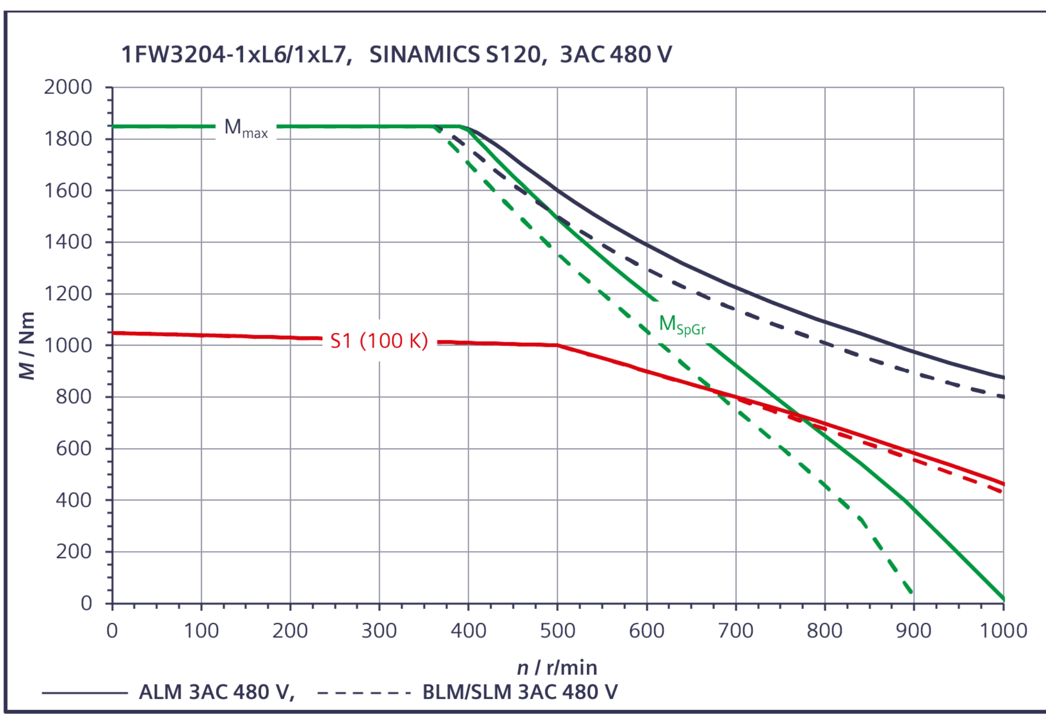
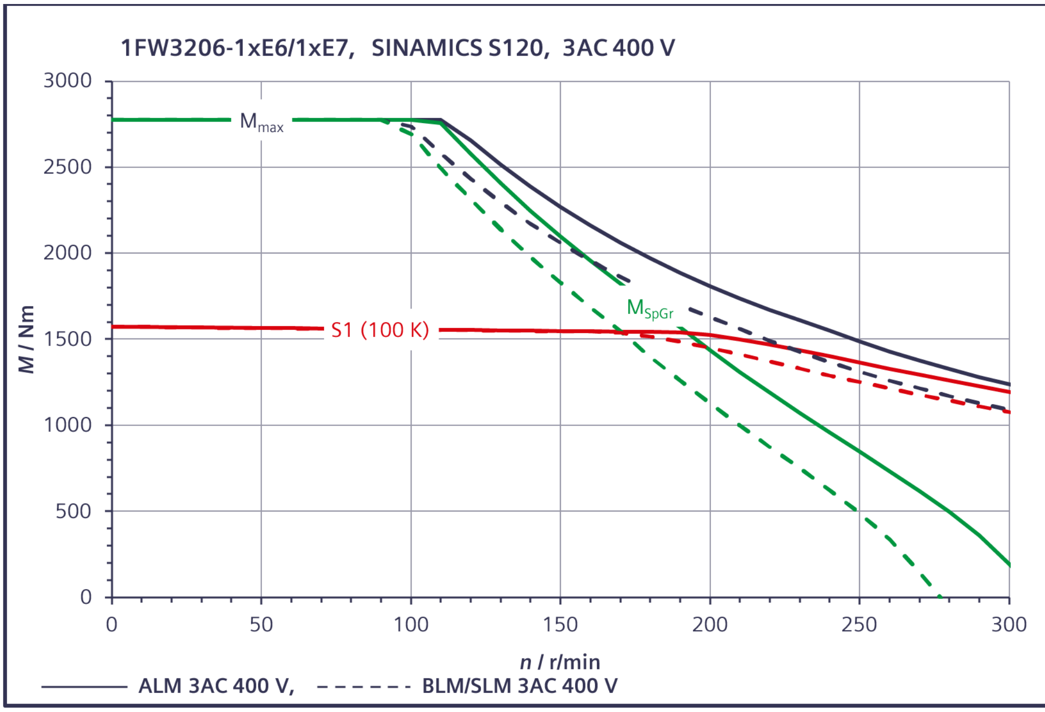


Table 6-32 1FW3206, rated speed 150 r/min

Engineering data	Code	Unit	1FW3206-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	23.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	65
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1575
Stall current (100 K)	$I_{0\ (100\ K)}$	A	68
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	390
Maximum torque	M_{max}	Nm	2775
Maximum current	I_{max}	A	145
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	23.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1465
Winding resistance (at 20 °C)	R_{ph}	Ω	0.255
Rotating field inductance	L_D	mH	9.0
Electrical time constant	T_{el}	ms	35.0
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.97
Shaft torsional stiffness	c_t	Nm/rad	1.24E+07
Weight	m	kg	280
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	0.97
Shaft torsional stiffness	c_t	Nm/rad	1.24E+07
Weight	m	kg	345
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.94
Shaft torsional stiffness	c_t	Nm/rad	2.65E+07
Weight	m	kg	315

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



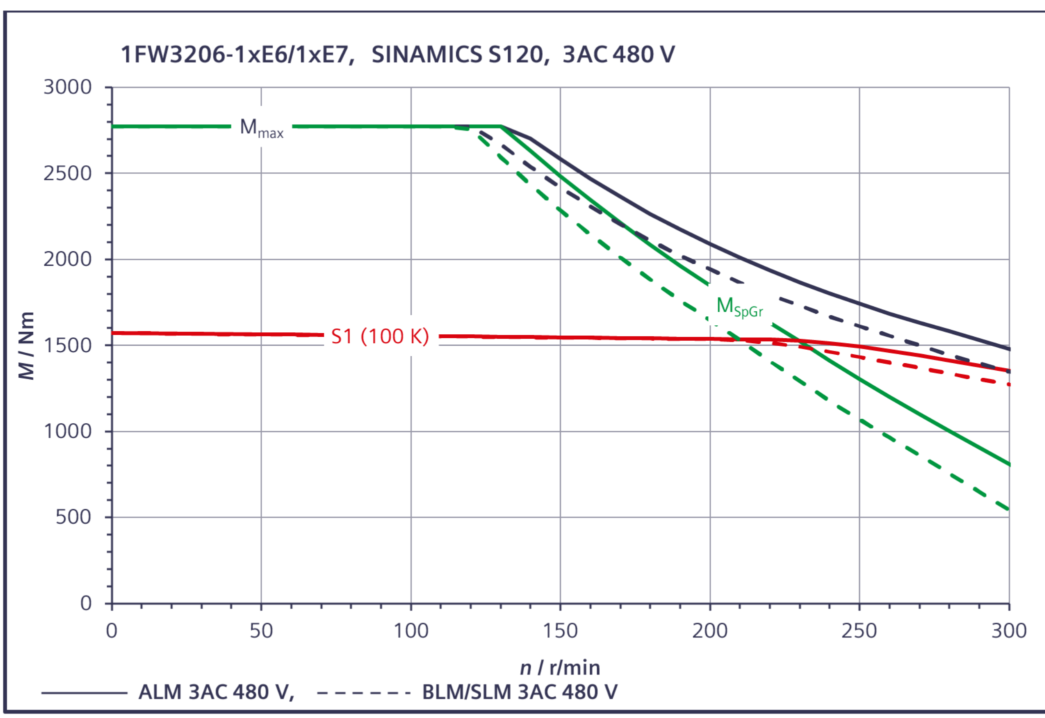
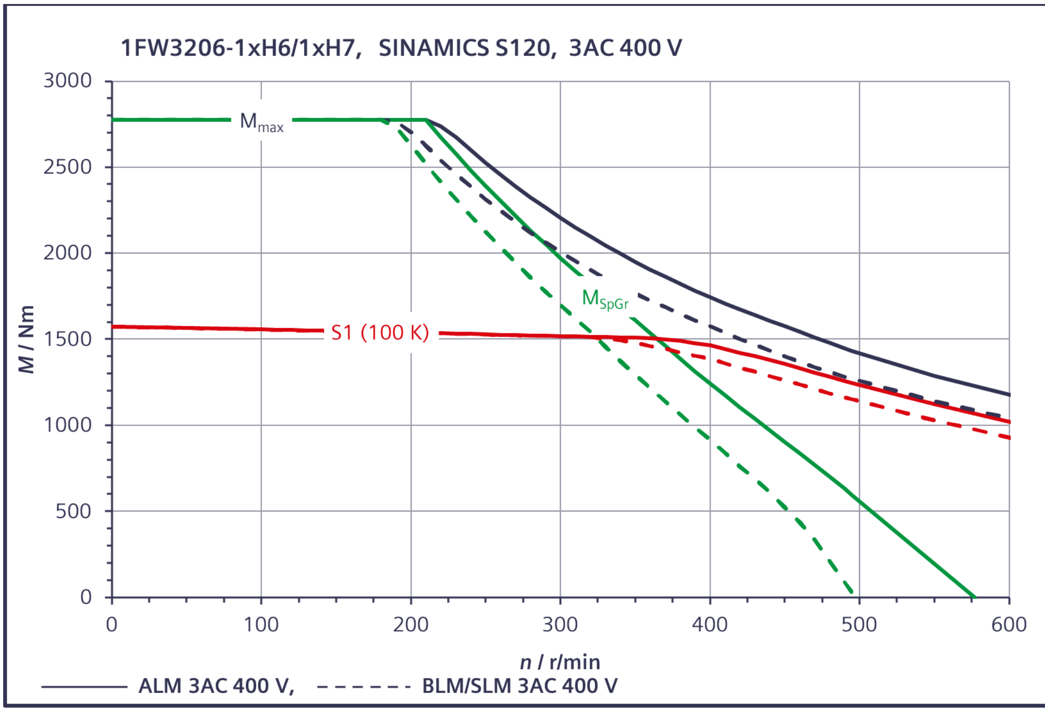


Table 6-33 1FW3206, rated speed 300 r/min

Engineering data	Code	Unit	1FW3206-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	47.0
Rated current (100 K)	$I_{N\ (100\ K)}$	A	118
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1575
Stall current (100 K)	$I_{0\ (100\ K)}$	A	121
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	700
Maximum torque	M_{max}	Nm	2775
Maximum current	I_{max}	A	255
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	12.8
Voltage constant (at 20 °C)	k_E	V/1000 r/min	820
Winding resistance (at 20 °C)	R_{ph}	Ω	0.076
Rotating field inductance	L_D	mH	2.7
Electrical time constant	T_{el}	ms	35.5
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.97
Shaft torsional stiffness	c_t	Nm/rad	1.24E+07
Weight	m	kg	280
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	0.84
Shaft torsional stiffness	c_t	Nm/rad	1.24E+07
Weight	m	kg	345
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.94
Shaft torsional stiffness	c_t	Nm/rad	2.65E+07
Weight	m	kg	315

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



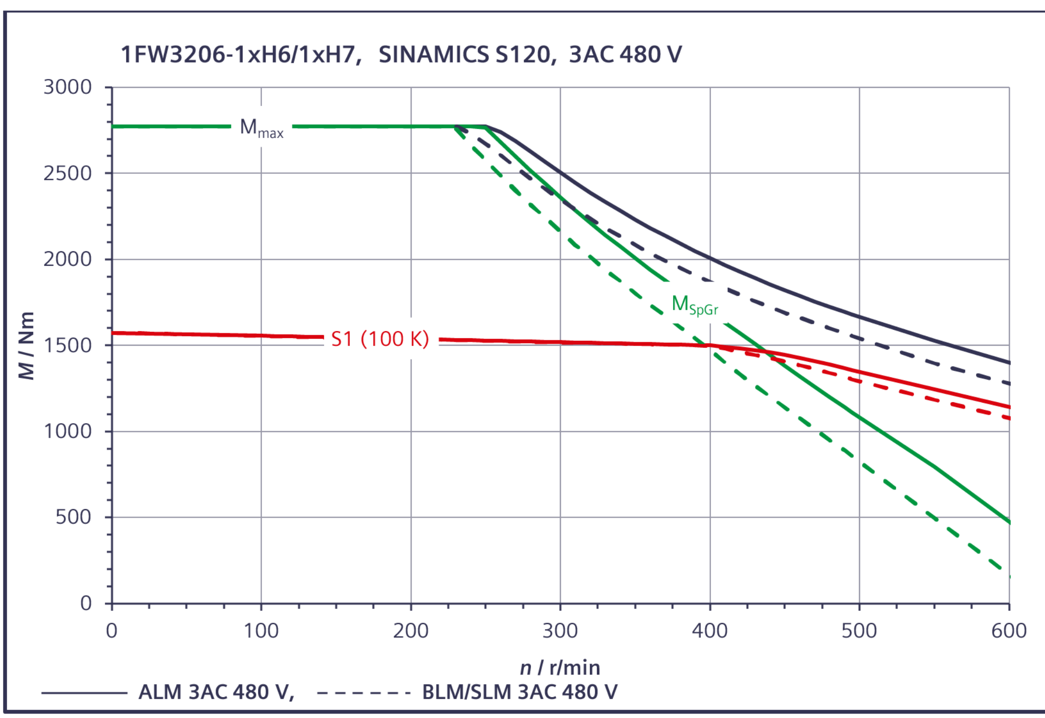
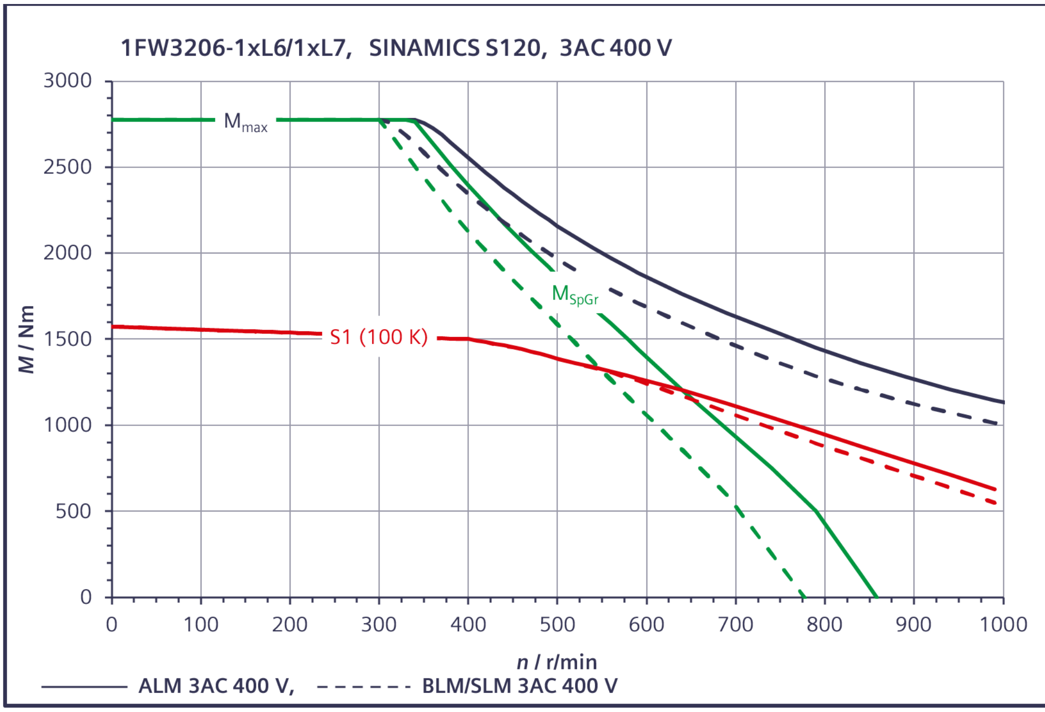


Table 6-34 1FW3206, rated speed 500 r/min

Engineering data	**Code**	**Unit**	**1FW3206-1☐L**
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	73
Rated current (100 K)	$I_{N\ (100\ K)}$	A	169
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1575
Stall current (100 K)	$I_{0\ (100\ K)}$	A	189
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1090
Maximum torque	M_{max}	Nm	2775
Maximum current	I_{max}	A	400
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.3
Voltage constant (at 20 °C)	k_E	V/1000 r/min	530
Winding resistance (at 20 °C)	R_{ph}	Ω	0.032
Rotating field inductance	L_D	mH	1.1
Electrical time constant	T_{el}	ms	34.5
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	0.97
Shaft torsional stiffness	c_t	Nm/rad	1.24E+07
Weight	m	kg	280
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	0.84
Shaft torsional stiffness	c_t	Nm/rad	2.62E+06
Weight	m	kg	345
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	0.94
Shaft torsional stiffness	c_t	Nm/rad	2.65E+07
Weight	m	kg	315

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



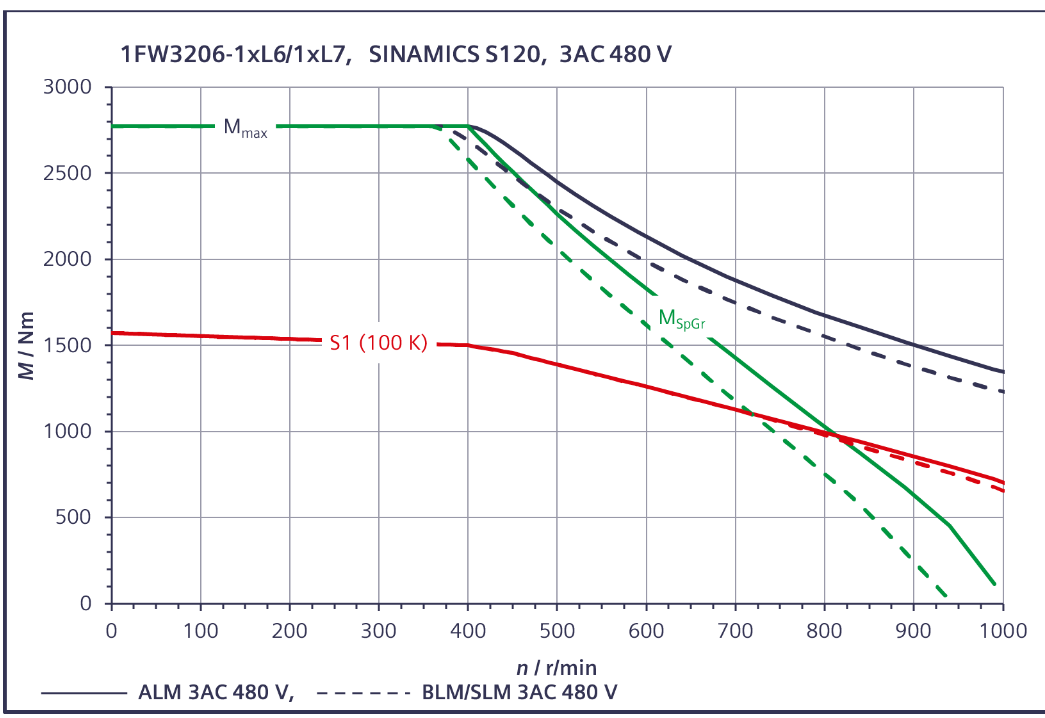
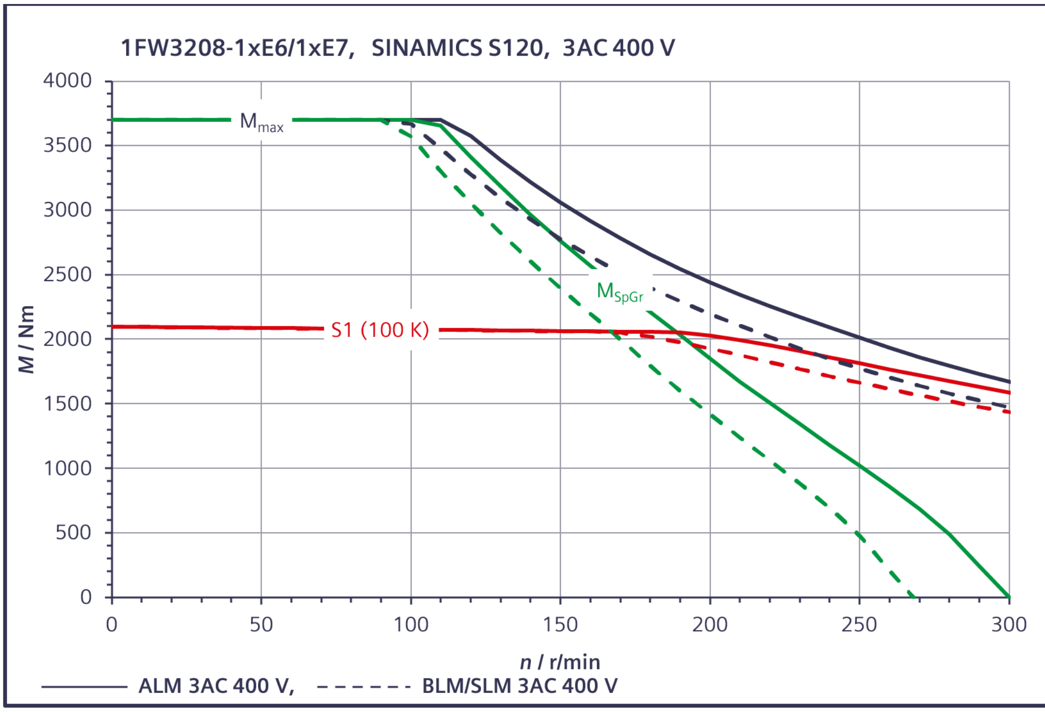


Table 6-35 1FW3208, rated speed 150 r/min

Engineering data	Code	Unit	1FW3208-1☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N (100 K)}$	Nm	2000
Rated power (100 K)	$P_{N (100 K)}$	kW	31.5
Rated current (100 K)	$I_{N (100 K)}$	A	84
Static torque (100 K)	$M_{0 (100 K)}$	Nm	2100
Stall current (100 K)	$I_{0 (100 K)}$	A	88
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	380
Maximum torque	M_{max}	Nm	3700
Maximum current	I_{max}	A	187
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	24.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1515
Winding resistance (at 20 °C)	R_{ph}	Ω	0.197
Rotating field inductance	L_D	mH	7.0
Electrical time constant	T_{el}	ms	35.0
Thermal time constant	T_{th}	min	20
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	1.31
Shaft torsional stiffness	c_t	Nm/rad	9.55E+06
Weight	m	kg	350
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	1.11
Shaft torsional stiffness	c_t	Nm/rad	2.35E+06
Weight	m	kg	420
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	1.24
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	385

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



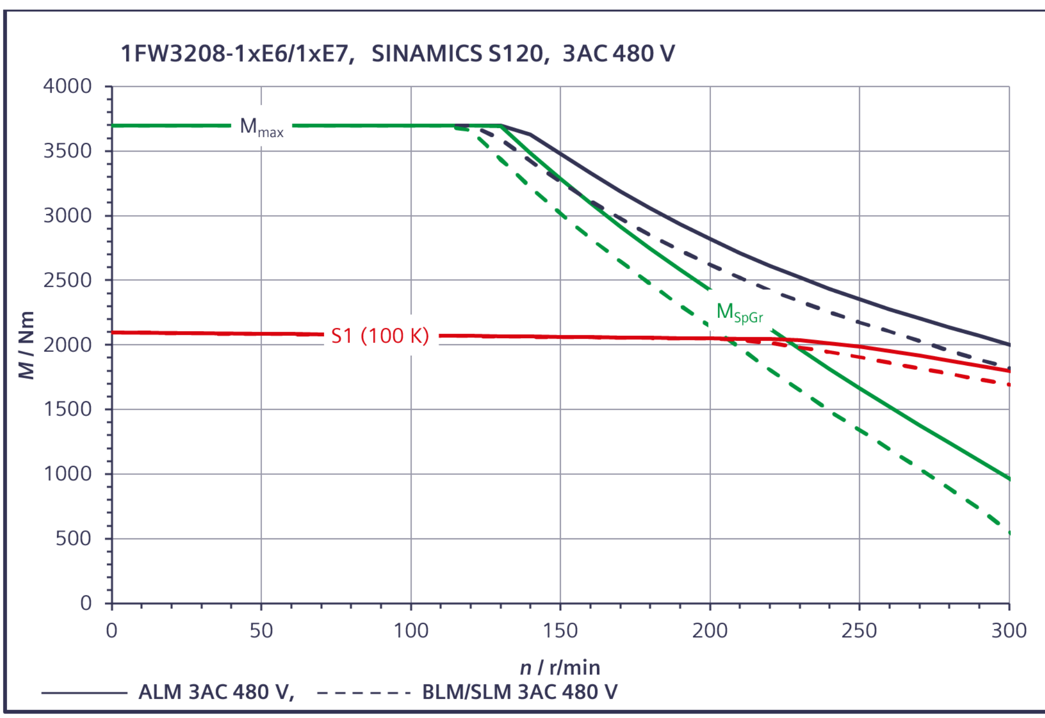
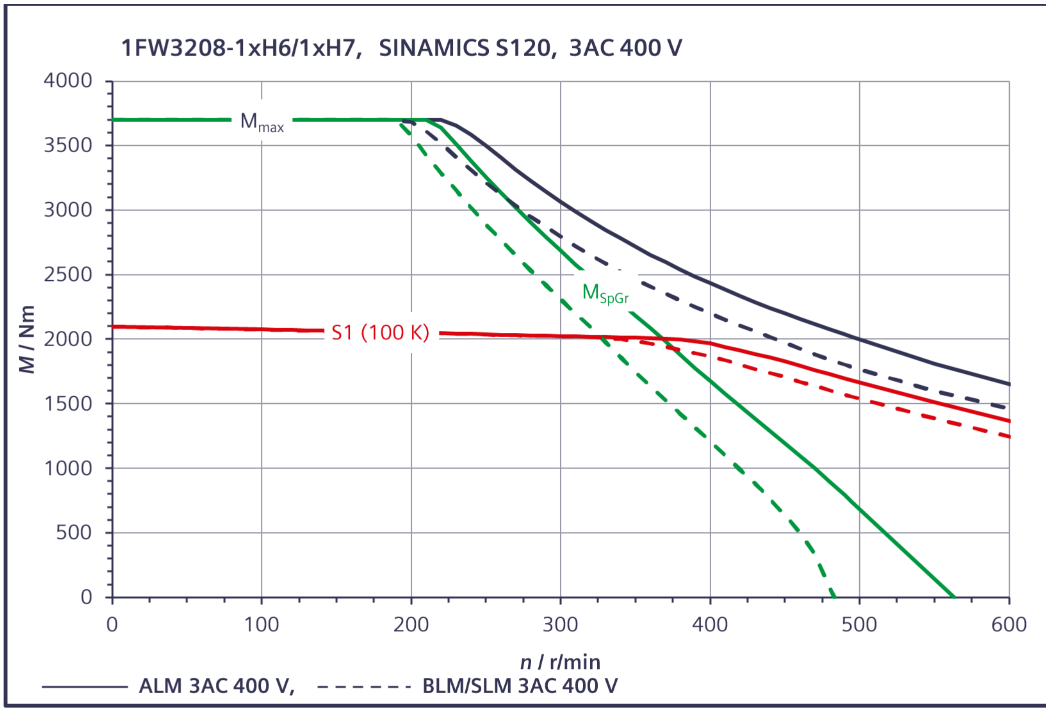


Table 6-36 1FW3208, rated speed 300 r/min

Engineering data	Code	Unit	1FW3208-1☐H
Rated speed	n_N	r/min	300
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	2000
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	63
Rated current (100 K)	$I_{N\ (100\ K)}$	A	153
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2100
Stall current (100 K)	$I_{0\ (100\ K)}$	A	160
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	690
Maximum torque	M_{max}	Nm	3700
Maximum current	I_{max}	A	340
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	13.1
Voltage constant (at 20 °C)	k_E	V/1000 r/min	835
Winding resistance (at 20 °C)	R_{ph}	Ω	0.056
Rotating field inductance	L_D	mH	2.0
Electrical time constant	T_{el}	ms	35.5
Thermal time constant	T_{th}	min	20
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	1.31
Shaft torsional stiffness	c_t	Nm/rad	9.55E+06
Weight	m	kg	350
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.1
Moment of inertia	J_{mot}	kgm^2	1.11
Shaft torsional stiffness	c_t	Nm/rad	2.35E+06
Weight	m	kg	420
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.2
Moment of inertia	J_{mot}	kgm^2	1.24
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	385

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



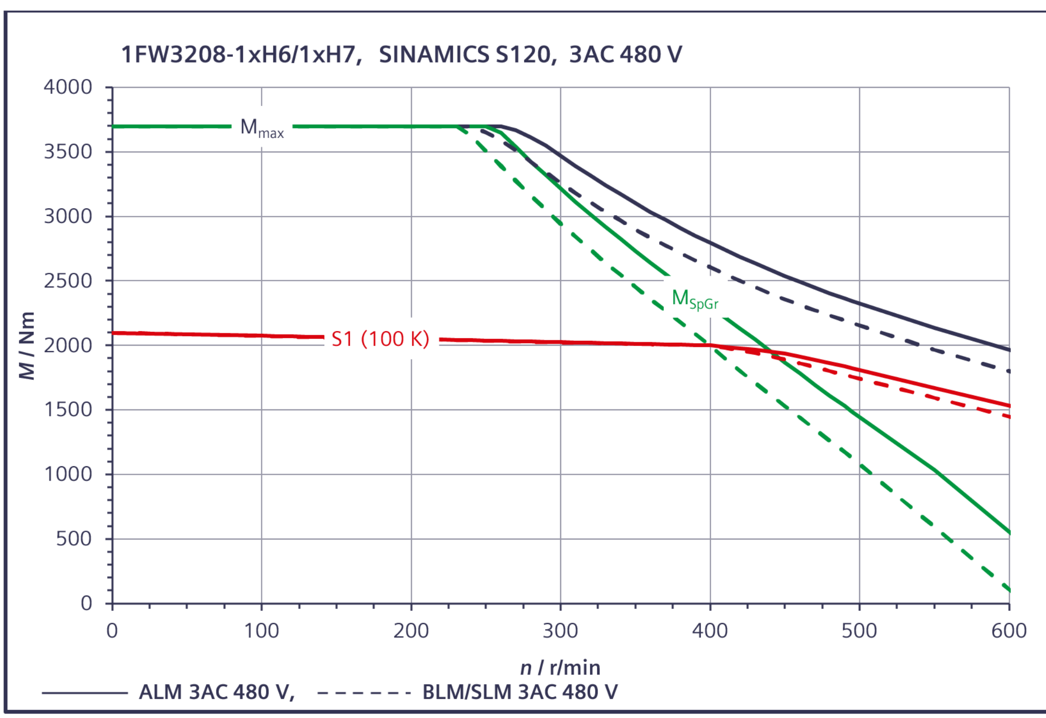
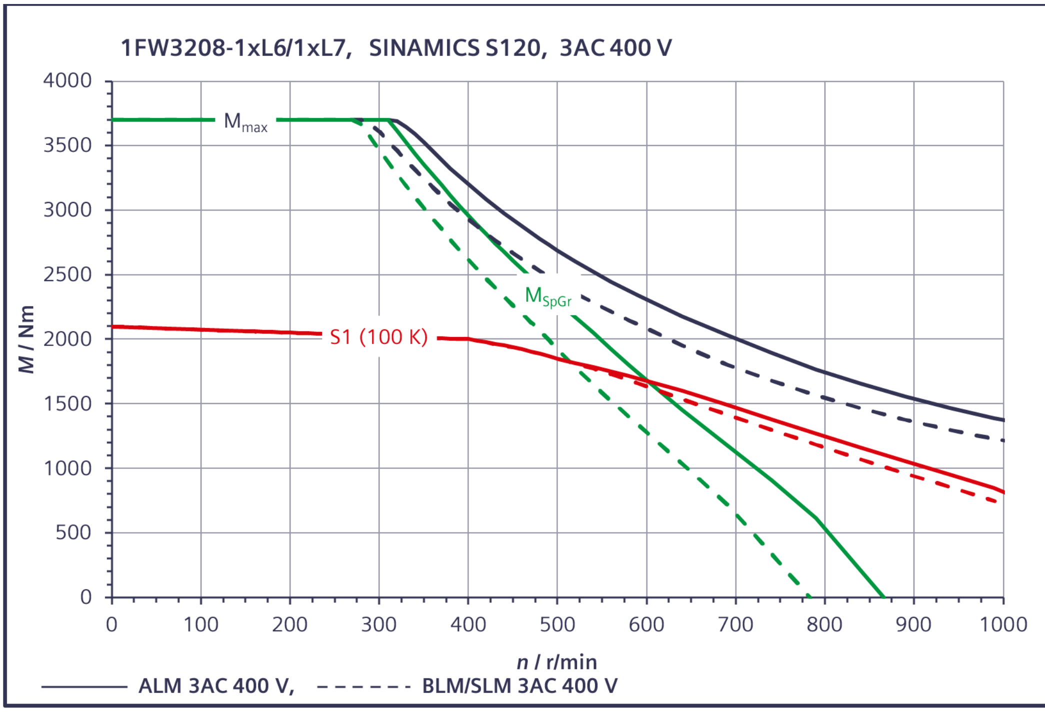


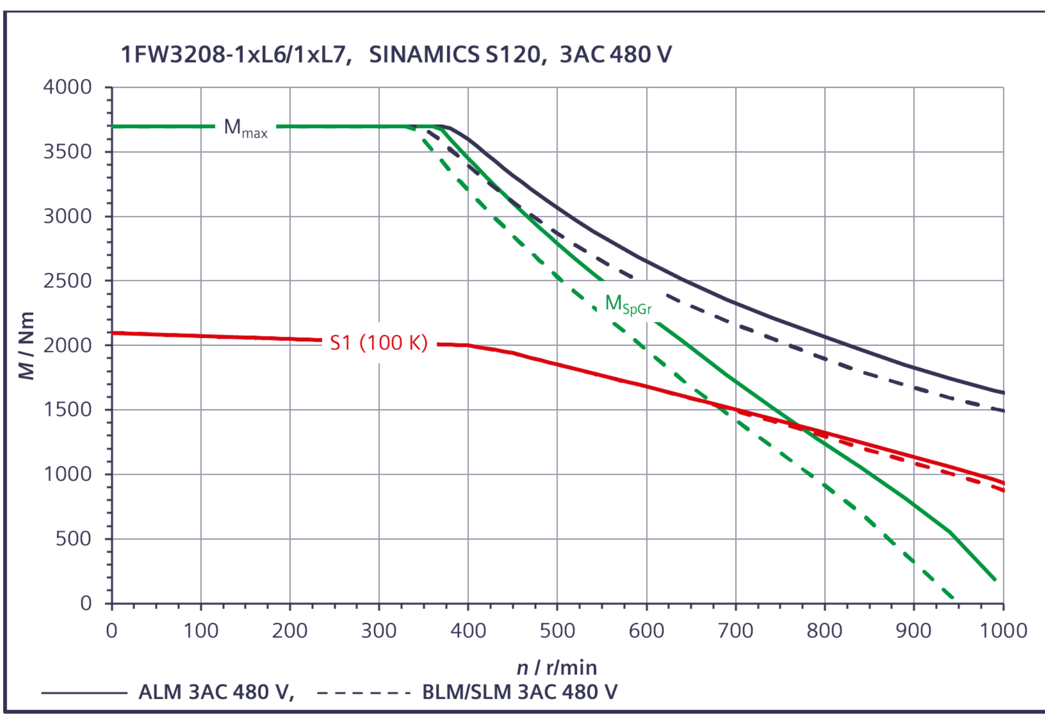
Table 6-37 1FW3208, rated speed 500 r/min

Engineering data	Code	Unit	1FW3208-1☐L
Rated speed	n_N	r/min	500
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1850
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	97
Rated current (100 K)	$I_{N\ (100\ K)}$	A	225
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2100
Stall current (100 K)	$I_{0\ (100\ K)}$	A	255
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1100
Maximum torque	M_{max}	Nm	3700
Maximum current	I_{max}	A	530
Motor data			
Number of poles	2p		28
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-3.5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	525
Winding resistance (at 20 °C)	R_{ph}	Ω	0.027
Rotating field inductance	L_D	mH	0.9
Electrical time constant	T_{el}	ms	33.5
Thermal time constant	T_{th}	min	20
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	1.31
Shaft torsional stiffness	c_t	Nm/rad	9.55E+06
Weight	m	kg	350
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.3
Moment of inertia	J_{mot}	kgm^2	1.11
Shaft torsional stiffness	c_t	Nm/rad	2.35E+06
Weight	m	kg	420
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.5
Moment of inertia	J_{mot}	kgm^2	1.24
Shaft torsional stiffness	c_t	Nm/rad	2.17E+07
Weight	m	kg	385

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*





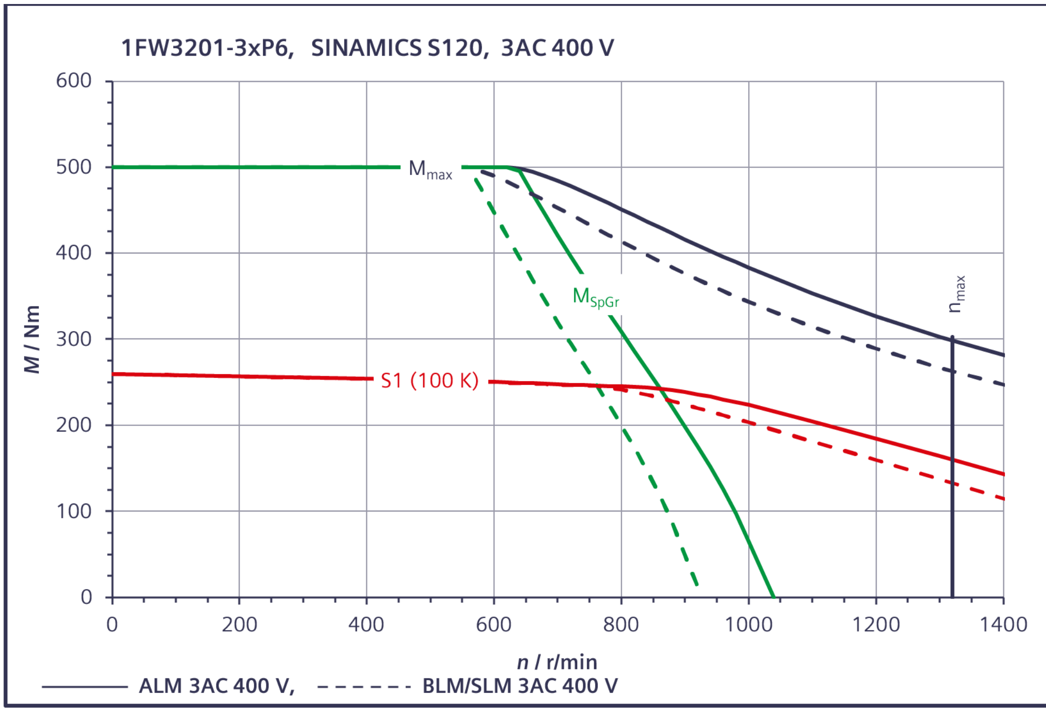
6.4.3 Shaft height 200, High Speed

Table 6-38 1FW3201, rated speed 800 r/min

Engineering data	Code	Unit	1FW3201-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	245
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	20.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	37.0
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	260
Stall current (100 K)	$I_{0\ (100\ K)}$	A	38.0
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1320
Maximum torque	M_{max}	Nm	500
Maximum current	I_{max}	A	80
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.8
Voltage constant (at 20 °C)	k_E	V/1000 r/min	437
Winding resistance (at 20 °C)	R_{ph}	Ω	0.285
Rotating field inductance	L_D	mH	4.1
Electrical time constant	T_{el}	ms	14.4
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	4.0
Moment of inertia	J_{mot}	kgm^2	0.22
Shaft torsional stiffness	c_t	Nm/rad	3.48E+06
Weight	m	kg	176
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	5.0
Moment of inertia	J_{mot}	kgm^2	0.27
Shaft torsional stiffness	c_t	Nm/rad	4.90E+07
Weight	m	kg	159

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



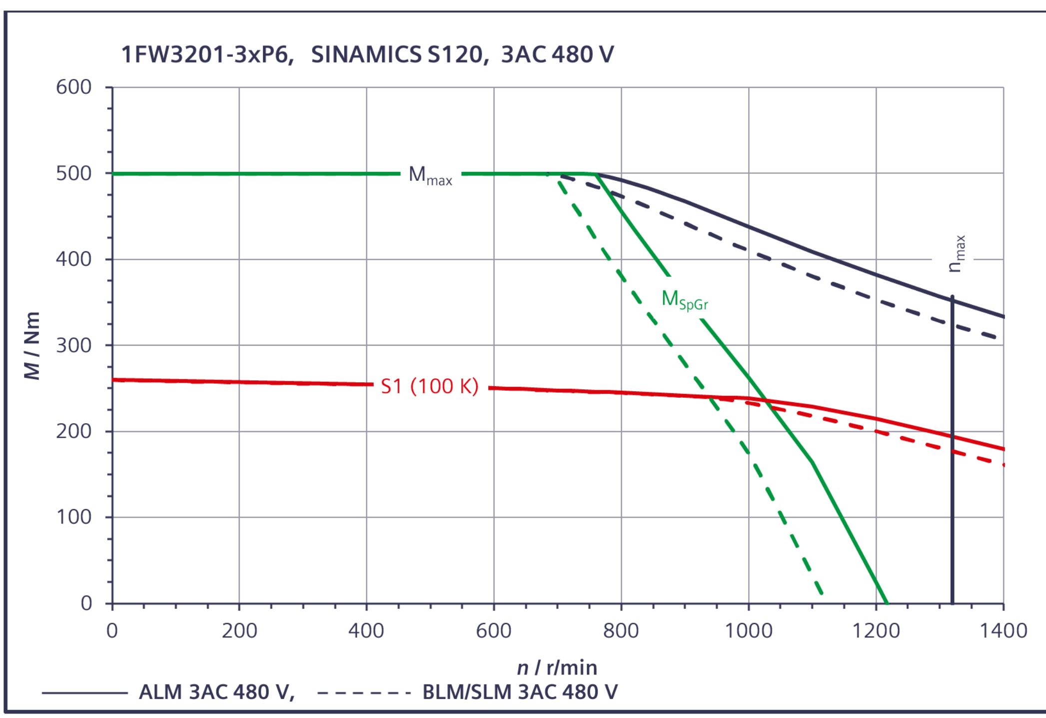
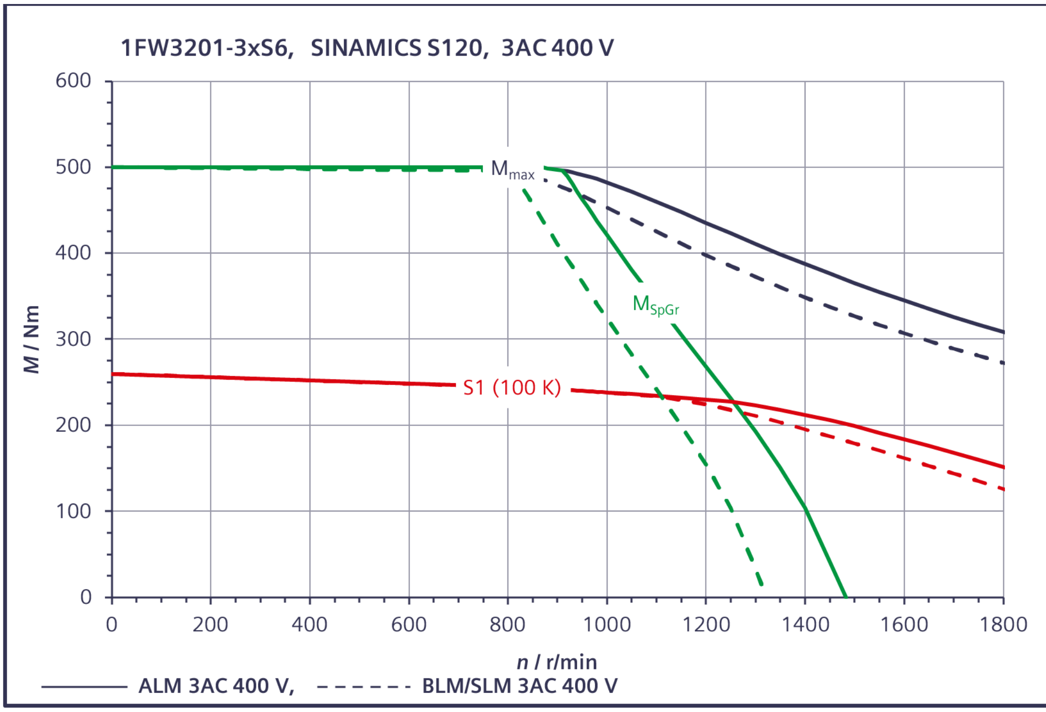


Table 6-39 1FW3201, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3201-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N (100 K)}$	Nm	230
Rated power (100 K)	$P_{N (100 K)}$	kW	29
Rated current (100 K)	$I_{N (100 K)}$	A	50
Static torque (100 K)	$M_{0 (100 K)}$	Nm	260
Stall current (100 K)	$I_{0 (100 K)}$	A	54
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max Inv}$	r/min	1890
Maximum torque	M_{max}	Nm	500
Maximum current	I_{max}	A	114
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	4.8
Voltage constant (at 20 °C)	k_E	V/1000 r/min	306
Winding resistance (at 20 °C)	R_{ph}	Ω	0.14
Rotating field inductance	L_D	mH	2.1
Electrical time constant	T_{el}	ms	15.3
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	4.0
Moment of inertia	J_{mot}	kgm^2	0.22
Shaft torsional stiffness	c_t	Nm/rad	3.48E+06
Weight	m	kg	176
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	5.0
Moment of inertia	J_{mot}	kgm^2	0.27
Shaft torsional stiffness	c_t	Nm/rad	4.90E+07
Weight	m	kg	159

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



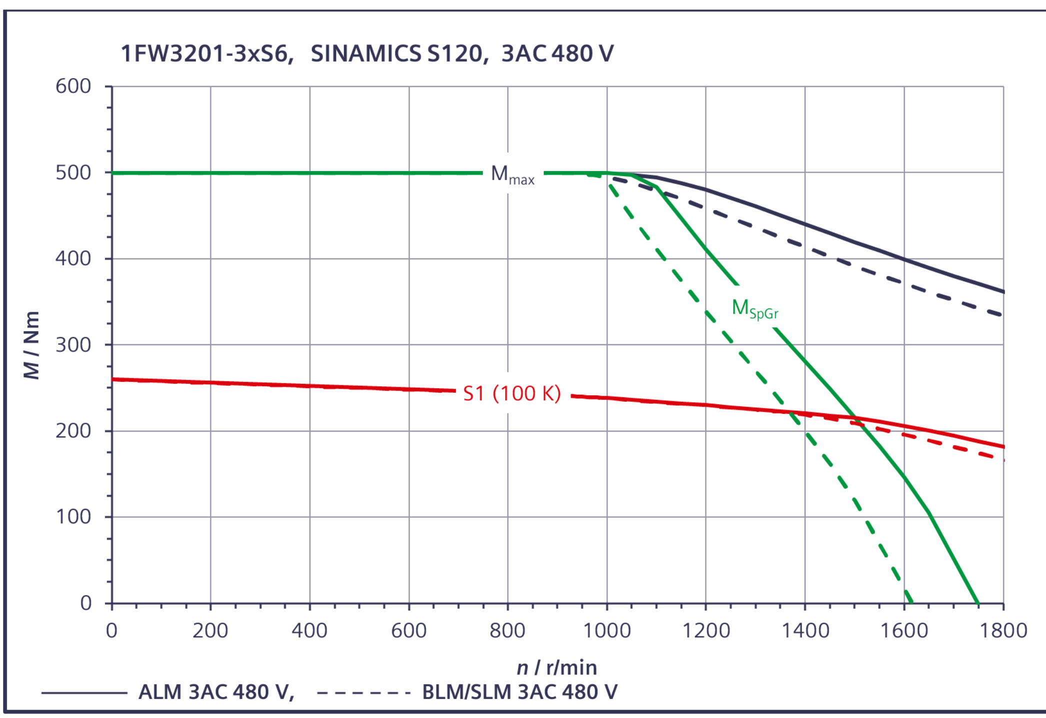
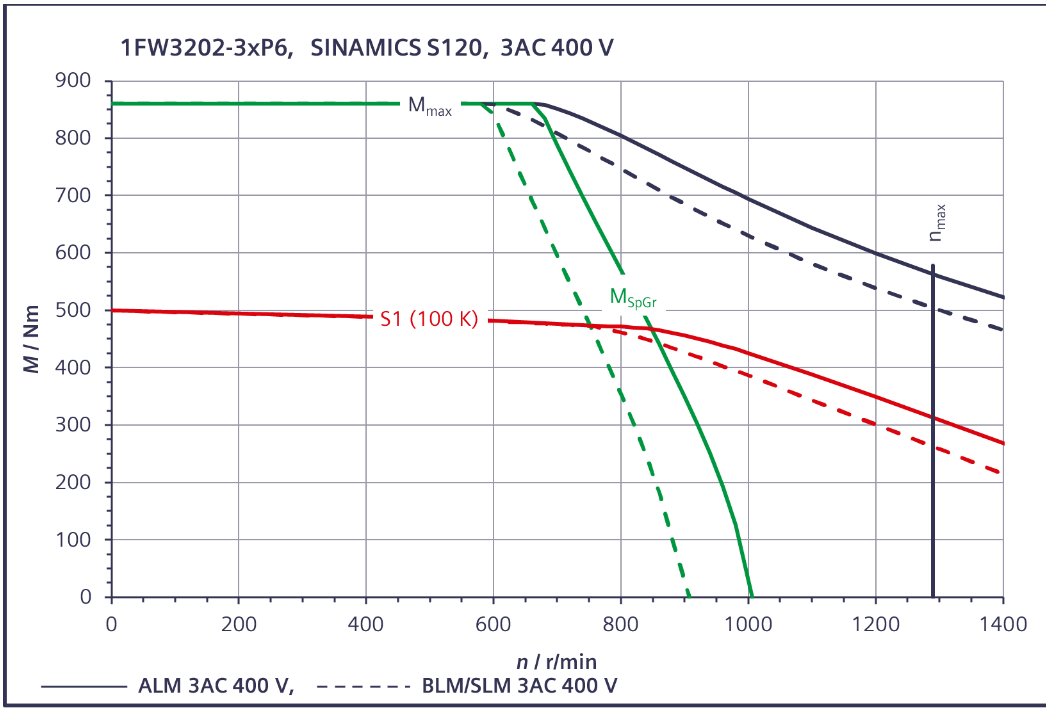


Table 6-40 1FW3202, rated speed 800 r/min

Engineering data	Code	Unit	1FW3202-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	470
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	39.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	69
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	72
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1290
Maximum torque	M_{max}	Nm	860
Maximum current	I_{max}	A	133
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	7
Voltage constant (at 20 °C)	k_E	V/1000 r/min	447
Winding resistance (at 20 °C)	R_{ph}	Ω	0.126
Rotating field inductance	L_D	mH	2.3
Electrical time constant	T_{el}	ms	18.2
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	0.34
Shaft torsional stiffness	c_t	Nm/rad	3.28E+06
Weight	m	kg	205
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm^2	0.4
Shaft torsional stiffness	c_t	Nm/rad	4.05E+07
Weight	m	kg	188

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



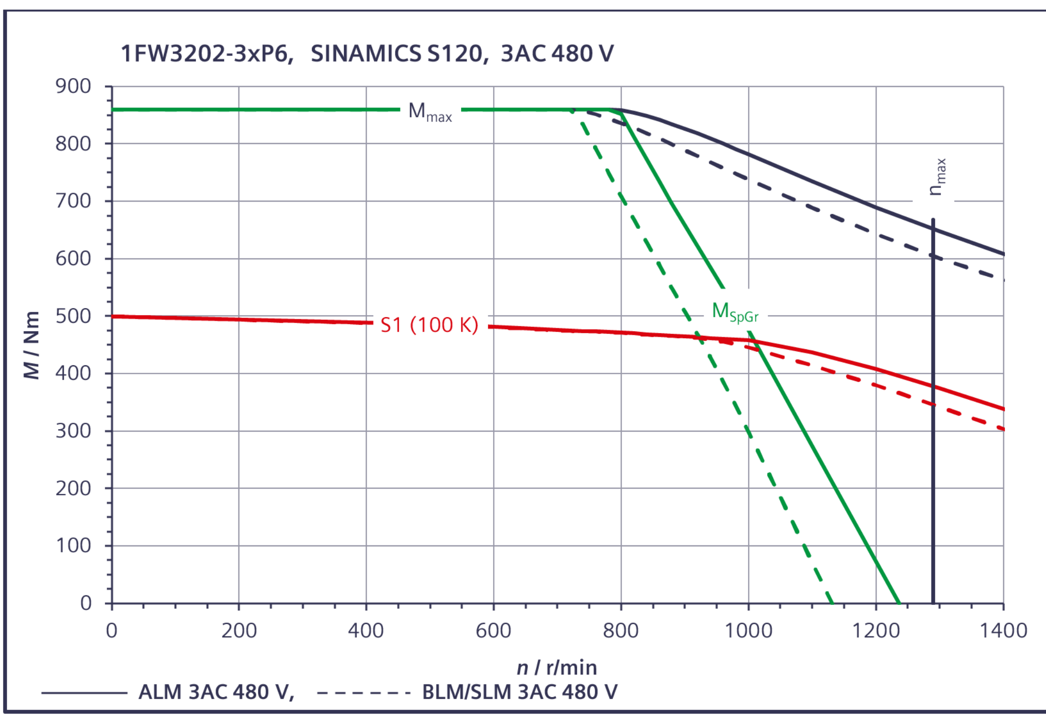
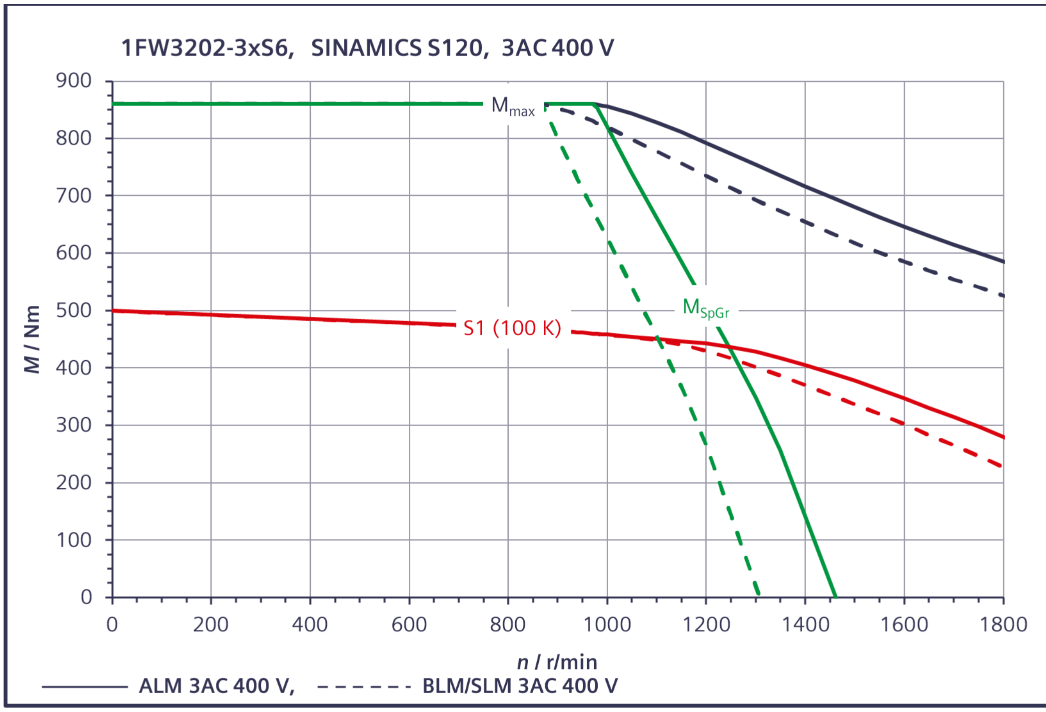


Table 6-41 1FW3202, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3202-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	440
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	55
Rated current (100 K)	$I_{N\ (100\ K)}$	A	92
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	102
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1850
Maximum torque	M_{max}	Nm	860
Maximum current	I_{max}	A	190
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	4.9
Voltage constant (at 20 °C)	k_E	V/1000 r/min	313
Winding resistance (at 20 °C)	R_{ph}	Ω	0.062
Rotating field inductance	L_D	mH	1.1
Electrical time constant	T_{el}	ms	18.1
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	0.34
Shaft torsional stiffness	c_t	Nm/rad	3.28E+06
Weight	m	kg	205
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm^2	0.4
Shaft torsional stiffness	c_t	Nm/rad	4.05E+07
Weight	m	kg	188

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



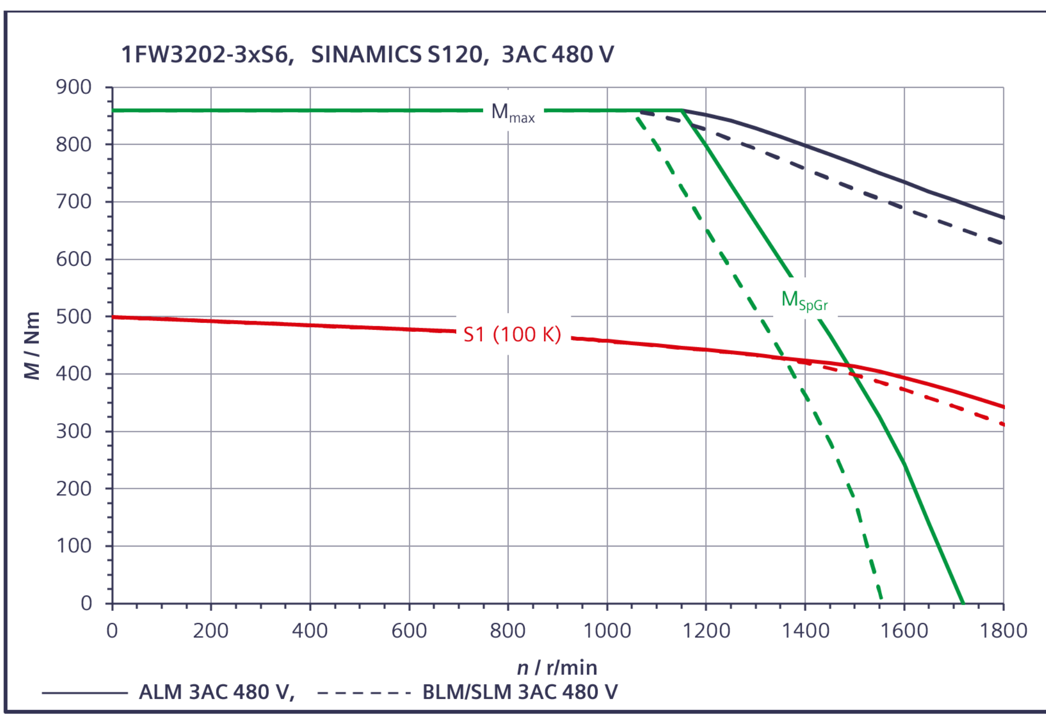
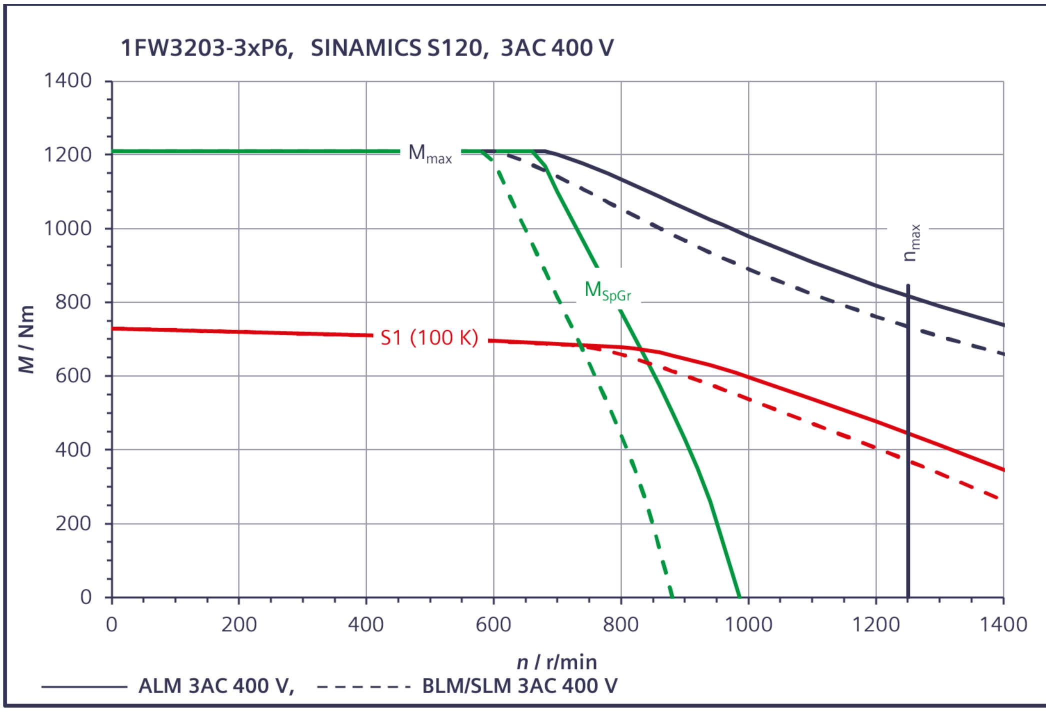


Table 6-42 1FW3203, rated speed 800 r/min

Engineering data	Code	Unit	1FW3203-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	680
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	57
Rated current (100 K)	$I_{N\ (100\ K)}$	A	96
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	730
Stall current (100 K)	$I_{0\ (100\ K)}$	A	102
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1250
Maximum torque	M_{max}	Nm	1210
Maximum current	I_{max}	A	182
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	7.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	460
Winding resistance (at 20 °C)	R_{ph}	Ω	0.084
Rotating field inductance	L_D	mH	1.65
Electrical time constant	T_{el}	ms	19.8
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.2
Moment of inertia	J_{mot}	kgm^2	0.45
Shaft torsional stiffness	c_t	Nm/rad	3.11E+06
Weight	m	kg	235
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	0.52
Shaft torsional stiffness	c_t	Nm/rad	3.44E+07
Weight	m	kg	215

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



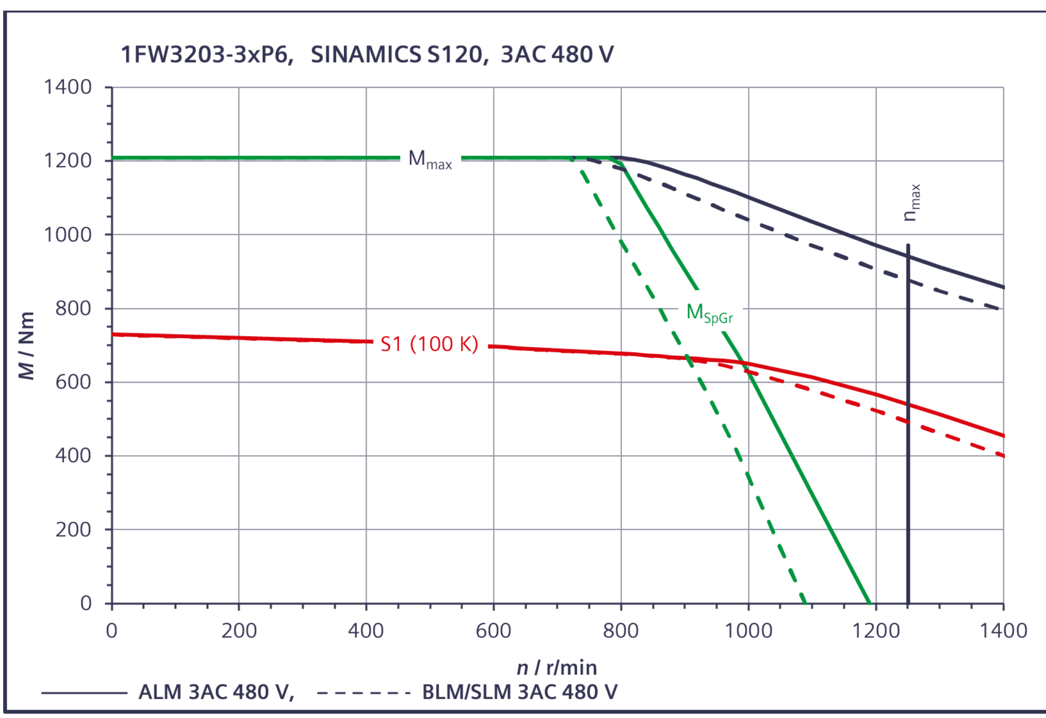
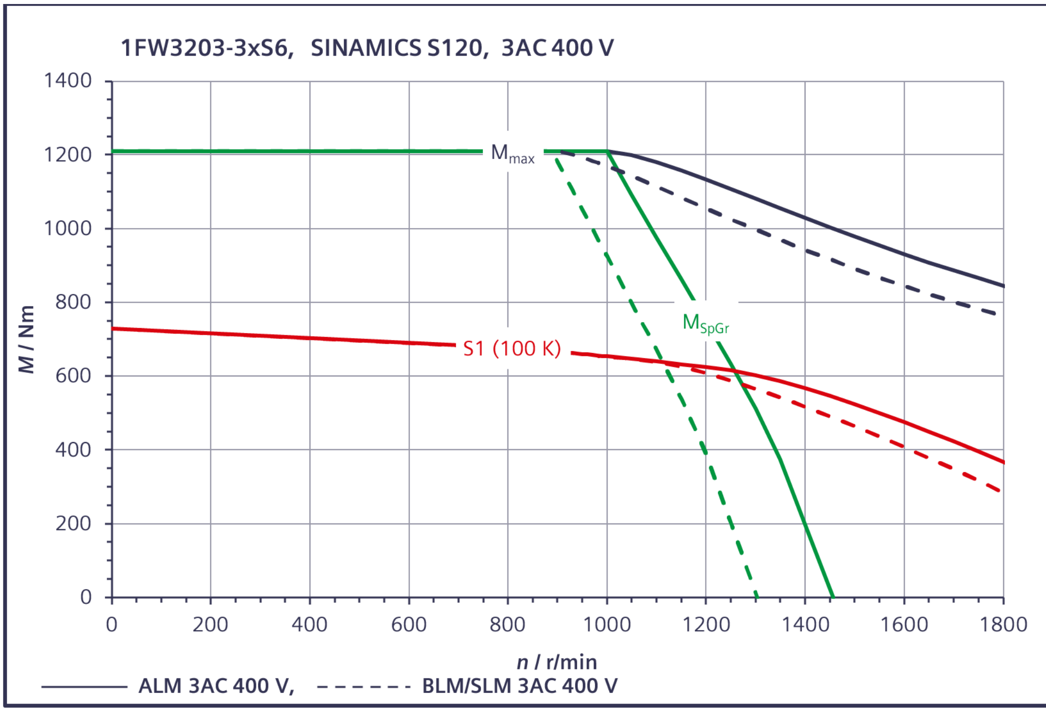


Table 6-43 1FW3203, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3203-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	630
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	79
Rated current (100 K)	$I_{N\ (100\ K)}$	A	131
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	730
Stall current (100 K)	$I_{0\ (100\ K)}$	A	149
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1840
Maximum torque	M_{max}	Nm	1210
Maximum current	I_{max}	A	265
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	4.9
Voltage constant (at 20 °C)	k_E	V/1000 r/min	314
Winding resistance (at 20 °C)	R_{ph}	Ω	0.038
Rotating field inductance	L_D	mH	0.75
Electrical time constant	T_{el}	ms	20
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.1
Moment of inertia	J_{mot}	kgm^2	0.45
Shaft torsional stiffness	c_t	Nm/rad	3.11E+06
Weight	m	kg	235
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	0.52
Shaft torsional stiffness	c_t	Nm/rad	3.44E+07
Weight	m	kg	215

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



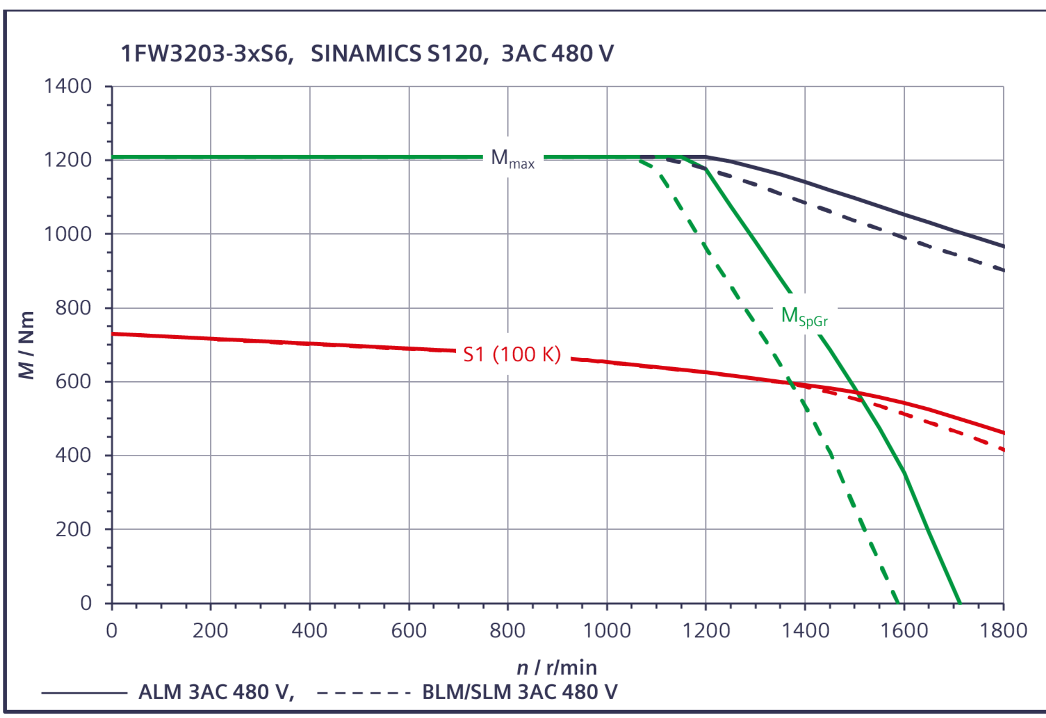
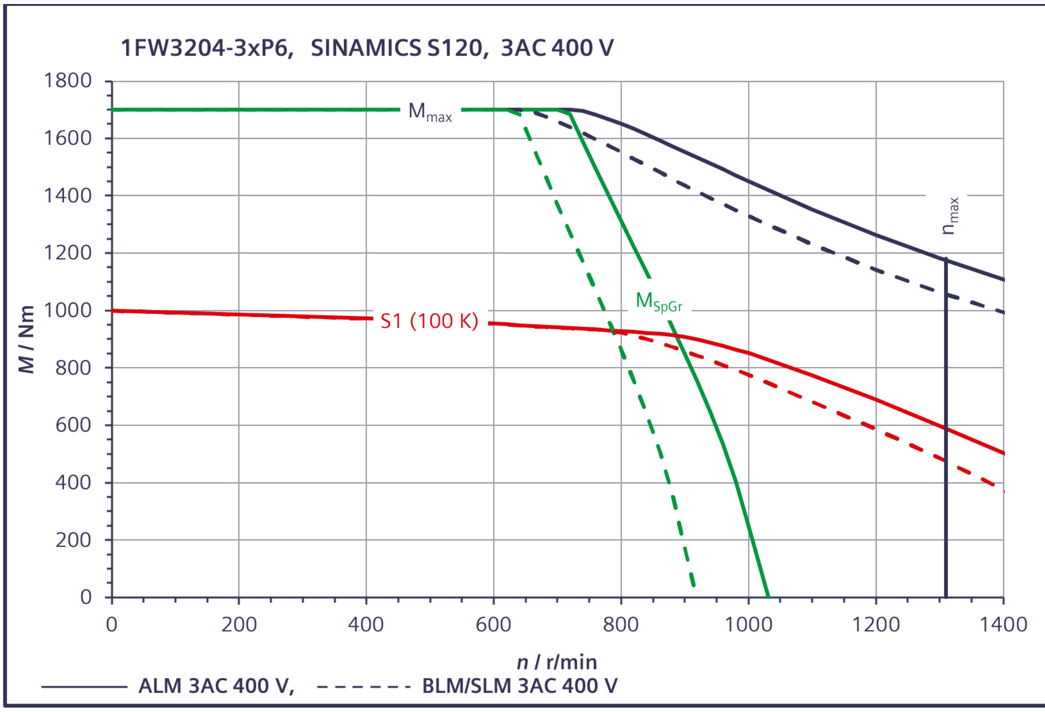


Table 6-44 1FW3204, rated speed 800 r/min

Engineering data	Code	Unit	1FW3204-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	930
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	78
Rated current (100 K)	$I_{N\ (100\ K)}$	A	137
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1000
Stall current (100 K)	$I_{0\ (100\ K)}$	A	145
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1310
Maximum torque	M_{max}	Nm	1700
Maximum current	I_{max}	A	265
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.9
Voltage constant (at 20 °C)	k_E	V/1000 r/min	441
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0465
Rotating field inductance	L_D	mH	1.05
Electrical time constant	T_{el}	ms	22.5
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	0.61
Shaft torsional stiffness	c_t	Nm/rad	2.88E+06
Weight	m	kg	285
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2
Moment of inertia	J_{mot}	kgm^2	0.69
Shaft torsional stiffness	c_t	Nm/rad	3.00E+07
Weight	m	kg	260

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



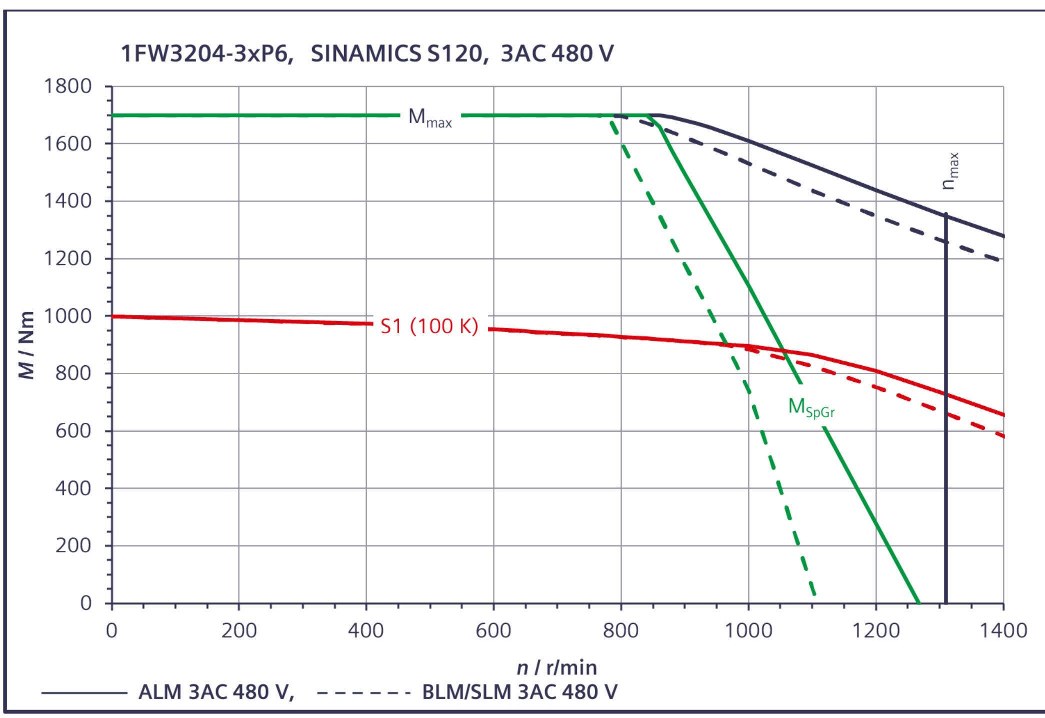
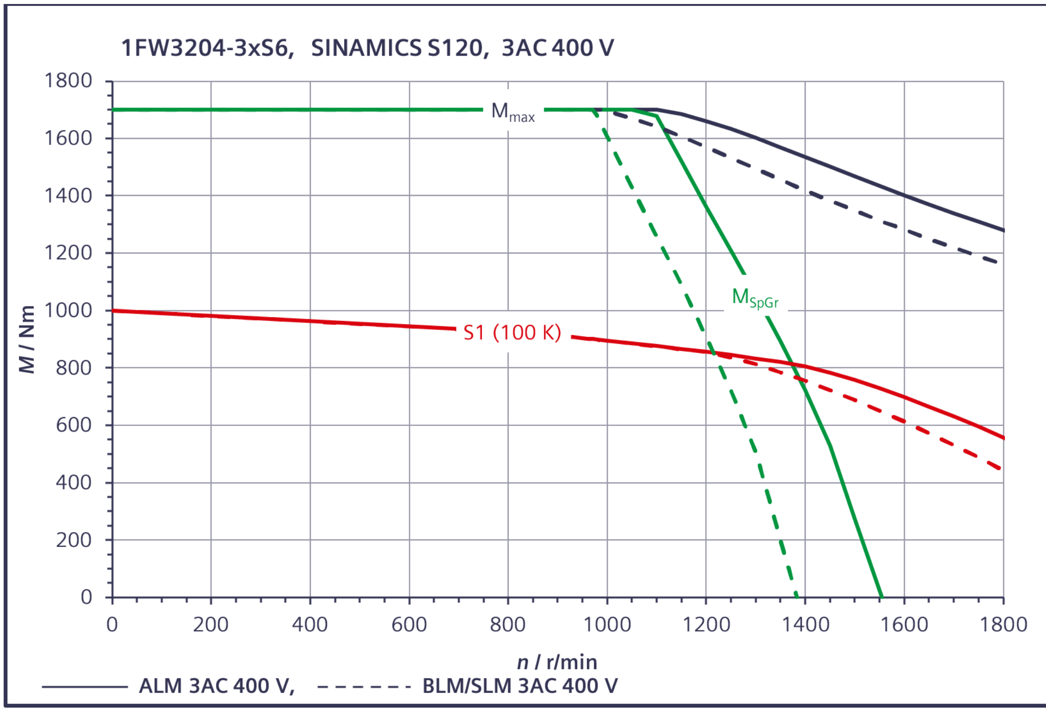


Table 6-45 1FW3204, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3204-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	860
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	108
Rated current (100 K)	$I_{N\ (100\ K)}$	A	191
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1000
Stall current (100 K)	$I_{0\ (100\ K)}$	A	220
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1970
Maximum torque	M_{max}	Nm	1700
Maximum current	I_{max}	A	400
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	4.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	294
Winding resistance (at 20 °C)	R_{ph}	Ω	0.021
Rotating field inductance	L_D	mH	0.46
Electrical time constant	T_{el}	ms	22
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	0.61
Shaft torsional stiffness	c_t	Nm/rad	2.88E+06
Weight	m	kg	285
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.1
Moment of inertia	J_{mot}	kgm^2	0.69
Shaft torsional stiffness	c_t	Nm/rad	3.00E+07
Weight	m	kg	260

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



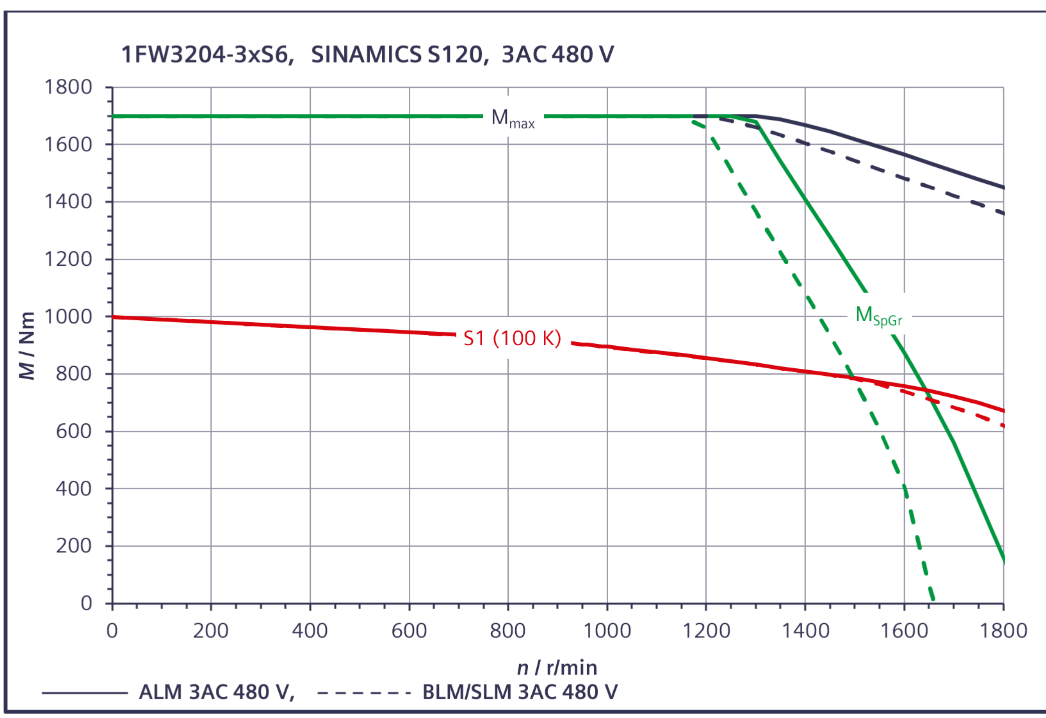
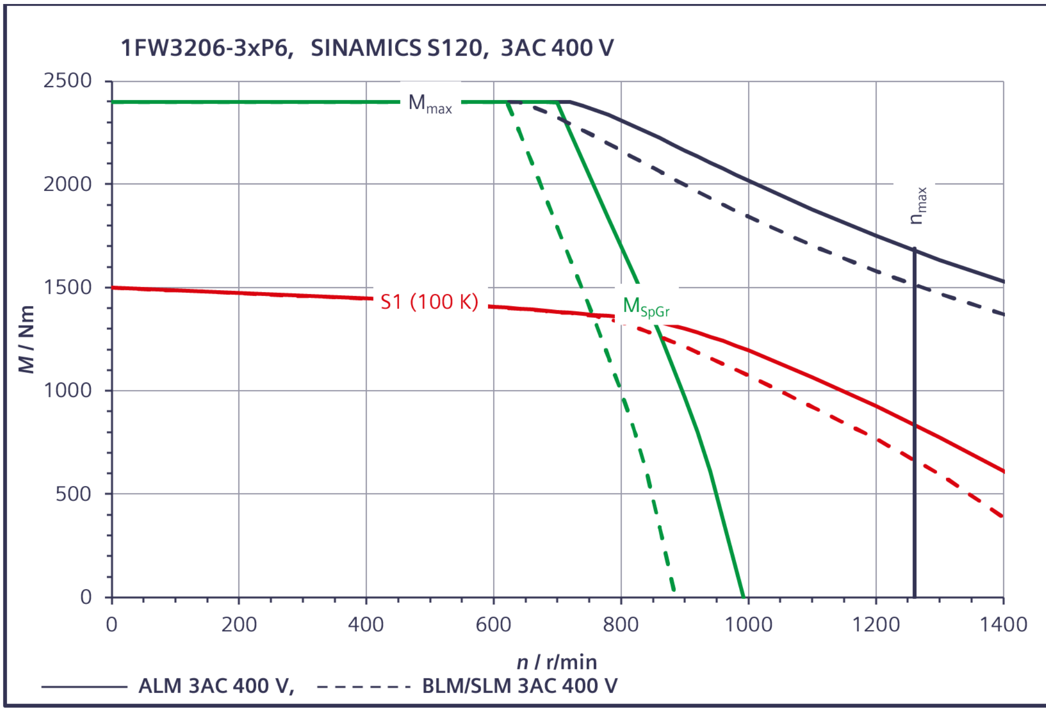


Table 6-46 1FW3206, rated speed 800 r/min

Engineering data	Code	Unit	1FW3206-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1360
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	114
Rated current (100 K)	$I_{N\ (100\ K)}$	A	192
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	210
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1260
Maximum torque	M_{max}	Nm	2400
Maximum current	I_{max}	A	365
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	7.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	460
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0325
Rotating field inductance	L_D	mH	0.8
Electrical time constant	T_{el}	ms	24
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm²	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm²	0.83
Shaft torsional stiffness	c_t	Nm/rad	2.62E+06
Weight	m	kg	370
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm²	0.94
Shaft torsional stiffness	c_t	Nm/rad	2.65E+07
Weight	m	kg	340

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



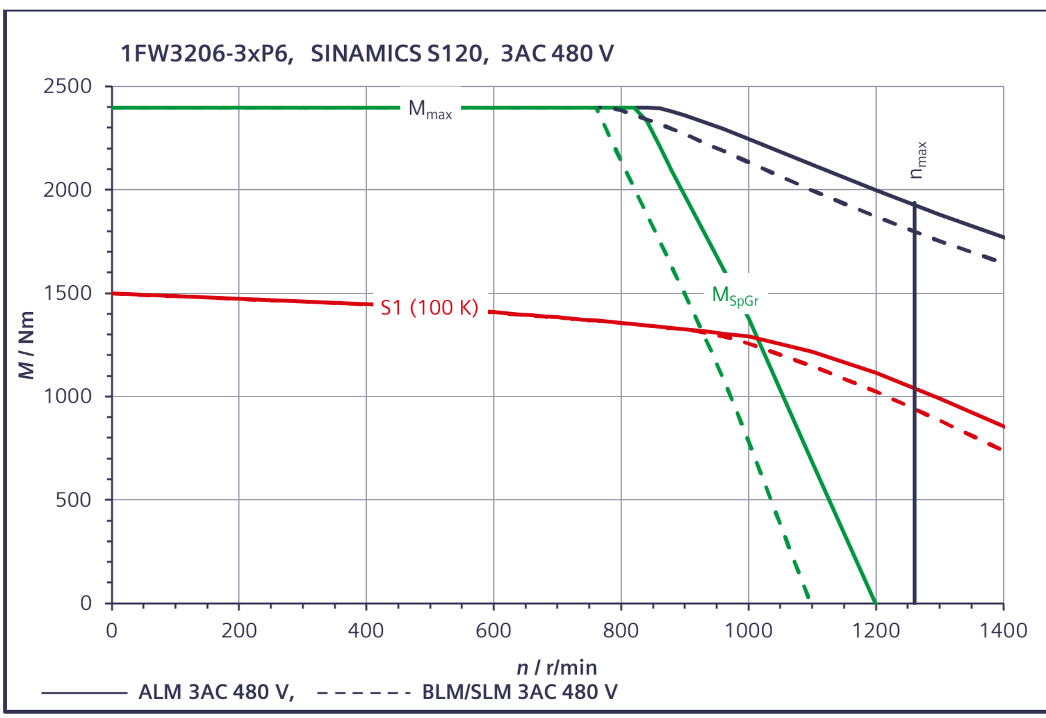
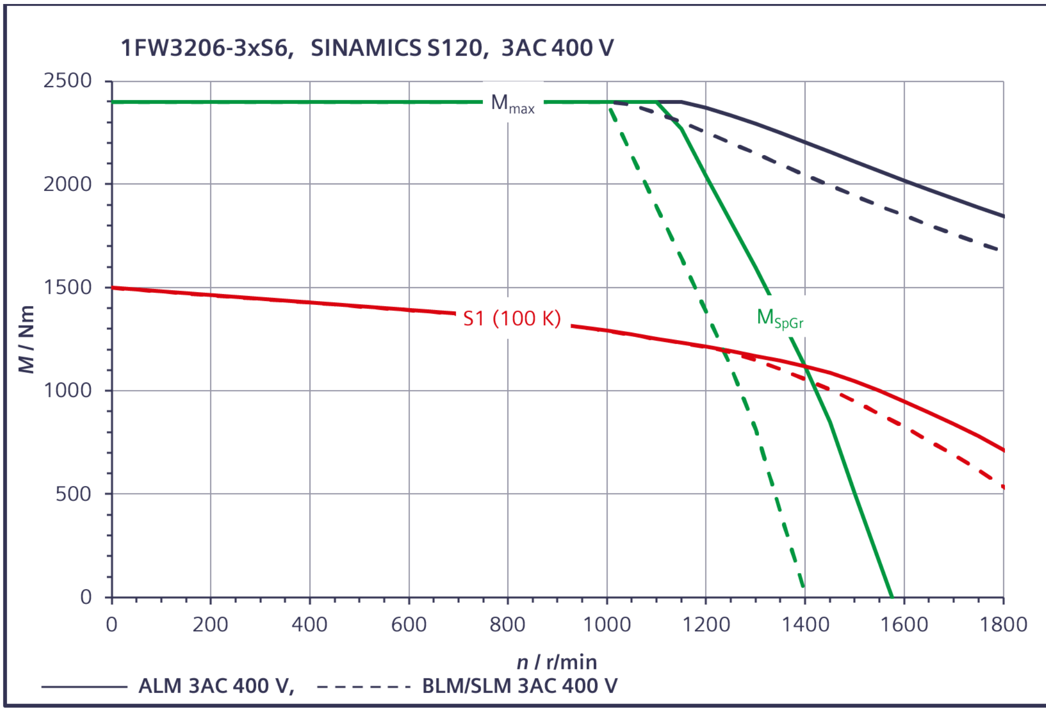


Table 6-47 1FW3206, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3206-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1210
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	152
Rated current (100 K)	$I_{N\ (100\ K)}$	A	270
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	1500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	330
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1980
Maximum torque	M_{max}	Nm	2400
Maximum current	I_{max}	A	570
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	4.55
Voltage constant (at 20 °C)	k_E	V/1000 r/min	292
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0131
Rotating field inductance	L_D	mH	0.32
Electrical time constant	T_{el}	ms	24
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm²	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm²	0.83
Shaft torsional stiffness	c_t	Nm/rad	2.62E+06
Weight	m	kg	370
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm²	0.94
Shaft torsional stiffness	c_t	Nm/rad	2.65E+0.7
Weight	m	kg	370

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



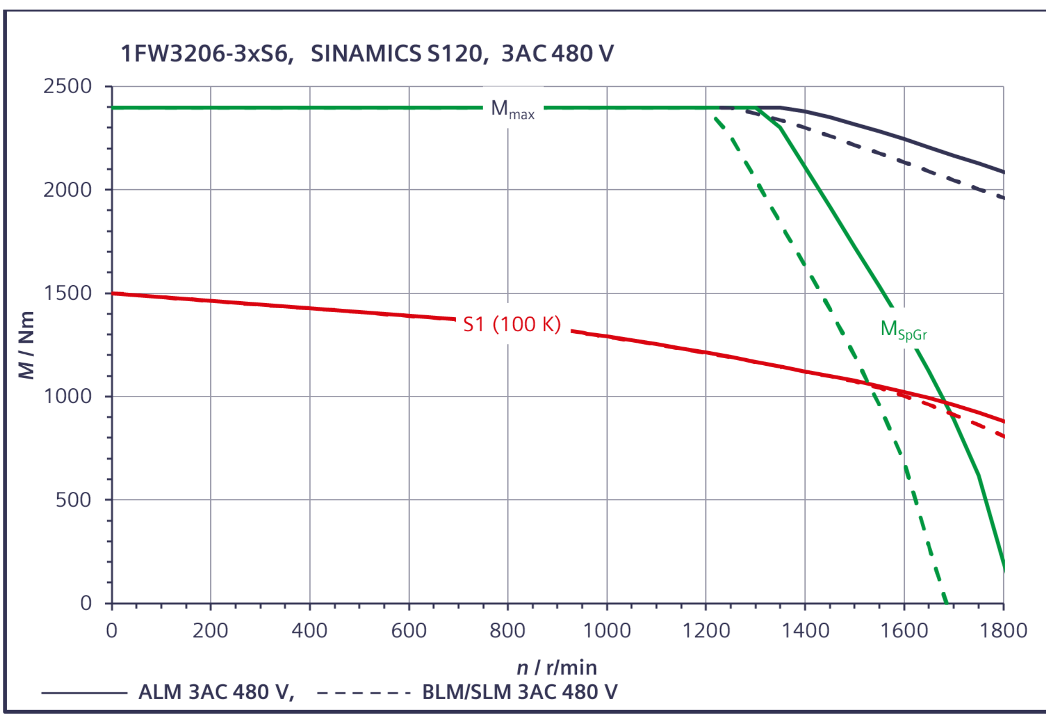
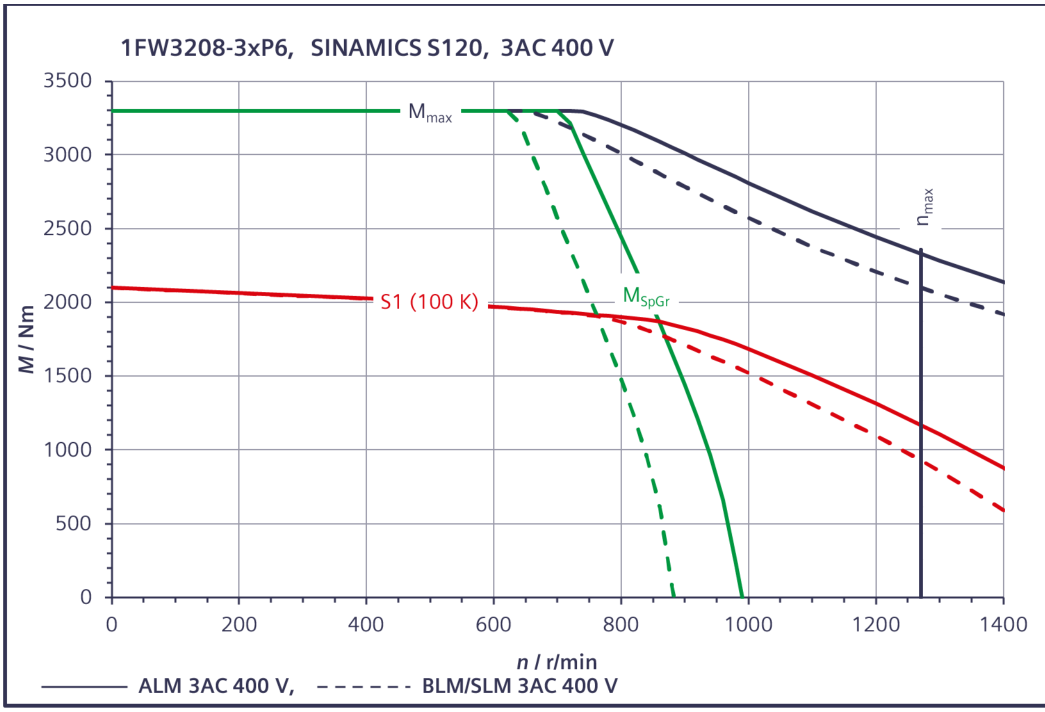


Table 6-48 1FW3208, rated speed 800 r/min

Engineering data	Code	Unit	1FW3208-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1900
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	159
Rated current (100 K)	$I_{N\ (100\ K)}$	A	270
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2100
Stall current (100 K)	$I_{0\ (100\ K)}$	A	295
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1270
Maximum torque	M_{max}	Nm	3300
Maximum current	I_{max}	A	500
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	7.1
Voltage constant (at 20 °C)	k_E	V/1000 r/min	456
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0215
Rotating field inductance	L_D	mH	0.55
Electrical time constant	T_{el}	ms	25.5
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	1.11
Shaft torsional stiffness	c_t	Nm/rad	2.35E+06
Weight	m	kg	445
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	1.24
Shaft torsional stiffness	c_t	Nm/rad	2.17E+0.6
Weight	m	kg	410

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



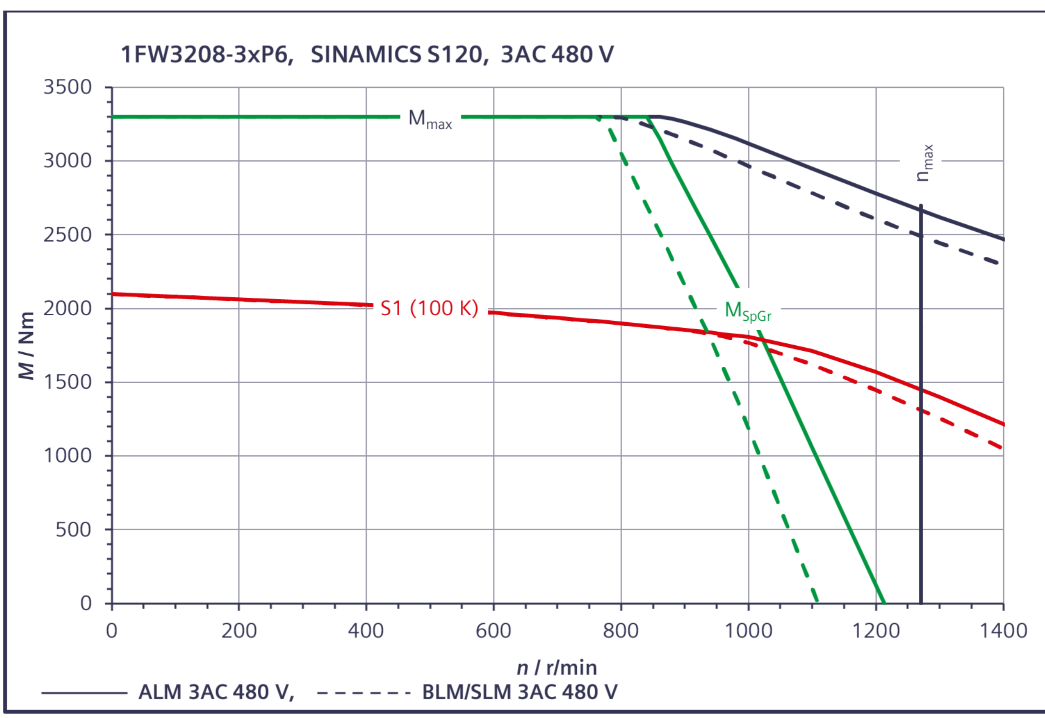
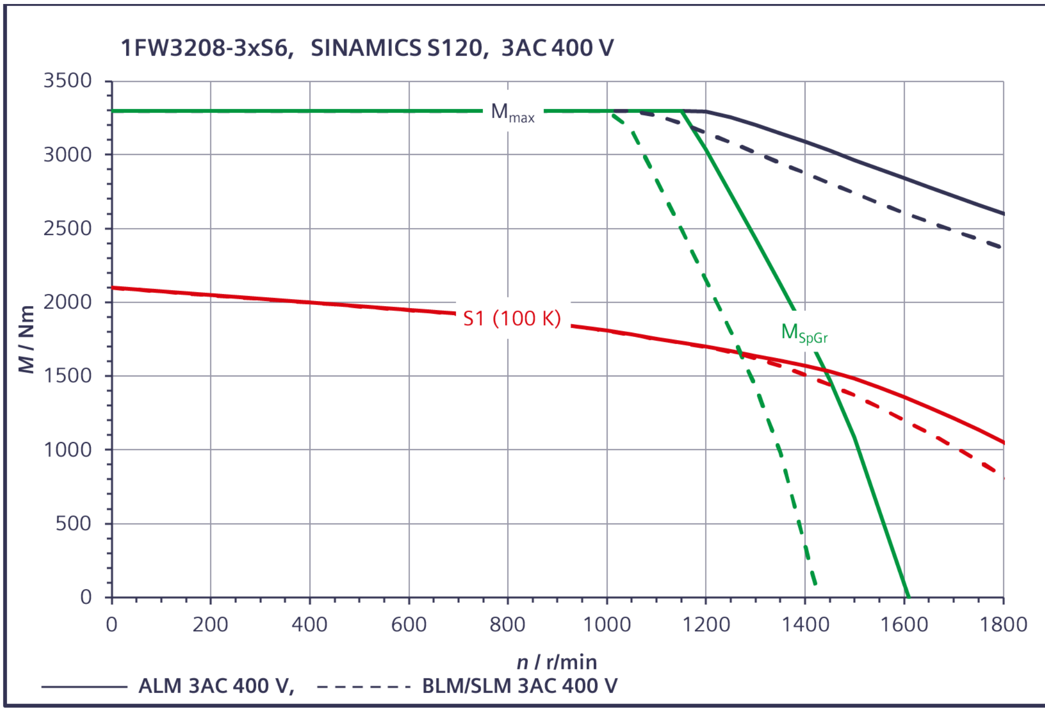


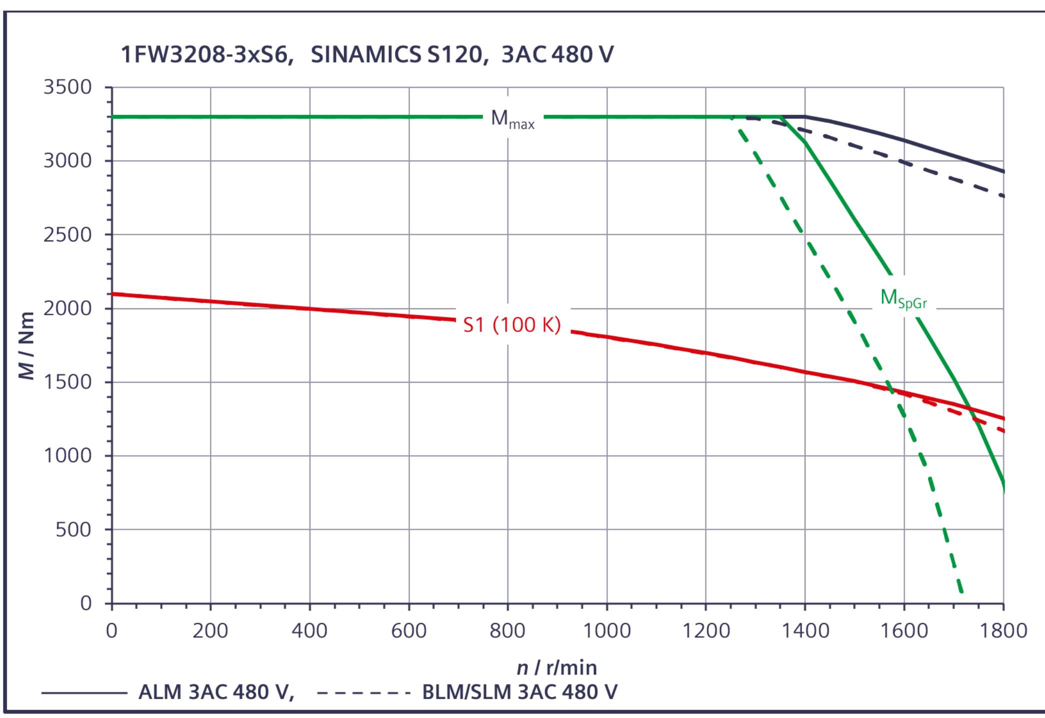
Table 6-49 1FW3208, rated speed 1200 r/min

Engineering data	Code	Unit	1FW3208-3☐S
Rated speed	n_N	r/min	1200
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1700
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	215
Rated current (100 K)	$I_{N\ (100\ K)}$	A	385
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2100
Stall current (100 K)	$I_{0\ (100\ K)}$	A	470
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1800
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	2050
Maximum torque	M_{max}	Nm	3300
Maximum current	I_{max}	A	800
Motor data			
Number of poles	2p		16
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	---
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	4.45
Voltage constant (at 20 °C)	k_E	V/1000 r/min	285
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0085
Rotating field inductance	L_D	mH	0.22
Electrical time constant	T_{el}	ms	25.5
Thermal time constant	T_{th}	min	10
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	---
Moment of inertia	J_{mot}	kgm^2	---
Shaft torsional stiffness	c_t	Nm/rad	---
Weight	m	kg	---
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.4
Moment of inertia	J_{mot}	kgm^2	1.11
Shaft torsional stiffness	c_t	Nm/rad	2.35E+06
Weight	m	kg	445
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.6
Moment of inertia	J_{mot}	kgm^2	1.24
Shaft torsional stiffness	c_t	Nm/rad	2.17E+0.6
Weight	m	kg	410

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*





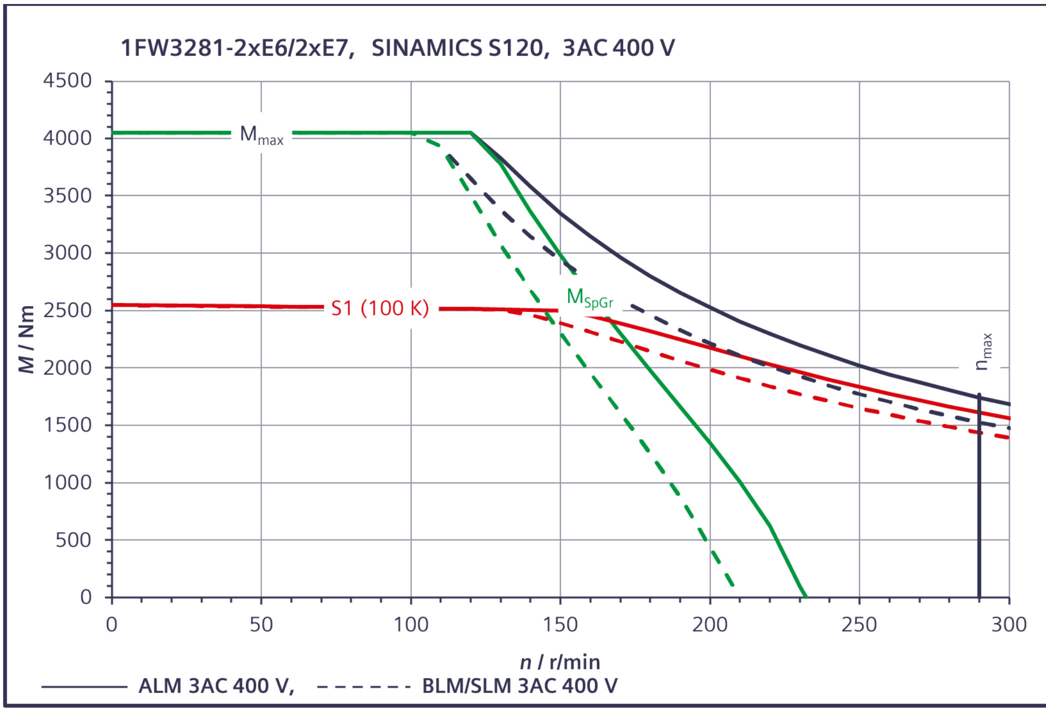
6.4.4 Shaft height 280, Standard

Table 6-50 1FW3281, rated speed 150 r/min

Engineering data	Code	Unit	1FW3281-2☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	2500
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	39.5
Rated current (100 K)	$I_{N\ (100\ K)}$	A	82
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2550
Stall current (100 K)	$I_{0\ (100\ K)}$	A	84
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	290
Maximum torque	M_{max}	Nm	4050
Maximum current	I_{max}	A	145
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	30.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1945
Winding resistance (at 20 °C)	R_{ph}	Ω	0.255
Rotating field inductance	L_D	mH	9.5
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm^2	3.8
Shaft torsional stiffness	c_t	Nm/rad	1.32E+08
Weight	m	kg	600
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	3.2
Shaft torsional stiffness	c_t	Nm/rad	9.48E+06
Weight	m	kg	750
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.0
Moment of inertia	J_{mot}	kgm^2	3.6
Shaft torsional stiffness	c_t	Nm/rad	1.52E+08
Weight	m	kg	670

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



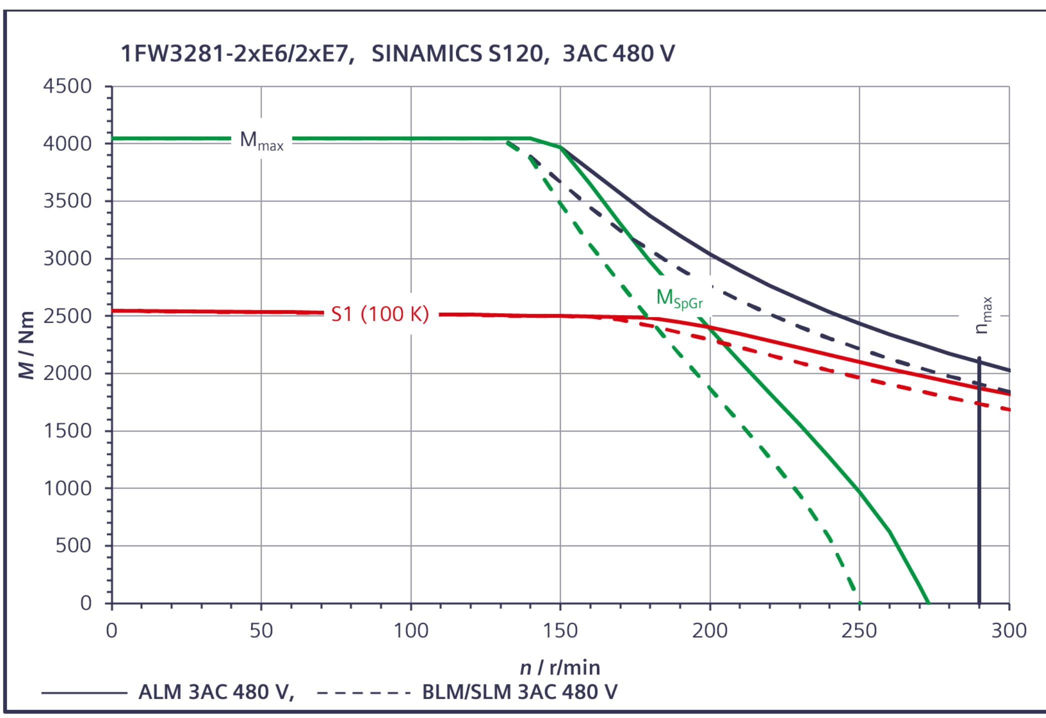
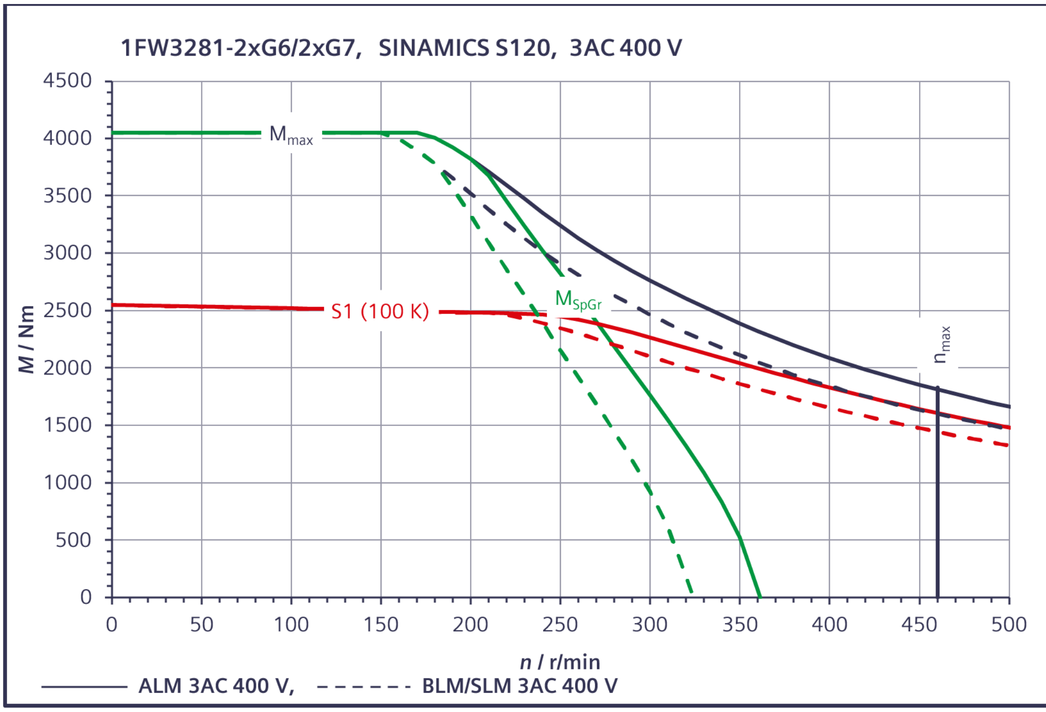


Table 6-51 1FW3281, rated speed 250 r/min

Engineering data	Code	Unit	1FW3281-2□G
Rated speed	n_N	r/min	250
Rated torque (100 K)	$M_{N (100 K)}$	Nm	2450
Rated power (100 K)	$P_{N (100 K)}$	kW	64
Rated current (100 K)	$I_{N (100 K)}$	A	126
Static torque (100 K)	$M_{0 (100 K)}$	Nm	2550
Stall current (100 K)	$I_{0 (100 K)}$	A	131
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	460
Maximum torque	M_{max}	Nm	4050
Maximum current	I_{max}	A	225
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	19.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1245
Winding resistance (at 20 °C)	R_{ph}	Ω	0.104
Rotating field inductance	L_D	mH	4.0
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm^2	3.8
Shaft torsional stiffness	c_t	Nm/rad	1.32E+08
Weight	m	kg	600
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	3.2
Shaft torsional stiffness	c_t	Nm/rad	9.48E+06
Weight	m	kg	750
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.0
Moment of inertia	J_{mot}	kgm^2	3.6
Shaft torsional stiffness	c_t	Nm/rad	1.52E+08
Weight	m	kg	670

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



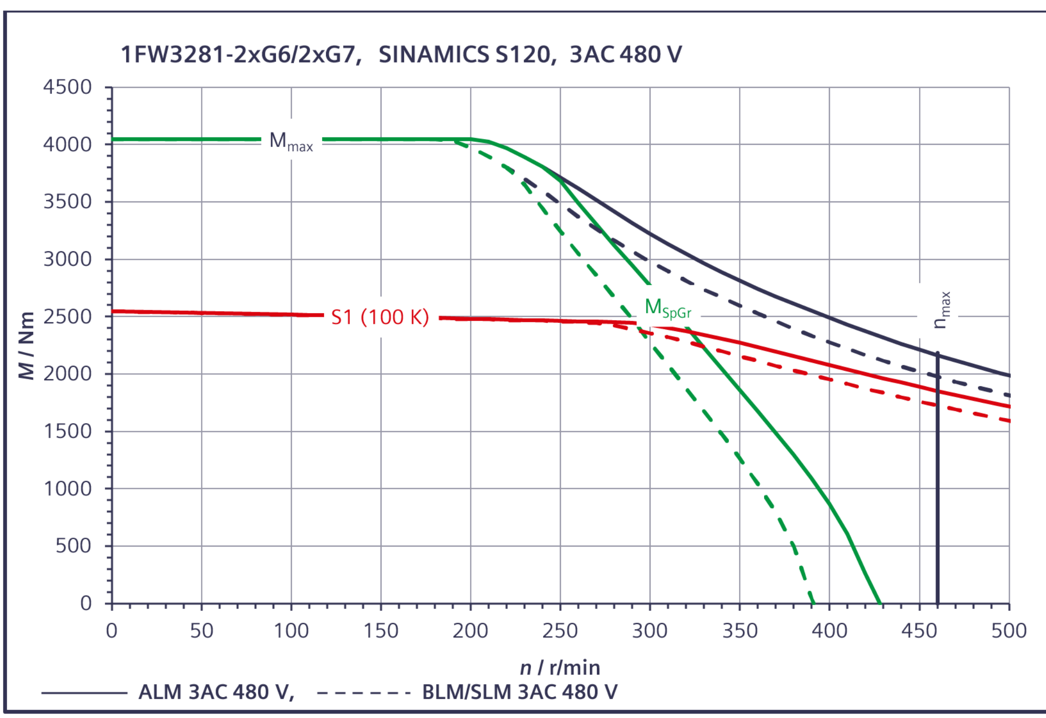
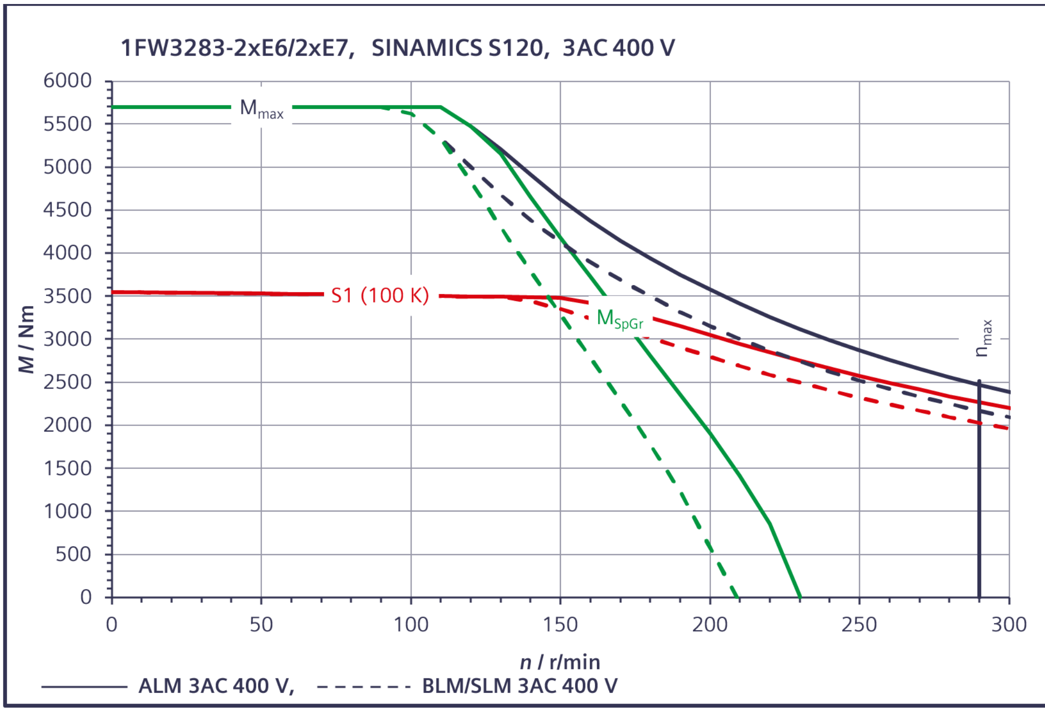


Table 6-52 1FW3283, rated speed 150 r/min

Engineering data	Code	Unit	1FW3283-2☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N (100 K)}$	Nm	3500
Rated power (100 K)	$P_{N (100 K)}$	kW	55
Rated current (100 K)	$I_{N (100 K)}$	A	115
Static torque (100 K)	$M_{0 (100 K)}$	Nm	3550
Stall current (100 K)	$I_{0 (100 K)}$	A	116
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	290
Maximum torque	M_{max}	Nm	5700
Maximum current	I_{max}	A	205
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	30.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1955
Winding resistance (at 20 °C)	R_{ph}	Ω	0.162
Rotating field inductance	L_D	mH	7.0
Electrical time constant	T_{el}	ms	43.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.65
Shaft torsional stiffness	c_t	Nm/rad	1.08E+08
Weight	m	kg	690
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	4.35
Shaft torsional stiffness	c_t	Nm/rad	9.42E+06
Weight	m	kg	880
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.5
Shaft torsional stiffness	c_t	Nm/rad	1.24E+08
Weight	m	kg	770

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



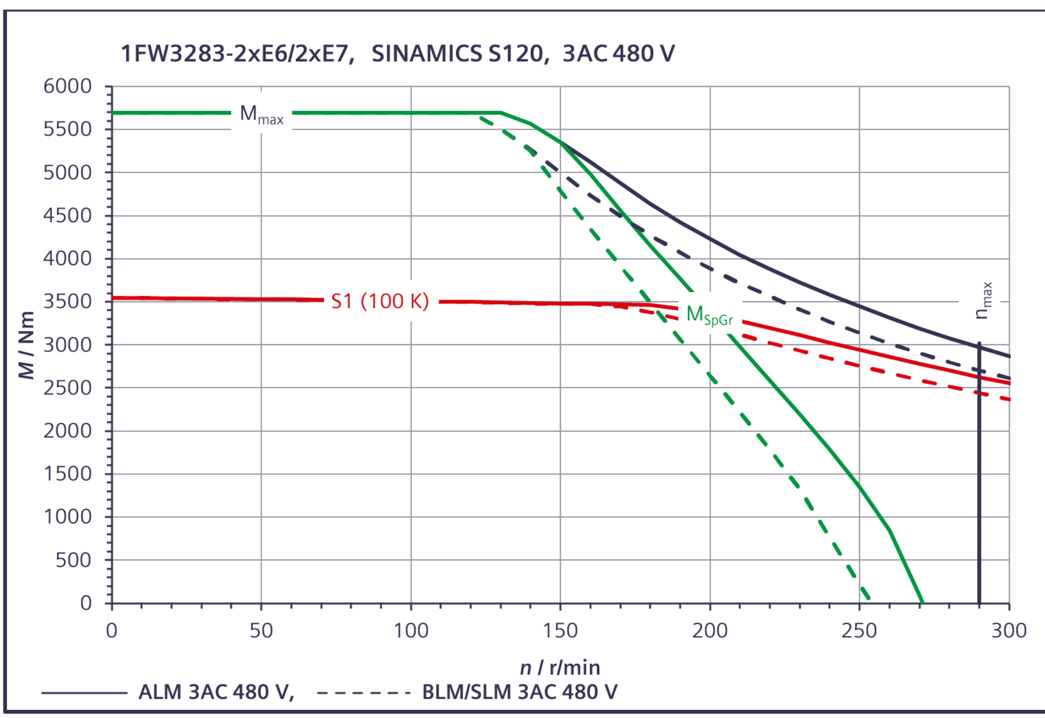
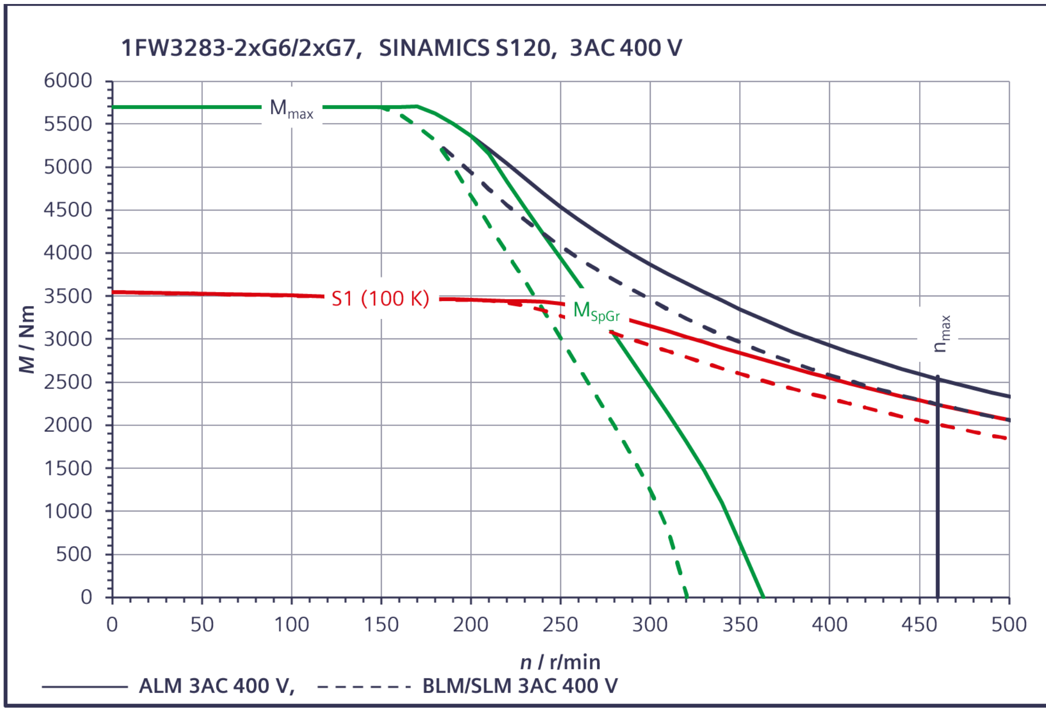


Table 6-53 1FW3283, rated speed 250 r/min

Engineering data	Code	Unit	1FW3283-2□G
Rated speed	n_N	r/min	250
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	3450
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	90
Rated current (100 K)	$I_{N\ (100\ K)}$	A	176
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	3550
Stall current (100 K)	$I_{0\ (100\ K)}$	A	181
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	460
Maximum torque	M_{max}	Nm	5700
Maximum current	I_{max}	A	315
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	19.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1255
Winding resistance (at 20 °C)	R_{ph}	Ω	0.067
Rotating field inductance	L_D	mH	2.9
Electrical time constant	T_{el}	ms	43.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.65
Shaft torsional stiffness	c_t	Nm/rad	1.08E+08
Weight	m	kg	690
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	4.35
Shaft torsional stiffness	c_t	Nm/rad	9.42E+06
Weight	m	kg	880
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.5
Shaft torsional stiffness	c_t	Nm/rad	1.24E+08
Weight	m	kg	770

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



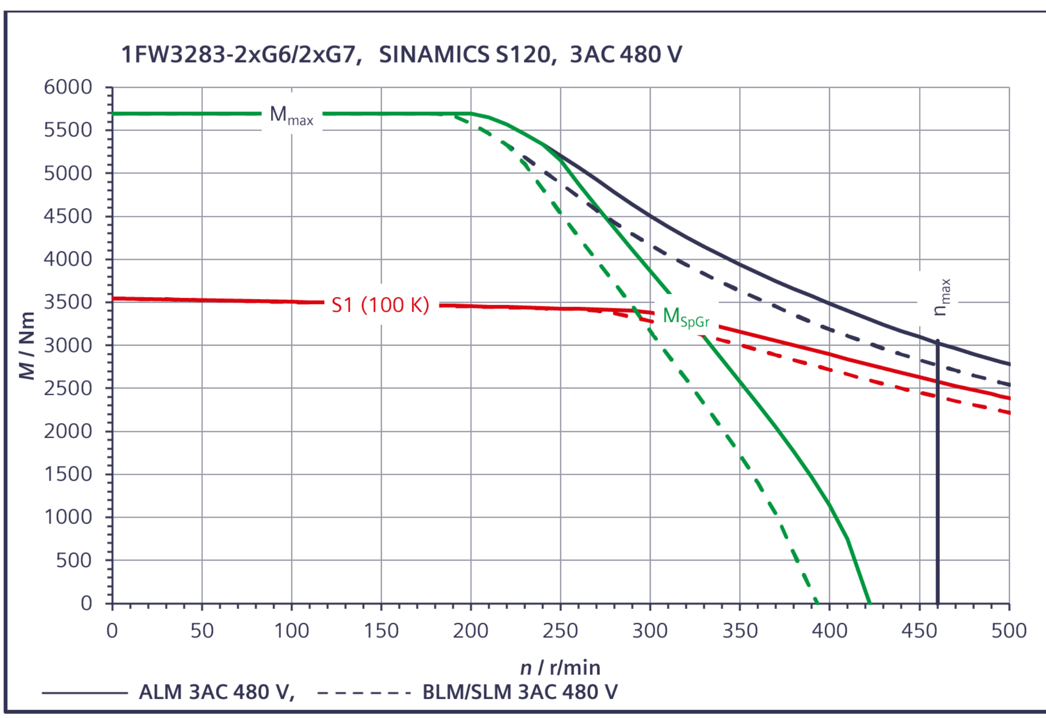
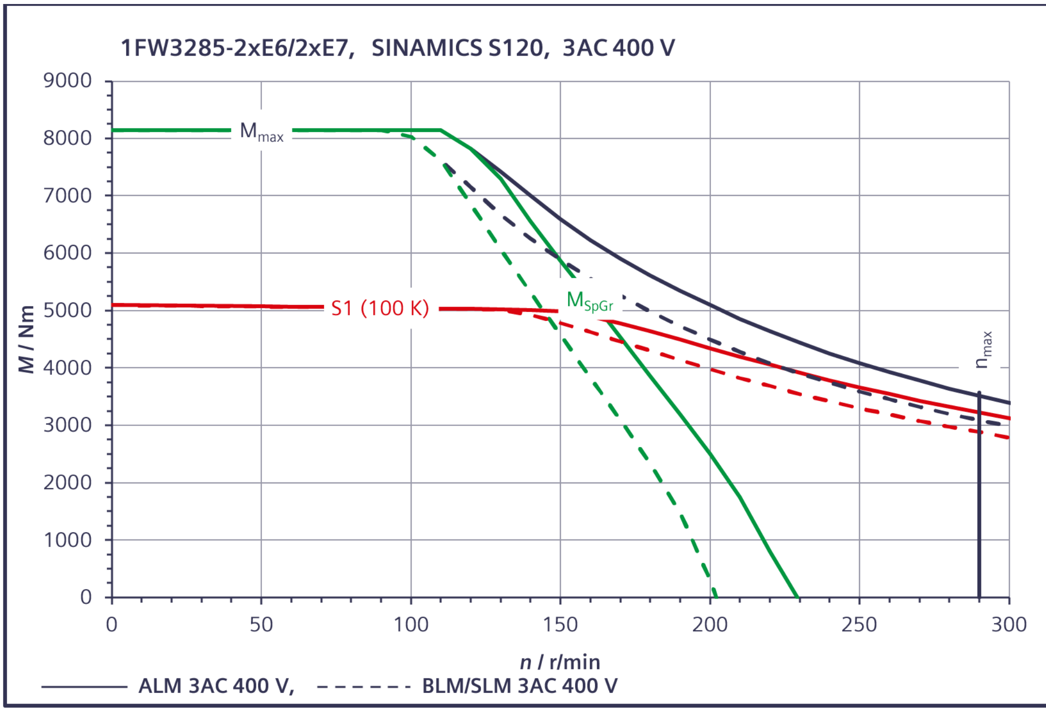


Table 6-54 1FW3285, rated speed 150 r/min

Engineering data	Code	Unit	1FW3285-2☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N (100 K)}$	Nm	5000
Rated power (100 K)	$P_{N (100 K)}$	kW	79
Rated current (100 K)	$I_{N (100 K)}$	A	160
Static torque (100 K)	$M_{0 (100 K)}$	Nm	5100
Stall current (100 K)	$I_{0 (100 K)}$	A	163
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	290
Maximum torque	M_{max}	Nm	8150
Maximum current	I_{max}	A	285
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	31.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1995
Winding resistance (at 20 °C)	R_{ph}	Ω	0.107
Rotating field inductance	L_D	mH	5.0
Electrical time constant	T_{el}	ms	47.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	6.0
Shaft torsional stiffness	c_t	Nm/rad	8.47E+07
Weight	m	kg	860
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	6.1
Shaft torsional stiffness	c_t	Nm/rad	9.32E+06
Weight	m	kg	1070
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	5.9
Shaft torsional stiffness	c_t	Nm/rad	9.75E+07
Weight	m	kg	920

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



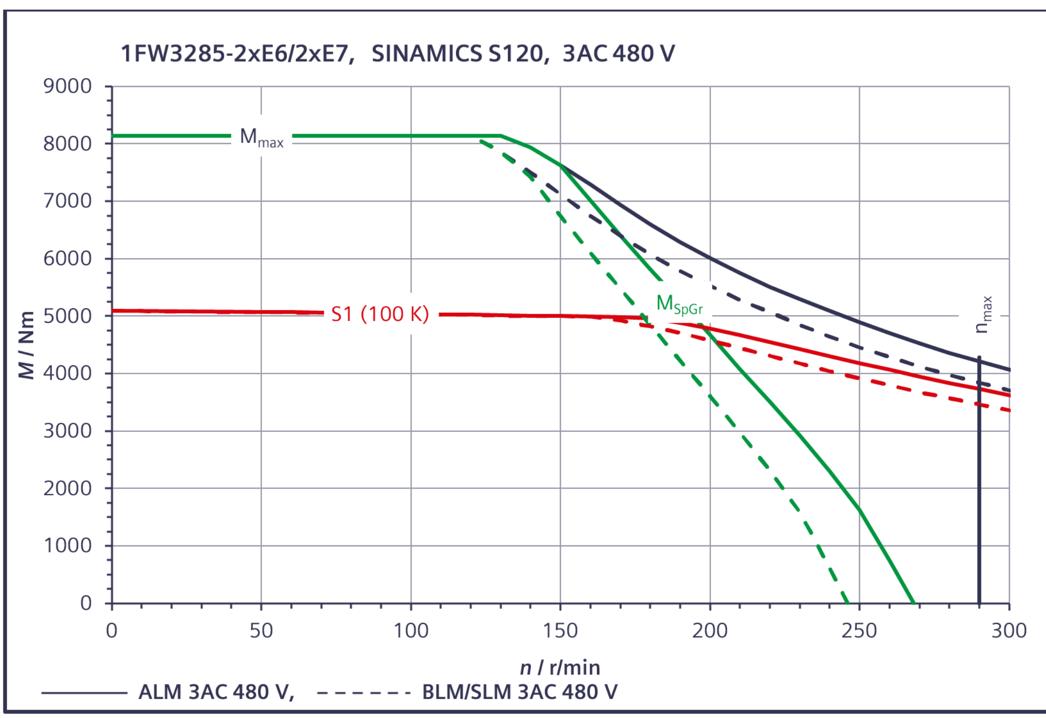
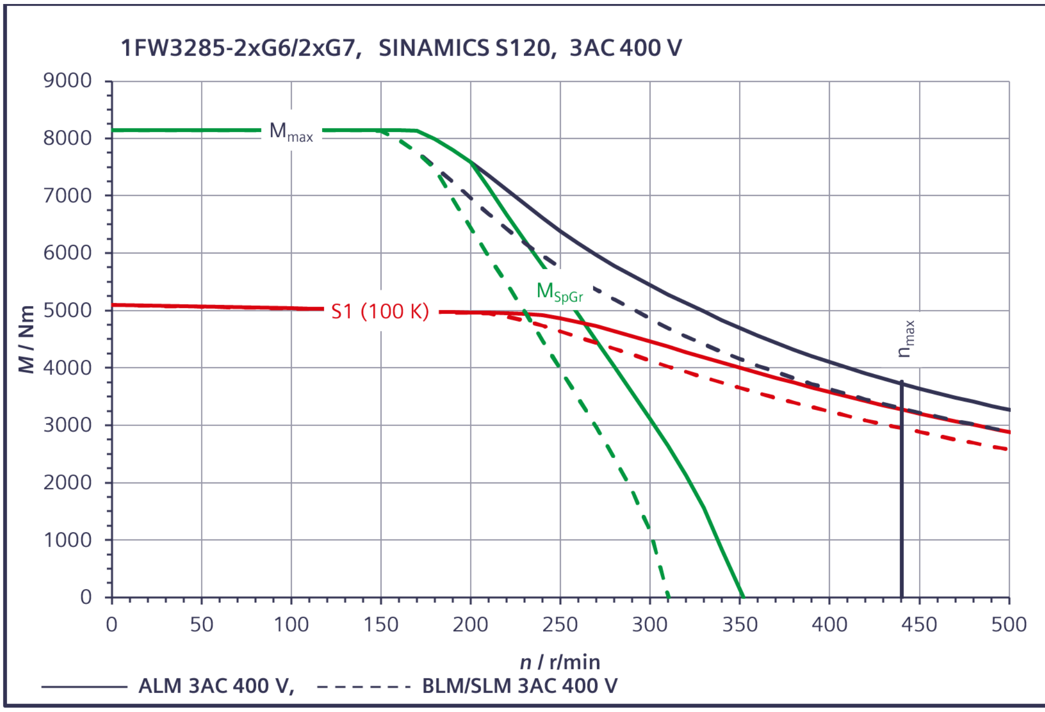


Table 6-55 1FW3285, rated speed 250 r/min

Engineering data	Code	Unit	1FW3285-2☐G
Rated speed	n_N	r/min	250
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	4950
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	130
Rated current (100 K)	$I_{N\ (100\ K)}$	A	245
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	5100
Stall current (100 K)	$I_{0\ (100\ K)}$	A	250
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	440
Maximum torque	M_{max}	Nm	8150
Maximum current	I_{max}	A	435
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	20.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1295
Winding resistance (at 20 °C)	R_{ph}	Ω	0.045
Rotating field inductance	L_D	mH	2.2
Electrical time constant	T_{el}	ms	47.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	6.0
Shaft torsional stiffness	c_t	Nm/rad	8.47E+07
Weight	m	kg	860
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	6.1
Shaft torsional stiffness	c_t	Nm/rad	9.32E+06
Weight	m	kg	1070
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	5.9
Shaft torsional stiffness	c_t	Nm/rad	9.75E+07
Weight	m	kg	920

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



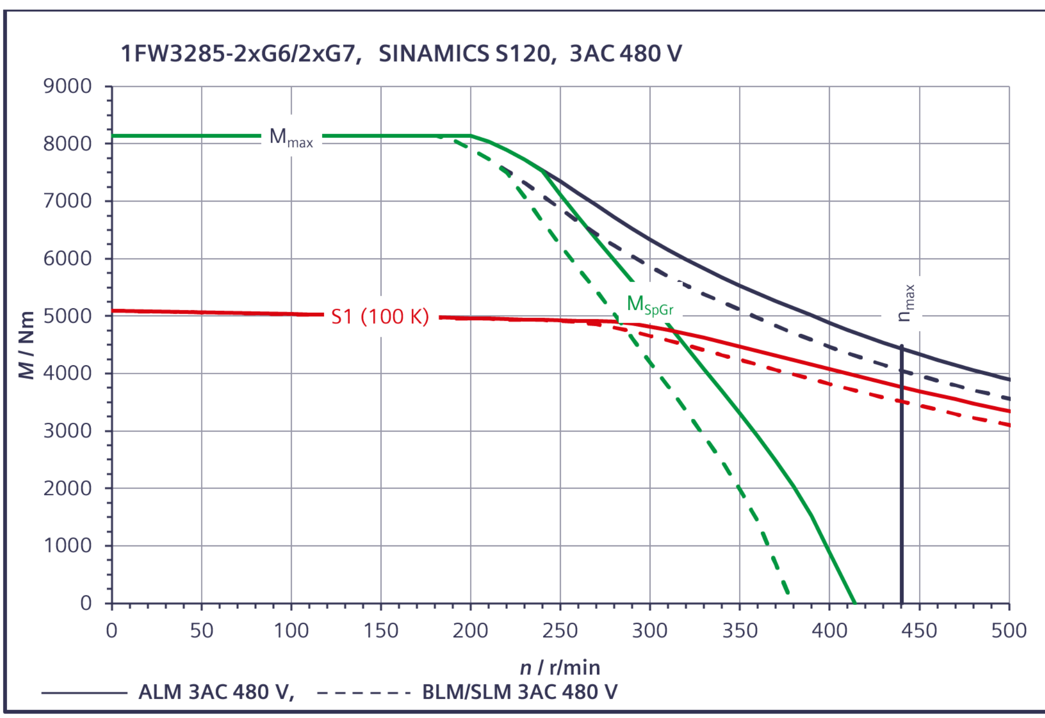
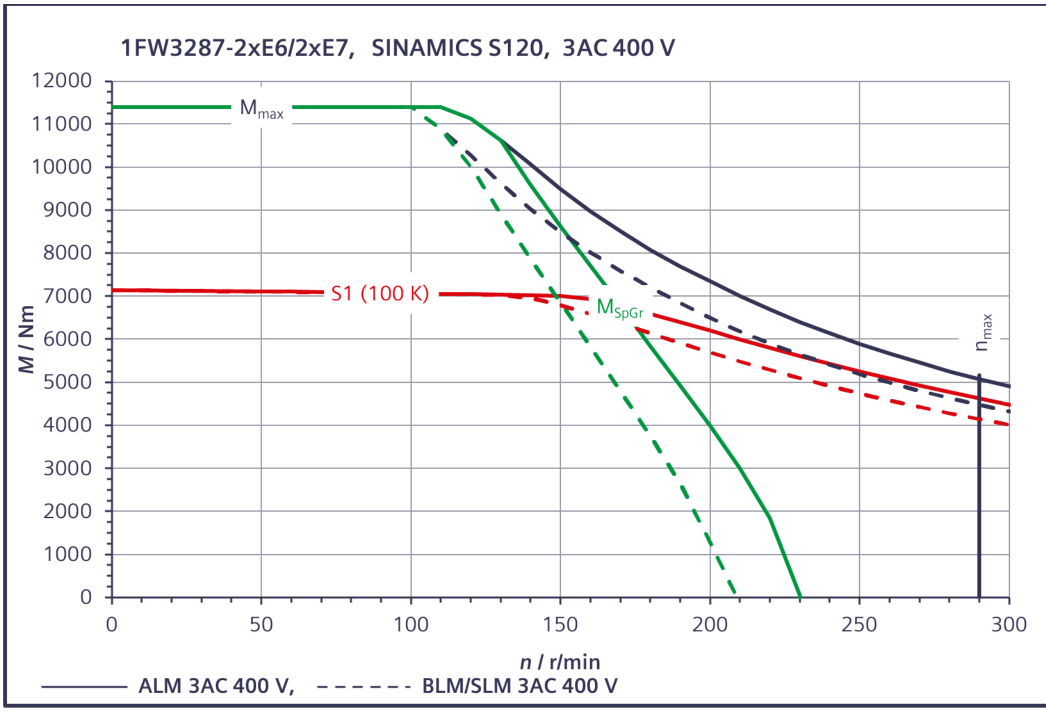


Table 6-56 1FW3287, rated speed 150 r/min

Engineering data	Code	Unit	1FW3287-2☐E
Rated speed	n_N	r/min	150
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	7000
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	110
Rated current (100 K)	$I_{N\ (100\ K)}$	A	230
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	7150
Stall current (100 K)	$I_{0\ (100\ K)}$	A	235
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	290
Maximum torque	M_{max}	Nm	11400
Maximum current	I_{max}	A	405
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	30.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1955
Winding resistance (at 20 °C)	R_{ph}	Ω	0.068
Rotating field inductance	L_D	mH	3.5
Electrical time constant	T_{el}	ms	51
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.8
Shaft torsional stiffness	c_t	Nm/rad	6.58E+07
Weight	m	kg	1030
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	8.4
Shaft torsional stiffness	c_t	Nm/rad	9.20E+06
Weight	m	kg	1300
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.7
Shaft torsional stiffness	c_t	Nm/rad	7.60E+07
Weight	m	kg	1130

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



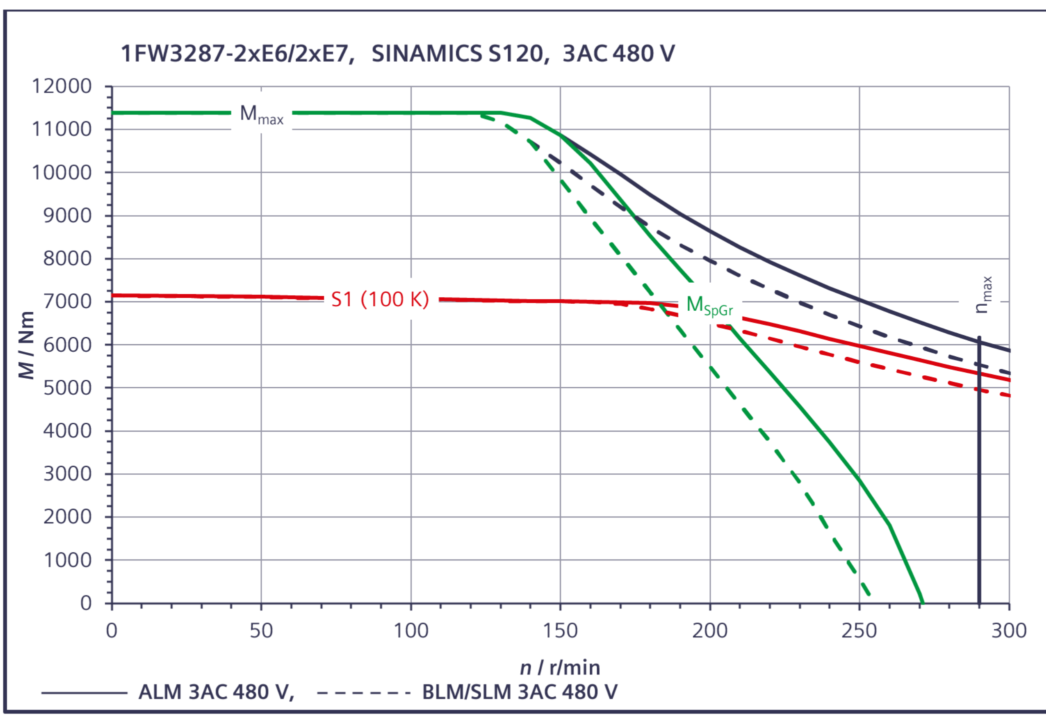
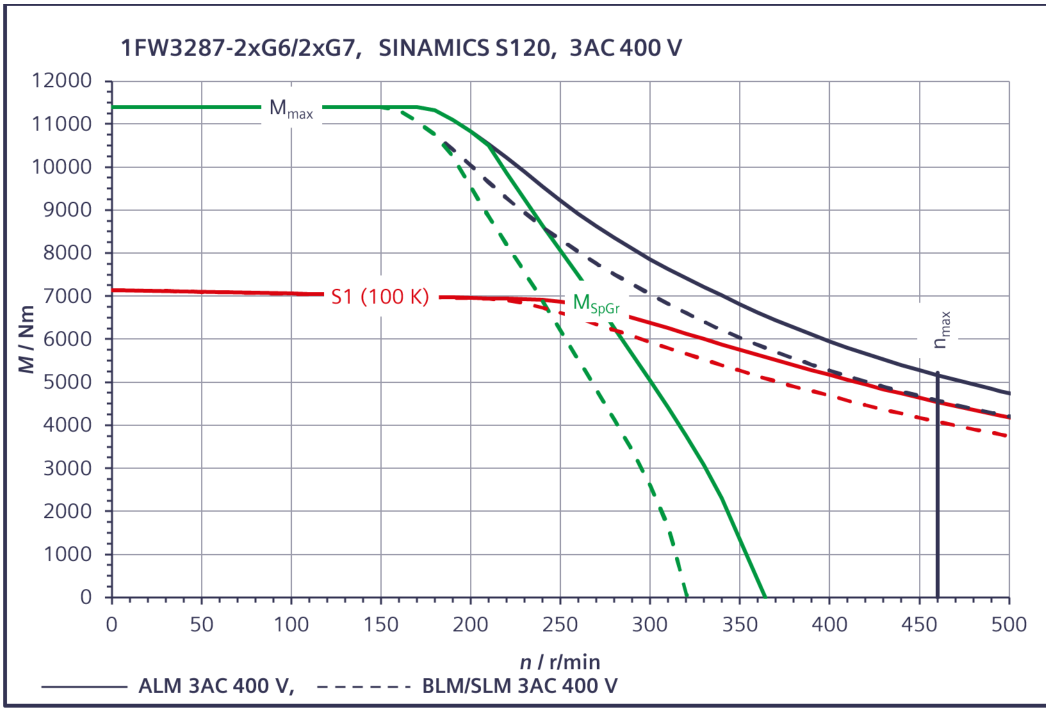


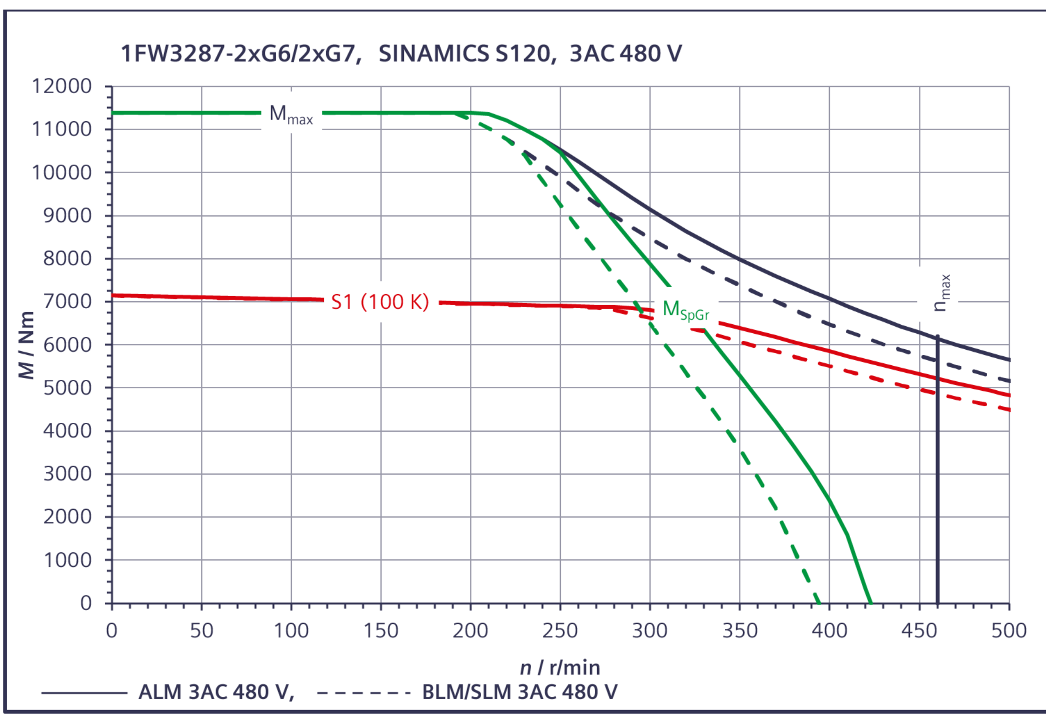
Table 6-57 1FW3287, rated speed 250 r/min

Engineering data	Code	Unit	1FW3287-2☐G
Rated speed	n_N	r/min	250
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	6900
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	181
Rated current (100 K)	$I_{N\ (100\ K)}$	A	350
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	7150
Stall current (100 K)	$I_{0\ (100\ K)}$	A	365
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	460
Maximum torque	M_{max}	Nm	11400
Maximum current	I_{max}	A	630
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	19.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	1255
Winding resistance (at 20 °C)	R_{ph}	Ω	0.028
Rotating field inductance	L_D	mH	1.45
Electrical time constant	T_{el}	ms	51
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.8
Shaft torsional stiffness	c_t	Nm/rad	6.58E+07
Weight	m	kg	1030
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	8.4
Shaft torsional stiffness	c_t	Nm/rad	9.20E+06
Weight	m	kg	1300
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.7
Shaft torsional stiffness	c_t	Nm/rad	7.60E+07
Weight	m	kg	1130

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*





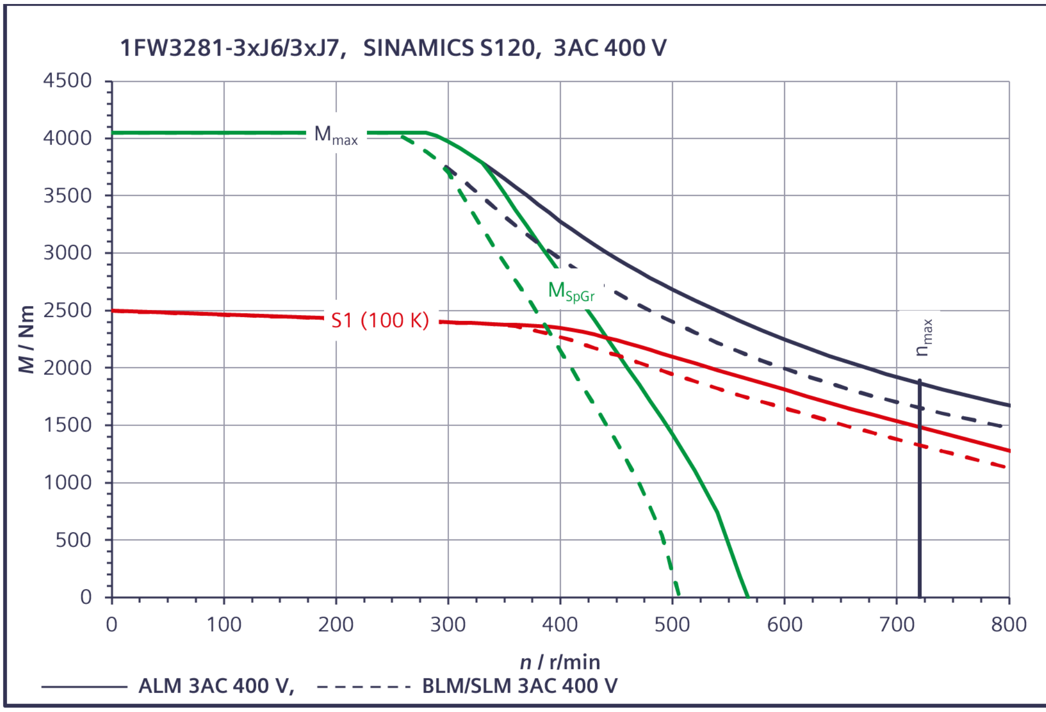
6.4.5 Shaft height 280, High Speed

Table 6-58 1FW3281, rated speed 400 r/min

Engineering data	Code	Unit	1FW3281-3☐J
Rated speed	n_N	r/min	400
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	2350
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	98
Rated current (100 K)	$I_{N\ (100\ K)}$	A	188
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	200
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	720
Maximum torque	M_{max}	Nm	4050
Maximum current	I_{max}	A	350
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	12.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	800
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0425
Rotating field inductance	L_D	mH	1.65
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm²	3.8
Shaft torsional stiffness	c_t	Nm/rad	1.32E+08
Weight	m	kg	600
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm²	3.2
Shaft torsional stiffness	c_t	Nm/rad	9.48E+06
Weight	m	kg	750
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.0
Moment of inertia	J_{mot}	kgm²	3.6
Shaft torsional stiffness	c_t	Nm/rad	1.52E+08
Weight	m	kg	670

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



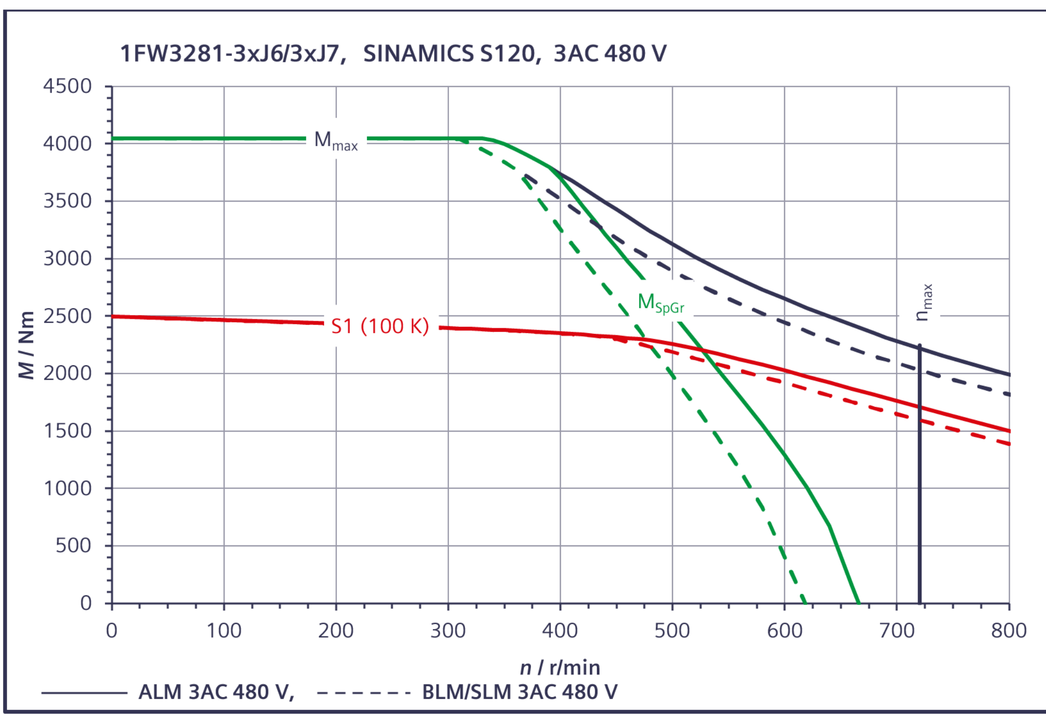
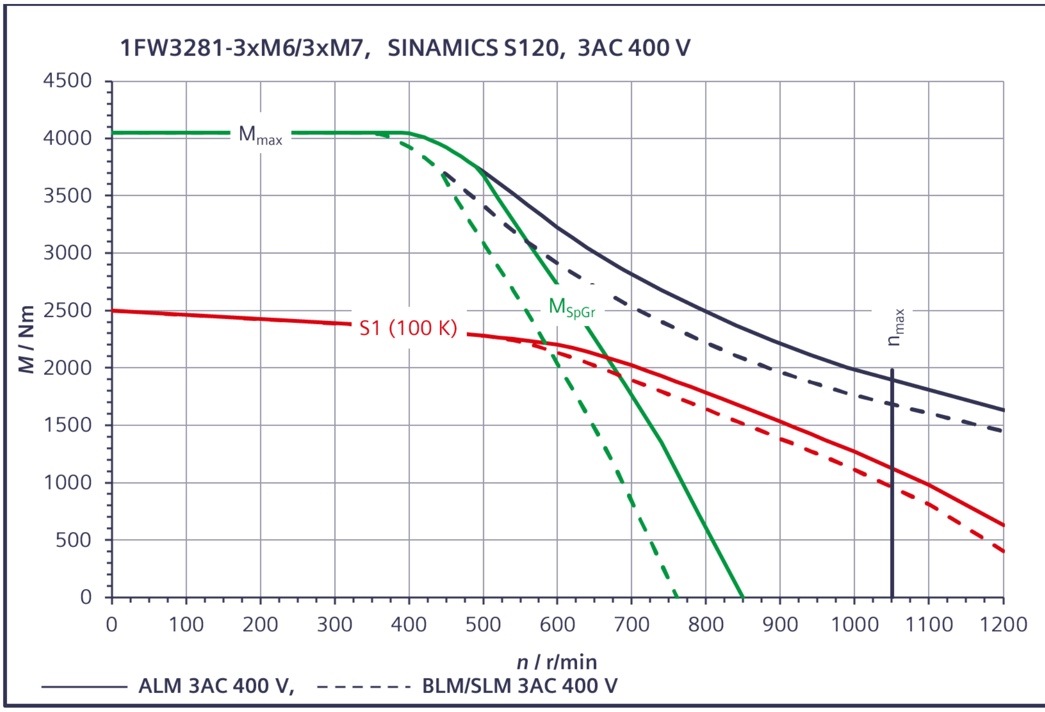


Table 6-59 1FW3281, rated speed 600 r/min

Engineering data	Code	Unit	1FW3281-3☐M
Rated speed	n_N	r/min	600
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	2200
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	138
Rated current (100 K)	$I_{N\ (100\ K)}$	A	255
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	290
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1050
Maximum torque	M_{max}	Nm	4050
Maximum current	I_{max}	A	510
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.6
Voltage constant (at 20 °C)	k_E	V/1000 r/min	550
Winding resistance (at 20 °C)	R_{ph}	Ω	0.02
Rotating field inductance	L_D	mH	0.75
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.1
Moment of inertia	J_{mot}	kgm^2	3.8
Shaft torsional stiffness	c_t	Nm/rad	1.32E+08
Weight	m	kg	600
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.6
Moment of inertia	J_{mot}	kgm^2	3.2
Shaft torsional stiffness	c_t	Nm/rad	9.48E+06
Weight	m	kg	750
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.0
Moment of inertia	J_{mot}	kgm^2	3.6
Shaft torsional stiffness	c_t	Nm/rad	1.52E+08
Weight	m	kg	670

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



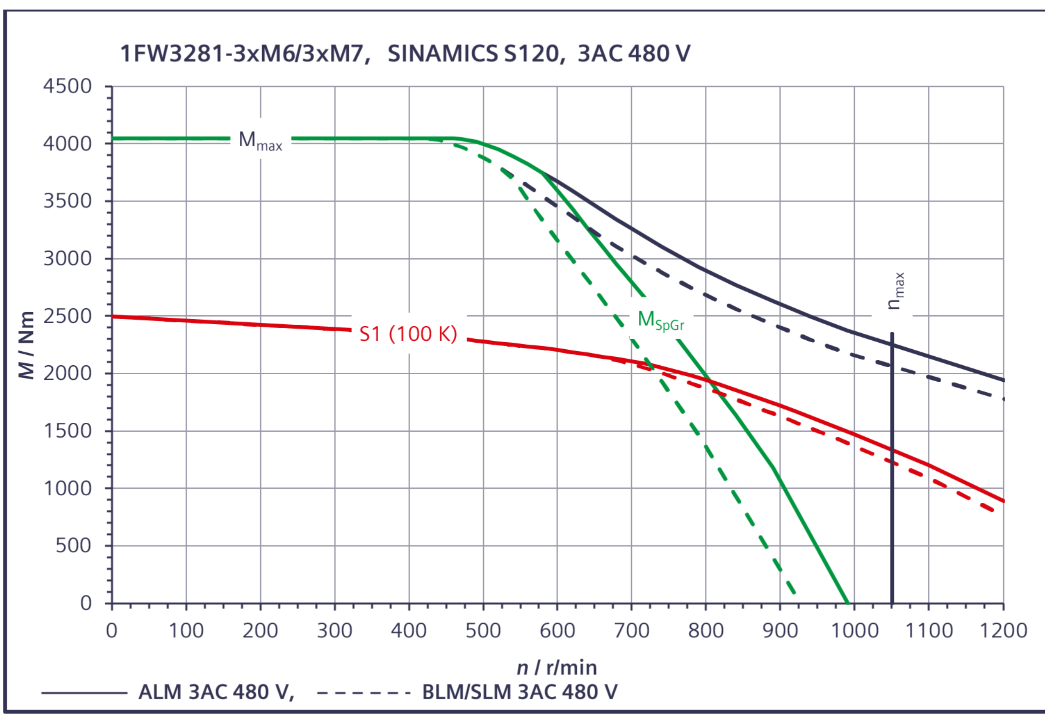
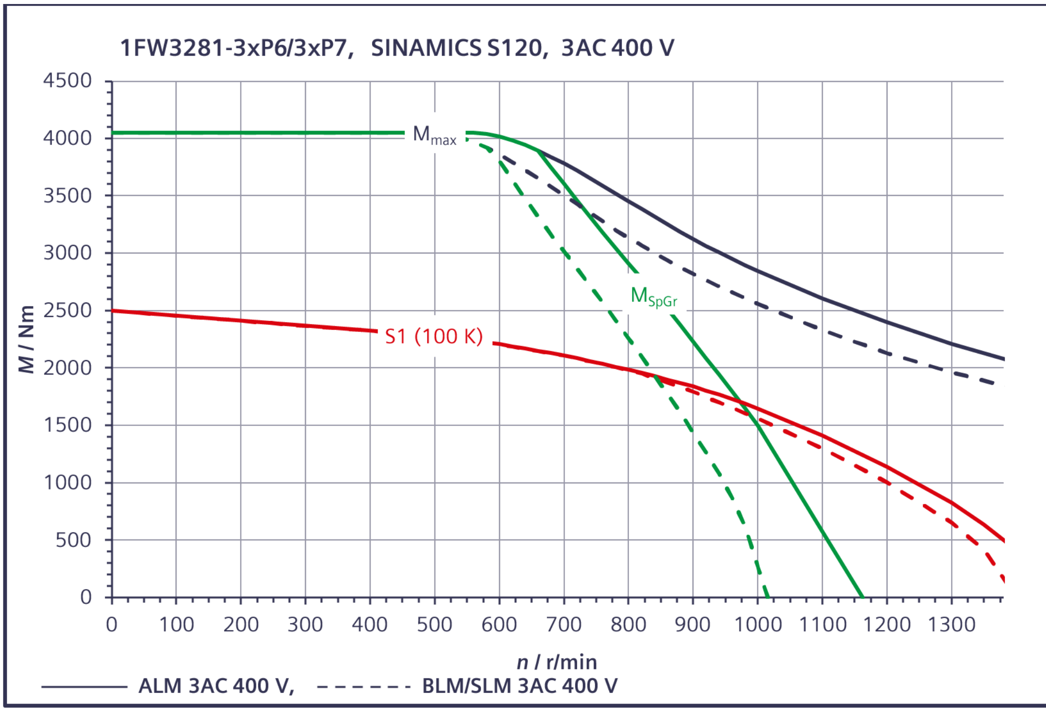


Table 6-60 1FW3281, rated speed 800 r/min

Engineering data	Code	Unit	1FW3281-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	1950
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	163
Rated current (100 K)	$I_{N\ (100\ K)}$	A	315
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	2500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	405
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1450
Maximum torque	M_{max}	Nm	4050
Maximum current	I_{max}	A	710
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	399
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0107
Rotating field inductance	L_D	mH	0.41
Electrical time constant	T_{el}	ms	38.0
Thermal time constant	T_{th}	min	10.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	3.2
Moment of inertia	J_{mot}	kgm²	3.8
Shaft torsional stiffness	c_t	Nm/rad	1.32E+08
Weight	m	kg	600
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.7
Moment of inertia	J_{mot}	kgm²	3.2
Shaft torsional stiffness	c_t	Nm/rad	9.48E+06
Weight	m	kg	750
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	3.0
Moment of inertia	J_{mot}	kgm²	3.6
Shaft torsional stiffness	c_t	Nm/rad	1.52E+08
Weight	m	kg	670

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



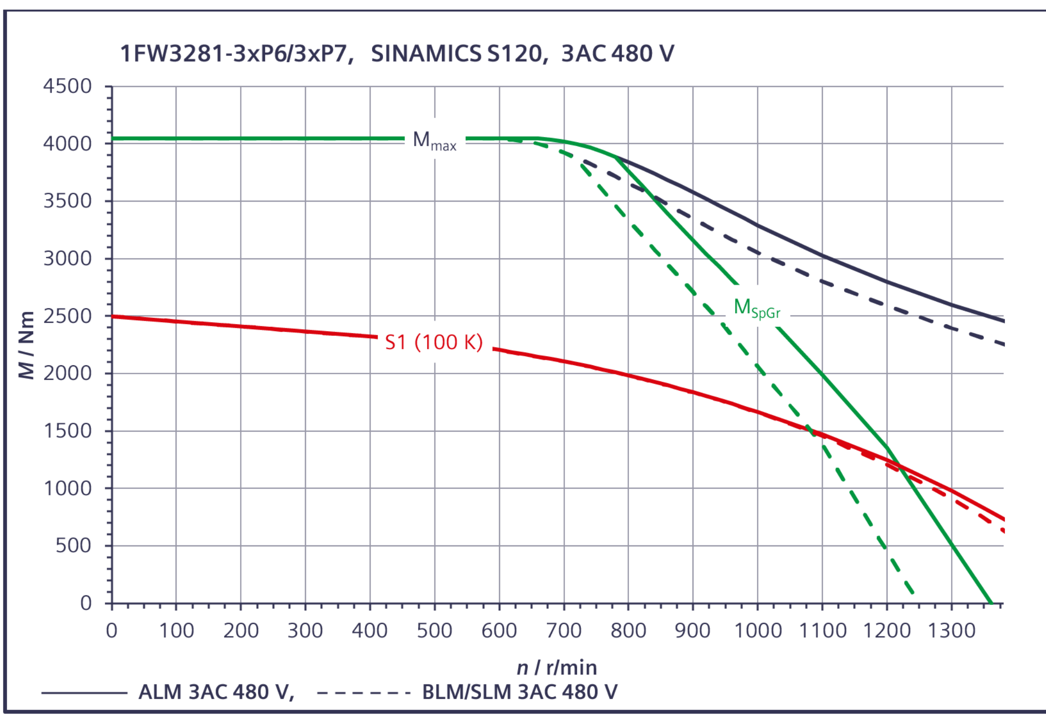
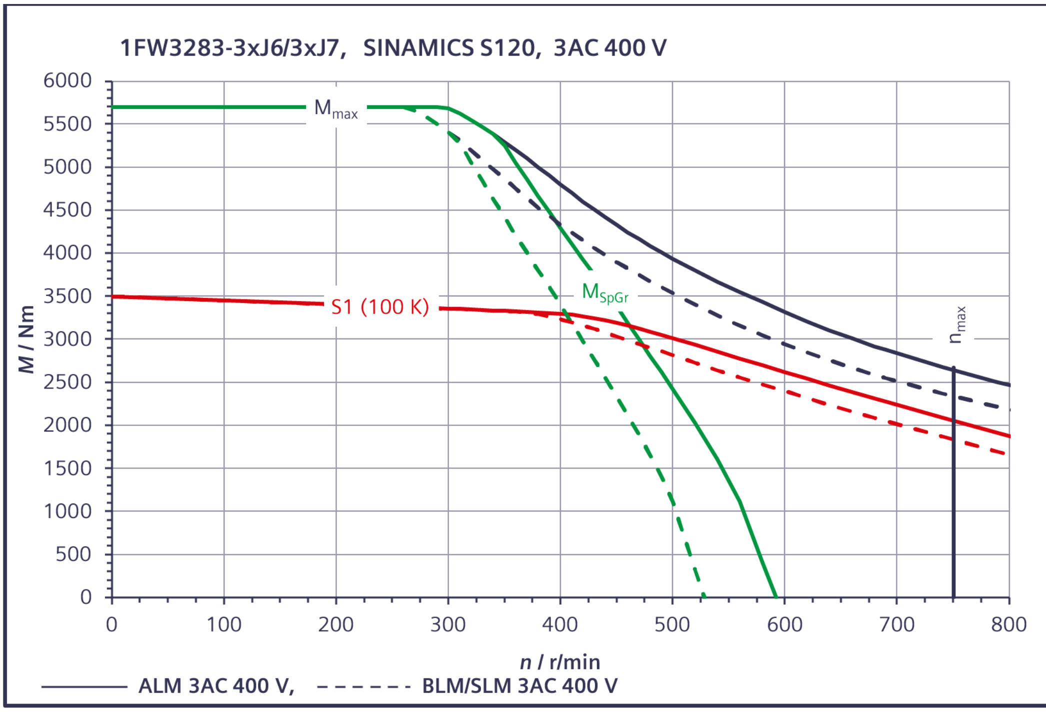


Table 6-61 1FW3283, rated speed 400 r/min

Engineering data	Code	Unit	1FW3283-3☐J
Rated speed	n_N	r/min	400
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	3300
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	138
Rated current (100 K)	$I_{N\ (100\ K)}$	A	275
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	3500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	290
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	750
Maximum torque	M_{max}	Nm	5700
Maximum current	I_{max}	A	520
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	12.0
Voltage constant (at 20 °C)	k_E	V/1000 r/min	765
Winding resistance (at 20 °C)	R_{ph}	Ω	0.025
Rotating field inductance	L_D	mH	1.1
Electrical time constant	T_{el}	ms	43.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.65
Shaft torsional stiffness	c_t	Nm/rad	1.08E+08
Weight	m	kg	690
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	4.35
Shaft torsional stiffness	c_t	Nm/rad	9.42E+06
Weight	m	kg	880
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.5
Shaft torsional stiffness	c_t	Nm/rad	1.24E+08
Weight	m	kg	770

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



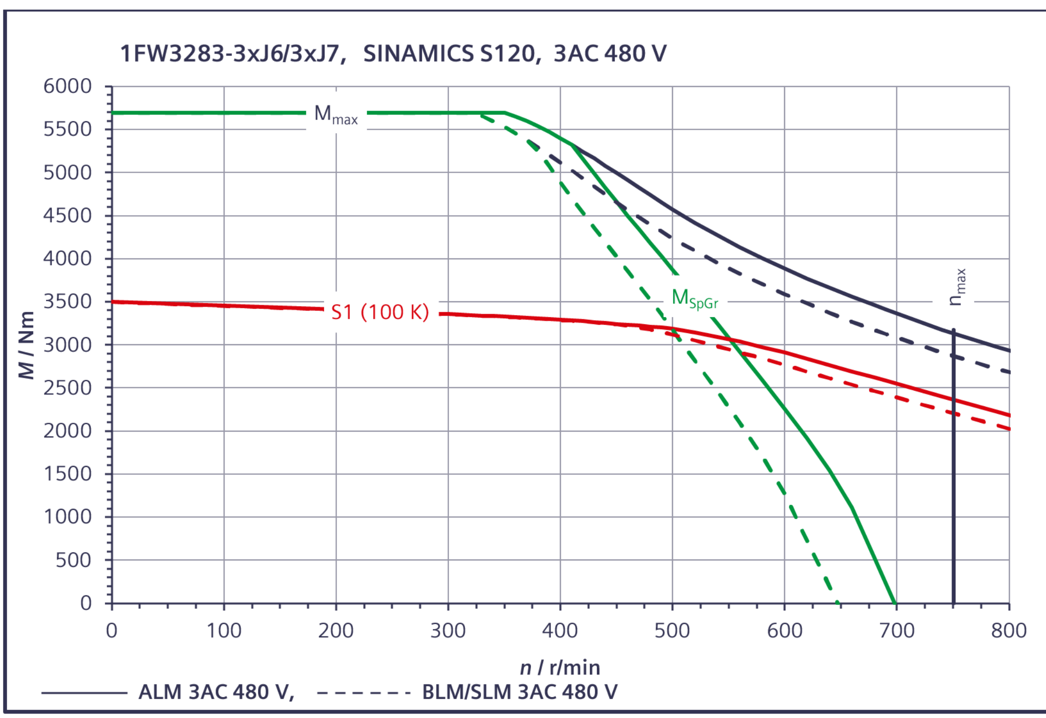
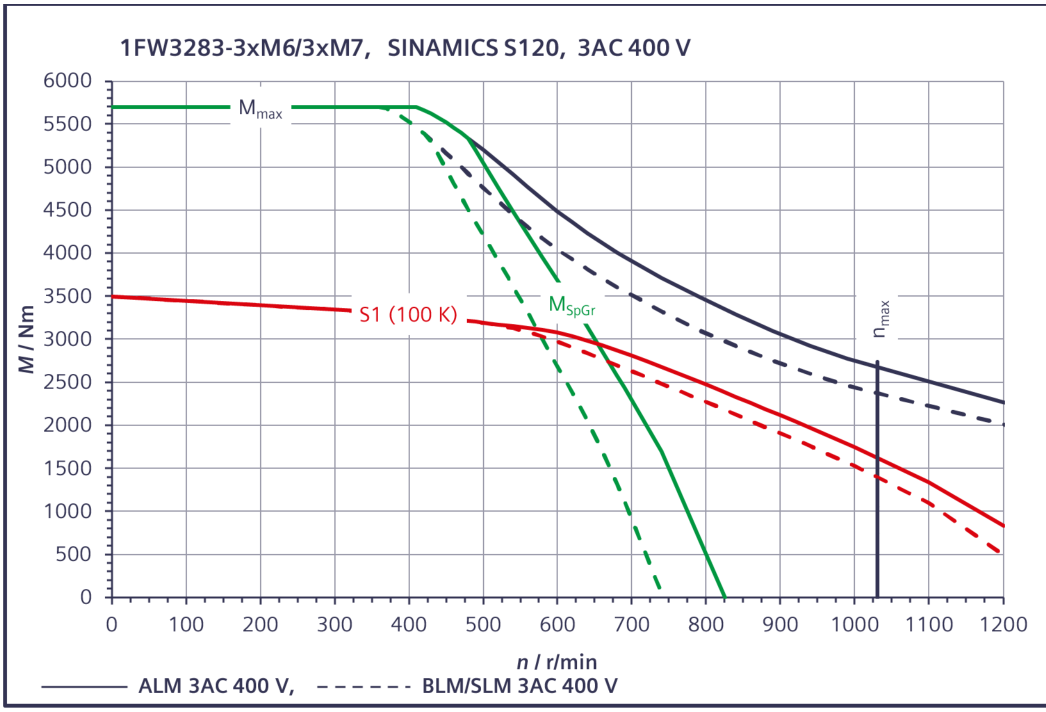


Table 6-62 1FW3283, rated speed 600 r/min

Engineering data	Code	Unit	1FW3283-3☐M
Rated speed	n_N	r/min	600
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	3100
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	195
Rated current (100 K)	$I_{N\ (100\ K)}$	A	355
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	3500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	400
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1030
Maximum torque	M_{max}	Nm	5700
Maximum current	I_{max}	A	710
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.7
Voltage constant (at 20 °C)	k_E	V/1000 r/min	560
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0132
Rotating field inductance	L_D	mH	0.55
Electrical time constant	T_{el}	ms	43.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.65
Shaft torsional stiffness	c_t	Nm/rad	1.08E+08
Weight	m	kg	690
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	4.35
Shaft torsional stiffness	c_t	Nm/rad	9.42E+06
Weight	m	kg	880
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.5
Shaft torsional stiffness	c_t	Nm/rad	1.24E+08
Weight	m	kg	770

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



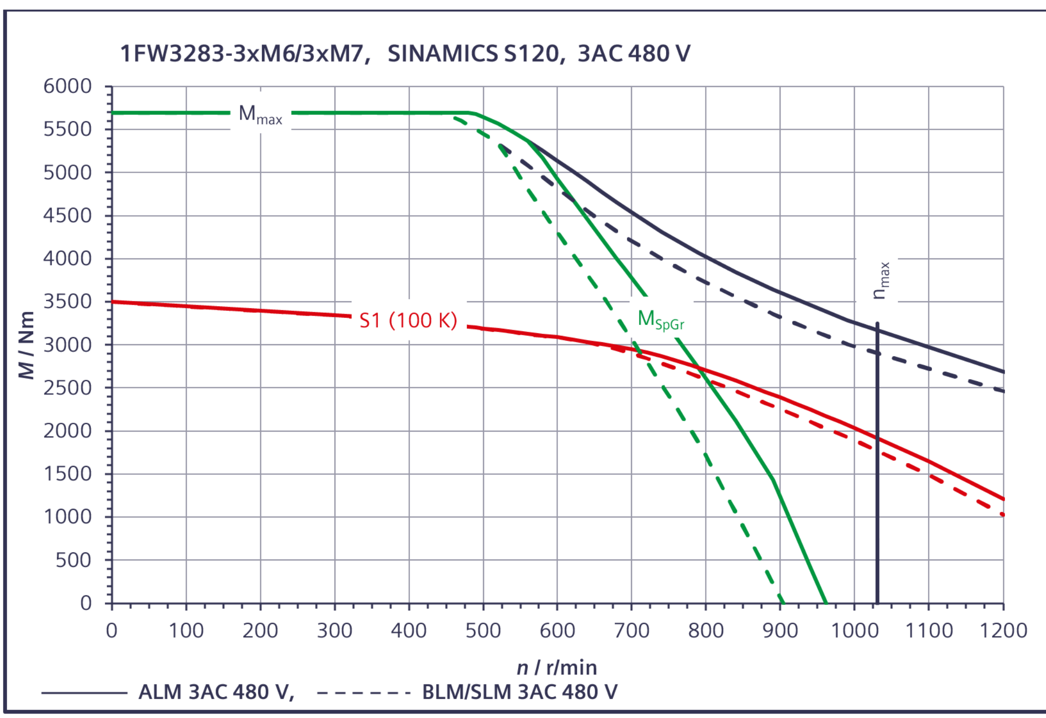
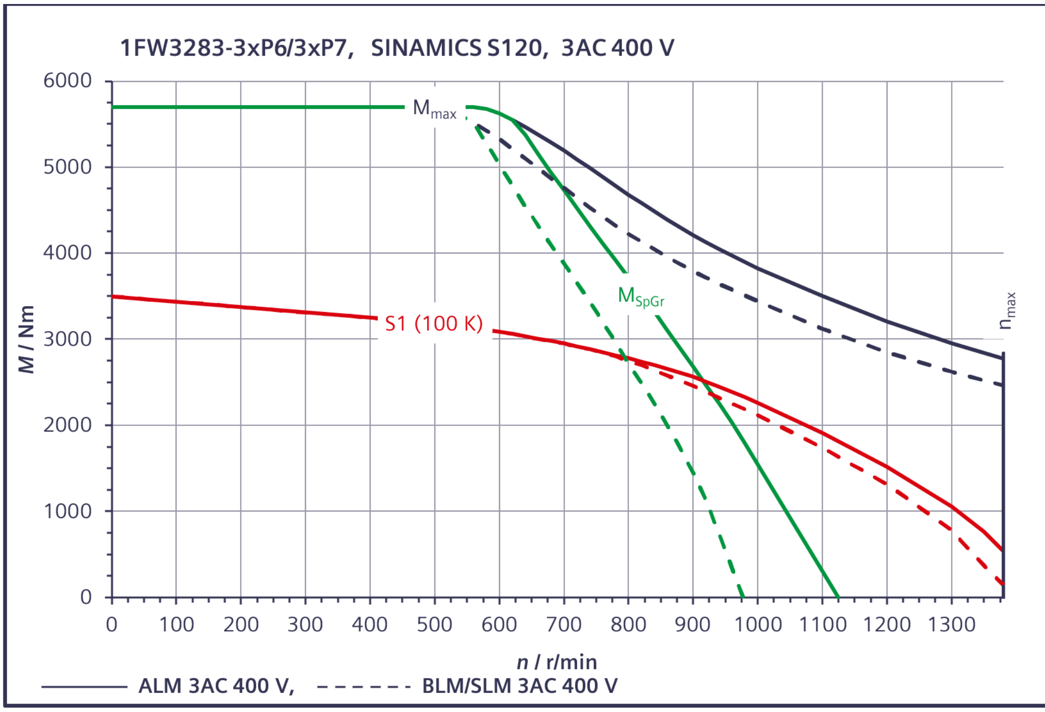


Table 6-63 1FW3283, rated speed 800 r/min

Engineering data	Code	Unit	1FW3283-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	2750
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	230
Rated current (100 K)	$I_{N\ (100\ K)}$	A	425
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	3500
Stall current (100 K)	$I_{0\ (100\ K)}$	A	540
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1380
Maximum torque	M_{max}	Nm	5700
Maximum current	I_{max}	A	950
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	419
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0074
Rotating field inductance	L_D	mH	0.32
Electrical time constant	T_{el}	ms	43.0
Thermal time constant	T_{th}	min	12.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.5
Moment of inertia	J_{mot}	kgm^2	4.65
Shaft torsional stiffness	c_t	Nm/rad	1.08E+08
Weight	m	kg	690
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.3
Moment of inertia	J_{mot}	kgm^2	4.35
Shaft torsional stiffness	c_t	Nm/rad	9.42E+06
Weight	m	kg	880
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.4
Moment of inertia	J_{mot}	kgm^2	4.5
Shaft torsional stiffness	c_t	Nm/rad	1.24E+08
Weight	m	kg	770

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



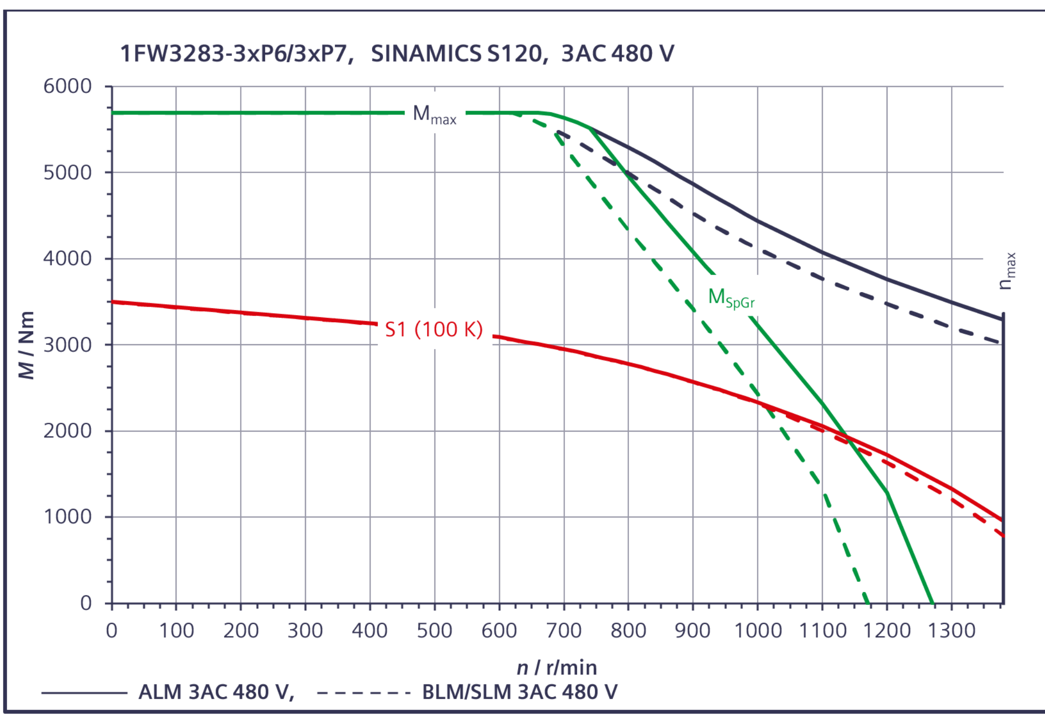
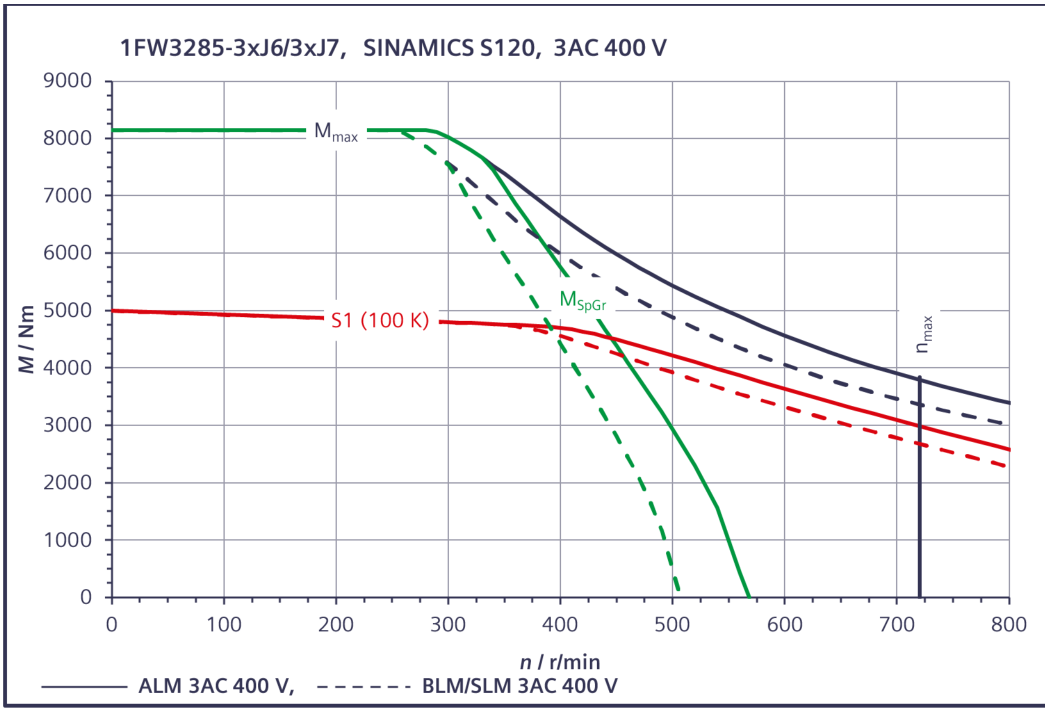


Table 6-64 1FW3285, rated speed 400 r/min

Engineering data	Code	Unit	1FW3285-3☐J
Rated speed	n_N	r/min	400
Rated torque (100 K)	$M_{N (100 K)}$	Nm	4700
Rated power (100 K)	$P_{N (100 K)}$	kW	197
Rated current (100 K)	$I_{N (100 K)}$	A	375
Static torque (100 K)	$M_{0 (100 K)}$	Nm	5000
Stall current (100 K)	$I_{0 (100 K)}$	A	400
Limiting data			
Max. permissible speed (mech.)	$n_{max mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max Inv}$	r/min	720
Maximum torque	M_{max}	Nm	8150
Maximum current	I_{max}	A	710
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100 K)}$	Nm/A	12.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	800
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0171
Rotating field inductance	L_D	mH	0.8
Electrical time constant	T_{el}	ms	47.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm²	6.0
Shaft torsional stiffness	c_t	Nm/rad	8.47E+07
Weight	m	kg	860
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm²	6.1
Shaft torsional stiffness	c_t	Nm/rad	9.32E+06
Weight	m	kg	1070
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm²	5.9
Shaft torsional stiffness	c_t	Nm/rad	9.75E+07
Weight	m	kg	920

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



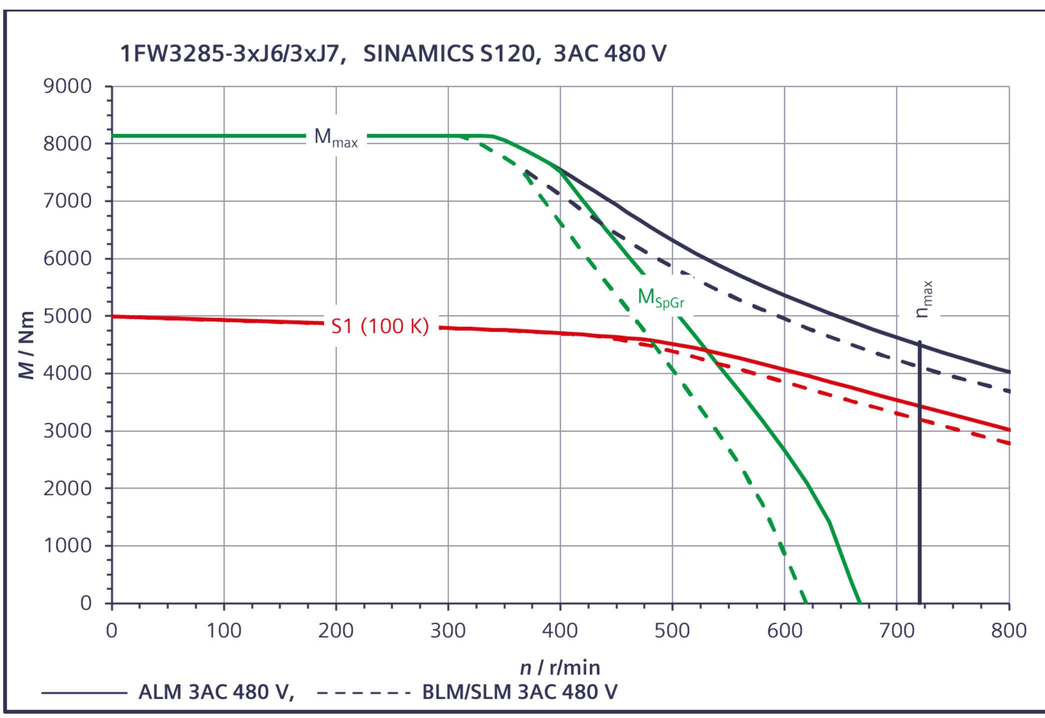
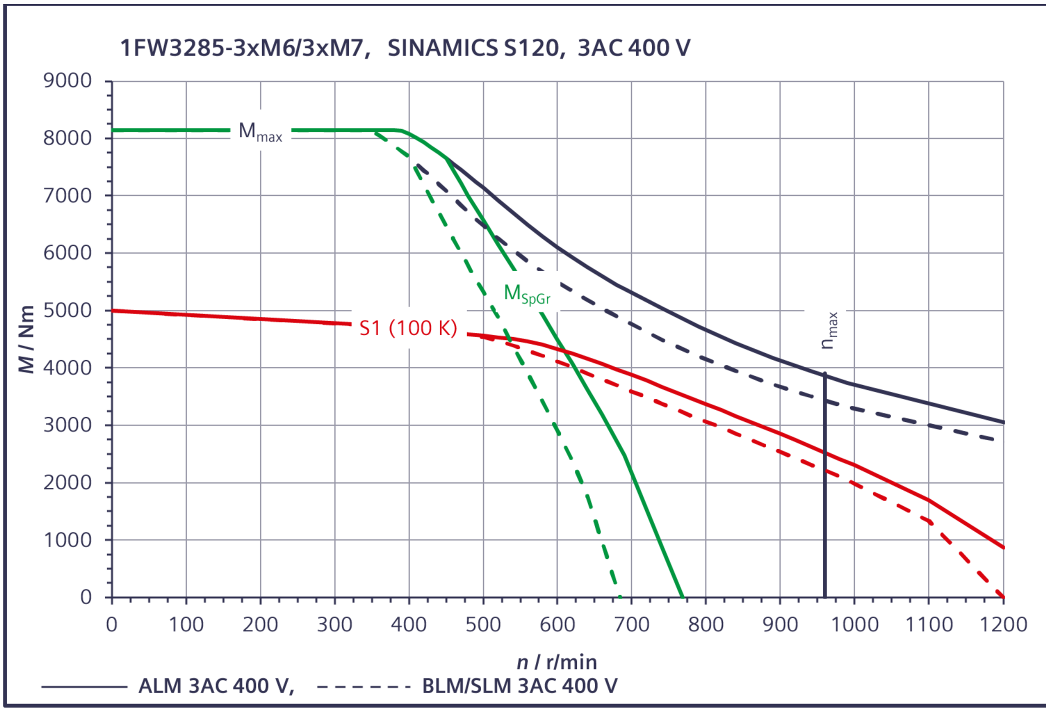


Table 6-65 1FW3285, rated speed 600 r/min

Engineering data	Code	Unit	1FW3285-3□M
Rated speed	n_N	r/min	600
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	4400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	275
Rated current (100 K)	$I_{N\ (100\ K)}$	A	470
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	5000
Stall current (100 K)	$I_{0\ (100\ K)}$	A	530
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	960
Maximum torque	M_{max}	Nm	8150
Maximum current	I_{max}	A	940
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	9.4
Voltage constant (at 20 °C)	k_E	V/1000 r/min	600
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0096
Rotating field inductance	L_D	mH	0.46
Electrical time constant	T_{el}	ms	47.5
Thermal time constant	T_{th}	min	14.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm²	6.0
Shaft torsional stiffness	c_t	Nm/rad	8.47E+07
Weight	m	kg	860
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm²	6.1
Shaft torsional stiffness	c_t	Nm/rad	9.32E+06
Weight	m	kg	1070
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm²	5.9
Shaft torsional stiffness	c_t	Nm/rad	9.75E+07
Weight	m	kg	920

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



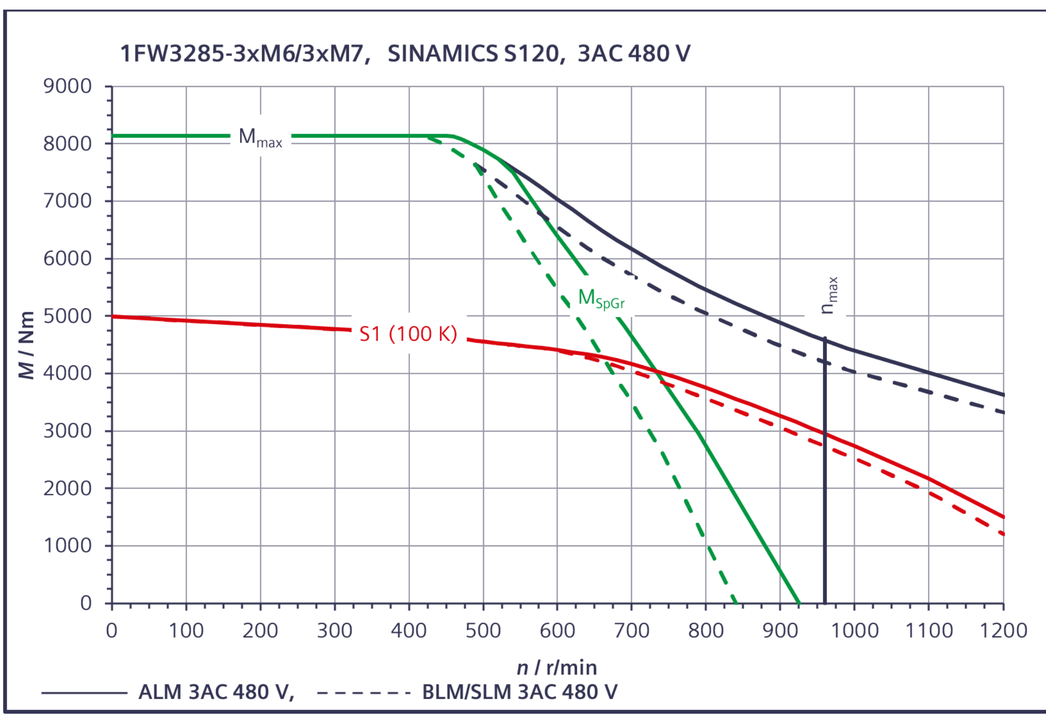
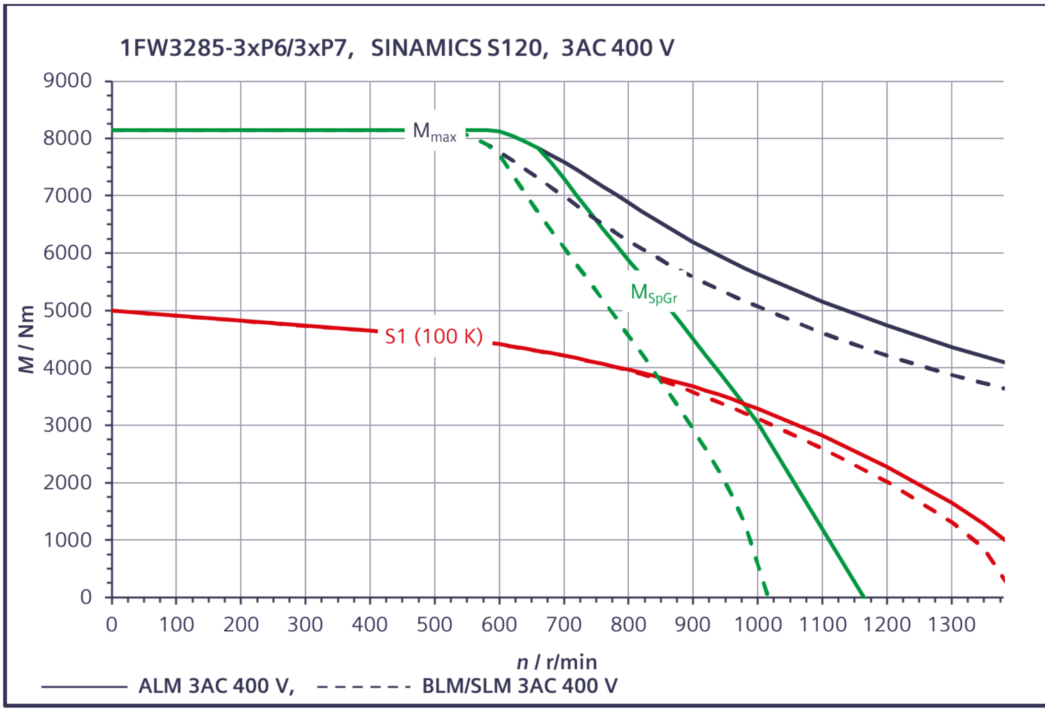


Table 6-66 1FW3285, rated speed 800 r/min

Engineering data	Code	Unit	1FW3285-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	3950
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	330
Rated current (100 K)	$I_{N\ (100\ K)}$	A	640
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	5000
Stall current (100 K)	$I_{0\ (100\ K)}$	A	810
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1450
Maximum torque	M_{max}	Nm	8150
Maximum current	I_{max}	A	1430
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.2
Voltage constant (at 20 °C)	k_E	V/1000 r/min	399
Winding resistance (at 20 °C)	R_{ph}	Ω	0.00427
Rotating field inductance	L_D	mH	0.2
Electrical time constant	T_{el}	ms	48
Thermal time constant	T_{th}	min	14
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	5.98
Shaft torsional stiffness	c_t	Nm/rad	8.47E+07
Weight	m	kg	860
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	6.08
Shaft torsional stiffness	c_t	Nm/rad	9.32E+06
Weight	m	kg	1070
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	2.0
Moment of inertia	J_{mot}	kgm^2	5.86
Shaft torsional stiffness	c_t	Nm/rad	9.75E+07
Weight	m	kg	920

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



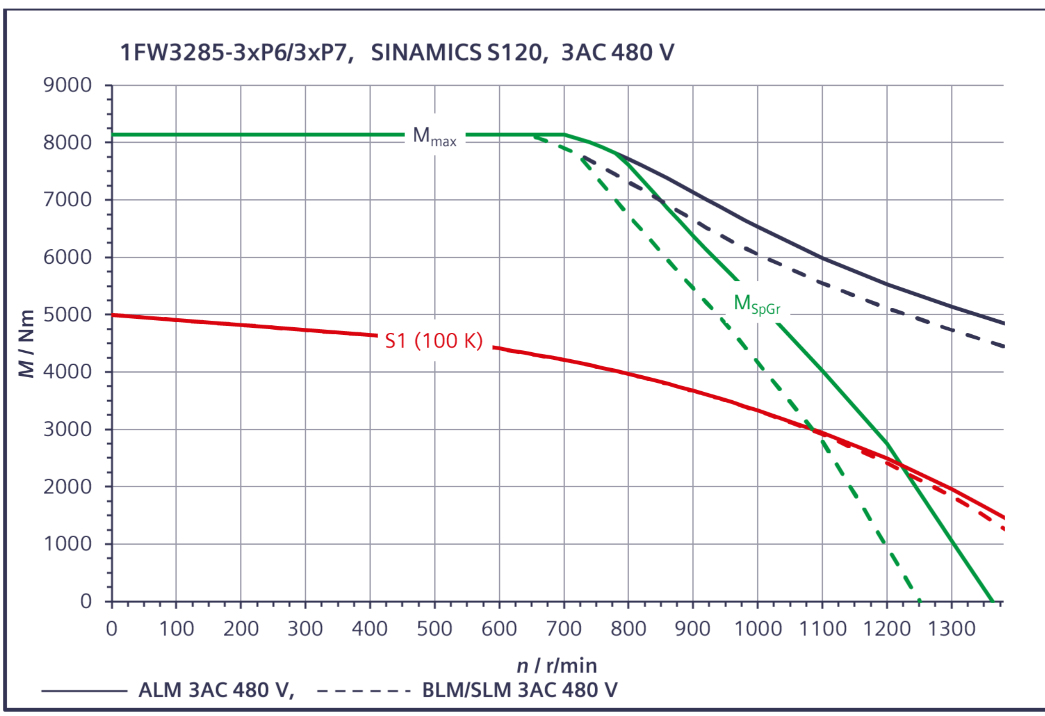
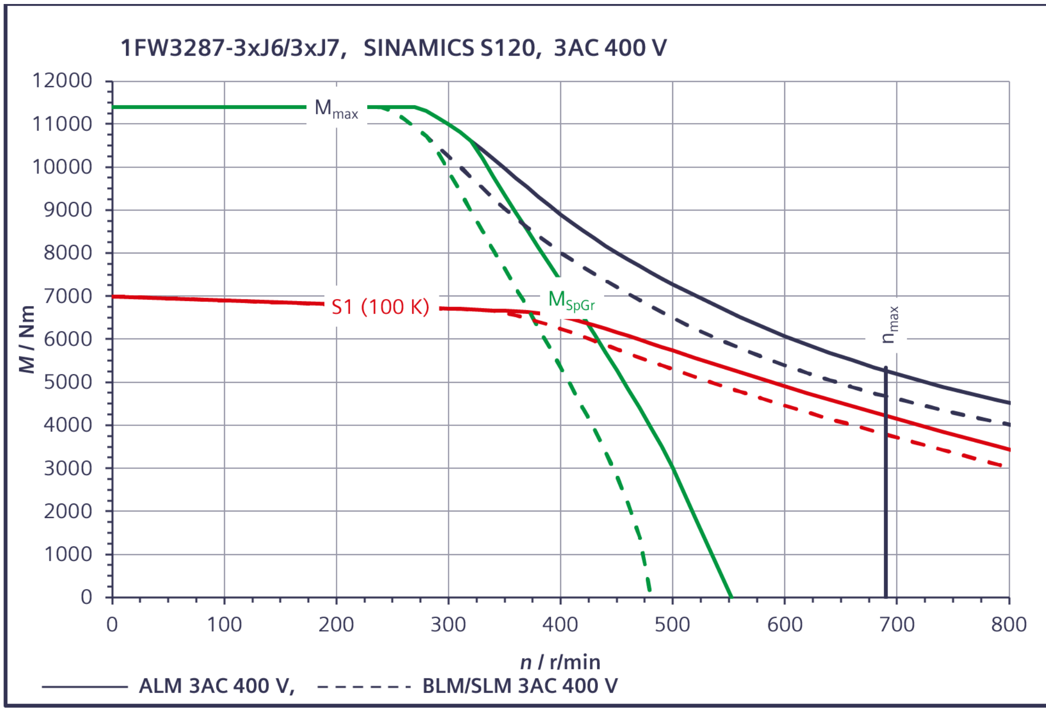


Table 6-67 1FW3287, rated speed 400 r/min

Engineering data	Code	Unit	1FW3287-3☐J
Rated speed	n_N	r/min	400
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	6600
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	275
Rated current (100 K)	$I_{N\ (100\ K)}$	A	500
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	7000
Stall current (100 K)	$I_{0\ (100\ K)}$	A	530
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1000
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	690
Maximum torque	M_{max}	Nm	11400
Maximum current	I_{max}	A	950
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	13.1
Voltage constant (at 20 °C)	k_E	V/1000 r/min	835
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0125
Rotating field inductance	L_D	mH	0.65
Electrical time constant	T_{el}	ms	51
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.8
Shaft torsional stiffness	c_t	Nm/rad	6.58E+07
Weight	m	kg	1030
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	8.4
Shaft torsional stiffness	c_t	Nm/rad	9.20E+06
Weight	m	kg	1030
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.7
Shaft torsional stiffness	c_t	Nm/rad	7.60E+07
Weight	m	kg	1130

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



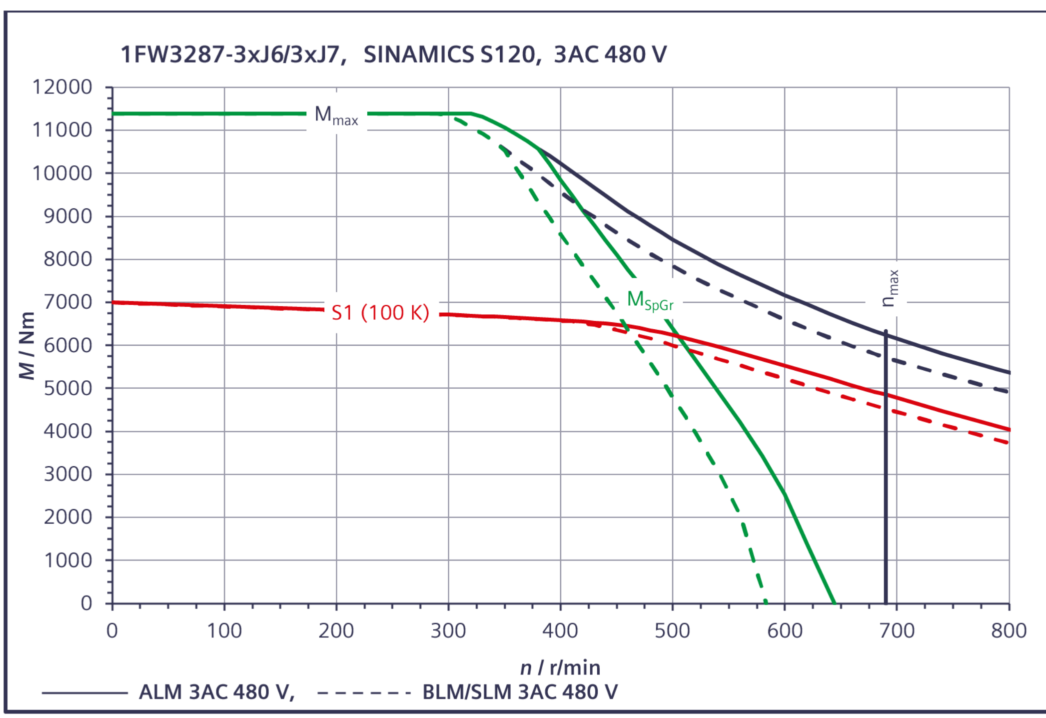
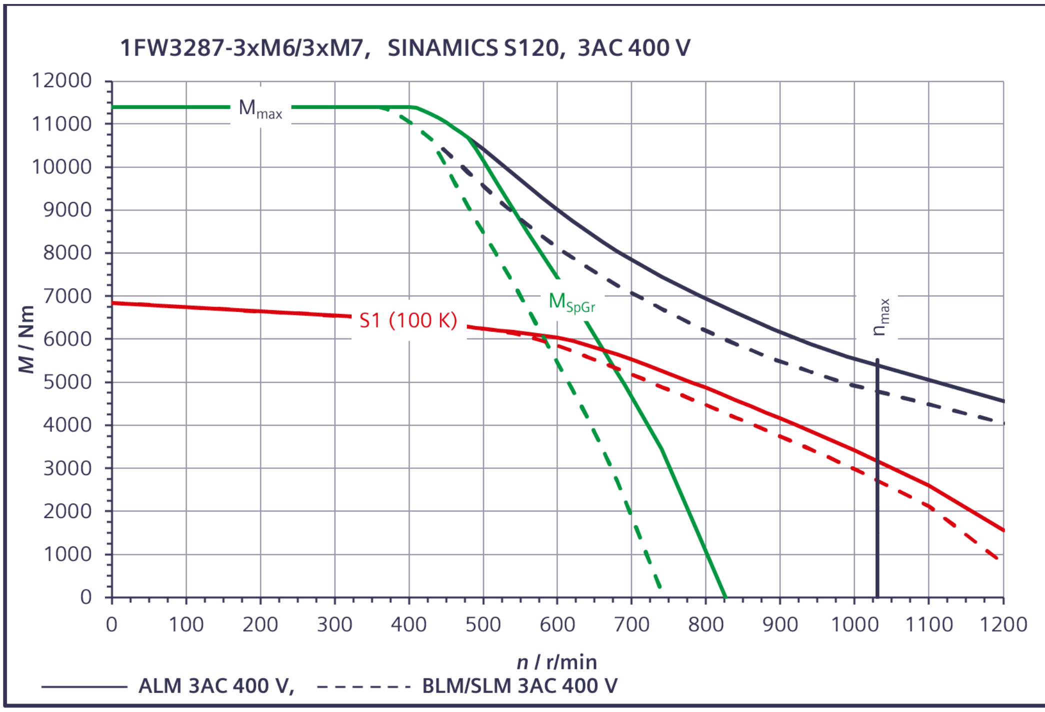


Table 6-68 1FW3287, rated speed 600 r/min

Engineering data	Code	Unit	1FW3287-3☐M
Rated speed	n_N	r/min	600
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	6050
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	380
Rated current (100 K)	$I_{N\ (100\ K)}$	A	700
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	6850
Stall current (100 K)	$I_{0\ (100\ K)}$	A	790
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1030
Maximum torque	M_{max}	Nm	11400
Maximum current	I_{max}	A	1420
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	8.7
Voltage constant (at 20 °C)	k_E	V/1000 r/min	560
Winding resistance (at 20 °C)	R_{ph}	Ω	0.0055
Rotating field inductance	L_D	mH	0.29
Electrical time constant	T_{el}	ms	51
Thermal time constant	T_{th}	min	16.0
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.8
Shaft torsional stiffness	c_t	Nm/rad	6.58E+07
Weight	m	kg	1030
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.8
Moment of inertia	J_{mot}	kgm^2	8.4
Shaft torsional stiffness	c_t	Nm/rad	9.20E+06
Weight	m	kg	1300
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.7
Shaft torsional stiffness	c_t	Nm/rad	7.60E+07
Weight	m	kg	1130

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*



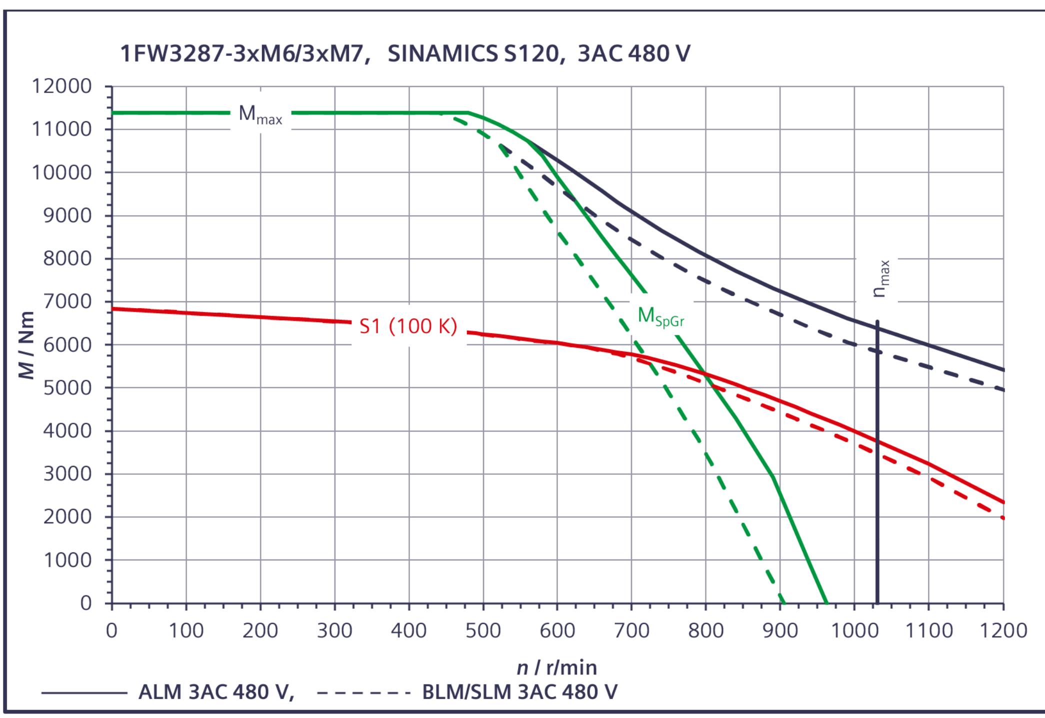
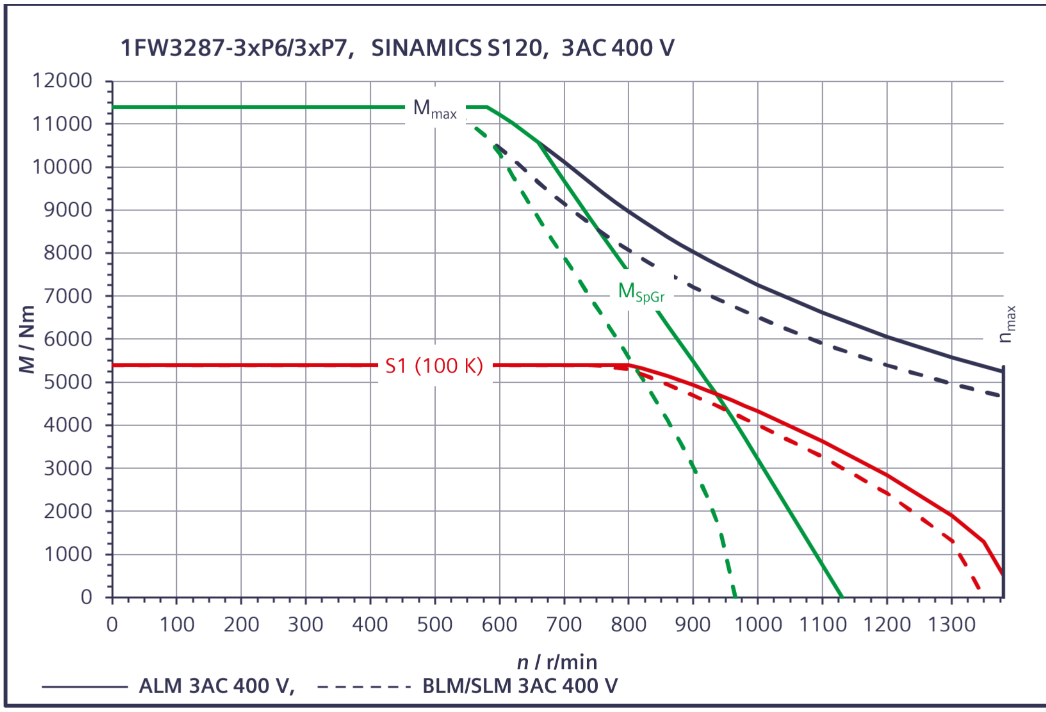


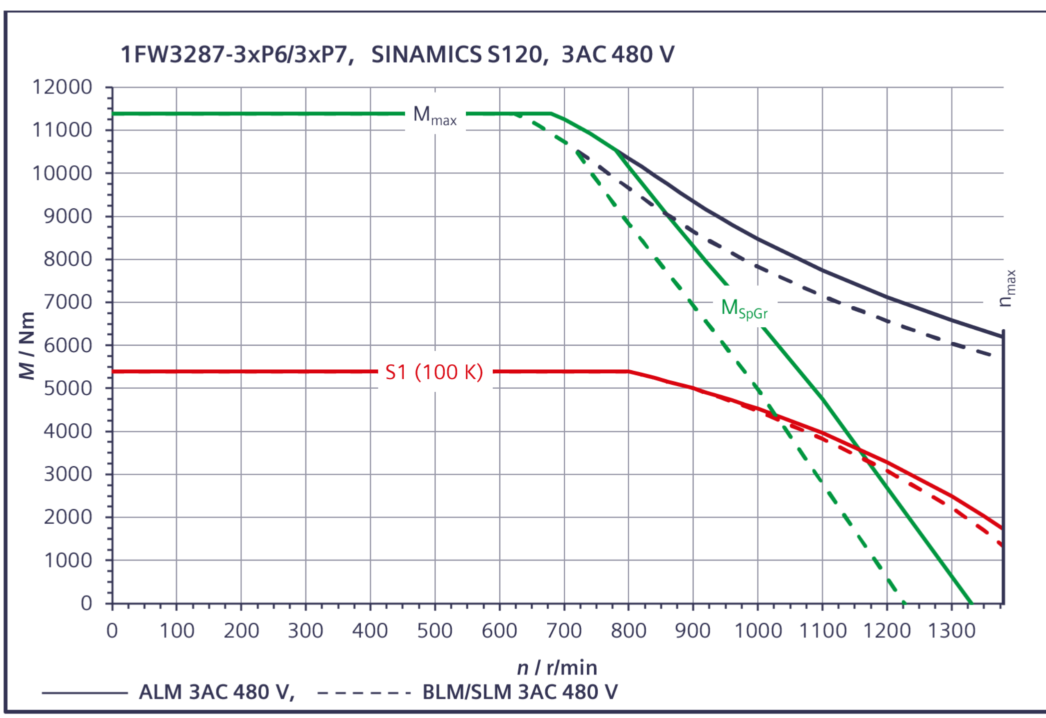
Table 6-69 1FW3287, rated speed 800 r/min

Engineering data	Code	Unit	1FW3287-3☐P
Rated speed	n_N	r/min	800
Rated torque (100 K)	$M_{N\ (100\ K)}$	Nm	5400
Rated power (100 K)	$P_{N\ (100\ K)}$	kW	450
Rated current (100 K)	$I_{N\ (100\ K)}$	A	830
Static torque (100 K)	$M_{0\ (100\ K)}$	Nm	5400
Stall current (100 K)	$I_{0\ (100\ K)}$	A	830
Limiting data			
Max. permissible speed (mech.)	$n_{max\ mech.}$	r/min	1380
Max. permissible speed (converter)	$n_{max\ Inv}$	r/min	1380
Maximum torque	M_{max}	Nm	11400
Maximum current	I_{max}	A	1910
Motor data			
Number of poles	2p		20
Ratio of speed measurement (belt-driven encoder)	i_{enc}	--	-5
Torque constant (100 K)	$k_{T(100\ K)}$	Nm/A	6.5
Voltage constant (at 20 °C)	k_E	V/1000 r/min	419
Winding resistance (at 20 °C)	R_{ph}	Ω	0.00312
Rotating field inductance	L_D	mH	0.16
Electrical time constant	T_{el}	ms	50
Thermal time constant	T_{th}	min	16
Mechanical data: Hollow-shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.81
Shaft torsional stiffness	c_t	Nm/rad	6.58E+07
Weight	m	kg	1030
Mechanical data: Solid shaft version			
Mechanical time constant	T_{mech}	ms	1.9
Moment of inertia	J_{mot}	kgm^2	8.39
Shaft torsional stiffness	c_t	Nm/rad	9.20E+06
Weight	m	kg	1300
Mechanical data: Plug-on shaft version / stub shaft version			
Mechanical time constant	T_{mech}	ms	1.7
Moment of inertia	J_{mot}	kgm^2	7.66
Shaft torsional stiffness	c_t	Nm/rad	7.60E+07
Weight	m	kg	1130

The specified rated data are valid for a 600 V DC link voltage

Torque *M* with respect to speed *n*





Preparation for use

7

7.1 Transporting

⚠ WARNING
Danger to life when lifting and transporting
Incorrect execution, unsuitable or damaged devices and equipment can result in severe injury and/or material damage. • Lifting devices, forklift trucks and load suspension equipment must comply with country-specific, local requirements. • Pay attention to the lifting capacity of the hoisting gear. Do not attach any additional loads. Take the weight of the motor from the rating plate. • To hoist the motor, use suitable cable-guidance or spreading equipment (particularly if additional components are mounted in or on the motor). • After the motor has been placed down, ensure that it cannot roll.

NOTICE
Damage to the motor caused by incorrect lifting
The motor can be damaged if you incorrectly use lifting equipment. • Use a cross beam when lifting and transporting the motor using the cable slings provided.

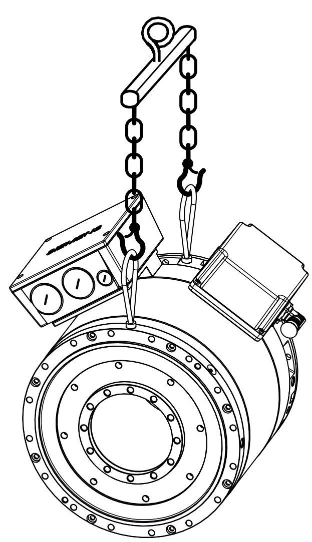


Figure 7-1 Lifting and transporting the motor with a cross beam

If you do not immediately commission a motor after it has been delivered, it must be stored in a dry, dust-free room that is not subject to vibration, see Chapter "Storing (Page 296)".

Transporting a motor that has already been in operation

Procedure

If you want to transport a motor that has already been in operation, proceed as follows:

1. Allow the motor to cool down.
2. Remove the connections on the customer side.
3. Empty the motor of any cooling water and purge it carefully with air.
4. Transport and lift the motor using the cable slings and a cross beam.

The motor is ready to be transported now.

❒

7.2 Storing

Storing indoors

NOTICE
Bearing damage when not in use
If the motors are stored incorrectly, bearing damage can occur (e.g. brinelling) - for example, as a result of vibration. • Observe the instructions for putting into storage.

The motors can be stored indoors for up to 2 years without any restrictions on the specified bearing service life at temperatures from 5 °C up to 40 °C.

- Apply a preservation agent to bare, external components. For example, use Tectyl if this has not already been carried out in the factory.
- Store the motor in an area that fulfills the following requirements:
  - The storage area must be dry, dust-free, frost-free and vibration-free (v_{rms} < 0.2 mm/s). Relative humidity should be less than 60%.
  - The storage space must be well ventilated.
  - The storage space must provide protection against extreme weather conditions.
  - The air in the storage area must not contain any harmful gases.
- Protect the motor against shocks and humidity.
- Make sure that motor is covered properly.
- Avoid contact corrosion.

Storing the motor after use

When you place the motor in storage after use, drain the cooling water ducts and purge them with air so that they are completely empty.

Ensure that the remaining water can drain.

Long-term storing

Note

Maximum storage time up to two years

The storage time affects the properties of the roller bearing grease.

- Store the motor for up to two years at 5 °C to 40 °C.

Note

In the case of intermediate storage lasting over 6 months, special measures must be applied for preservation.

- Contact Technical Support.

If you store the motor for longer than six months, the storage area must meet the following conditions:

- The motor must be protected against extreme weather conditions.
- The air must be free of corrosive gases.
- The storage area must be free of vibration (v_{rms} < 0.2 mm/s)
- In accordance with EN 60034-1, the temperature must lie in the range 5 °C up to 40 °C.
- The relative humidity of the air must be less than 60%.

Check the correct state of the motor every six months.

- Check the motor for any damage.
- Perform any necessary maintenance work.
- Check the state of the desiccant and replace it when necessary.
- Record the preservation work so that all preservation coating can be removed prior to the commissioning.

Condensation

The following ambient conditions encourage the formation of condensation:

- Significant fluctuations of the ambient temperature,
- Direct sunshine,
- High air humidity during storage.

Avoid these ambient conditions.

Use a desiccant in the packaging.

Electrical connection

8

WARNING

Risk of electric shock

There is a risk of electric shock if you incorrectly establish an electrical connection.

- Only work on the electrical connection if you are appropriately qualified to do so.
- Carry out all work at the motor with the system in a no-voltage condition.
- Connect the motor according to the circuit diagram provided.
- In the motor terminal box, ensure that the connecting cables are connected so that there is electrical isolation between the cables and the terminal box cover.
- Ensure that the terminal box is tight and sealed.

WARNING

Electric shock as a result of defective connecting cables

Using defective connecting cables can result in an electric shock. Further, material damage can occur, e.g. as a result of fire.

- When installing the motor, make sure that the connecting cables
  - are not damaged
  - are not under tension
  - cannot come into contact with any rotating parts.
- Maintain the permissible bending radii.
- Do not use the cables to hold the motor.
- Do not pull on the motor cables.

WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 μC. In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

⚠ WARNING
Danger to life due to electric shock
As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock. • Do not touch the cable ports. • Connect the motor cable ports correctly, or insulate them properly.

NOTICE
Destruction of the motor if it is directly connected to the three-phase line supply
The motor will be destroyed if it is directly connected to the three-phase line supply. • Only operate the motors with the appropriately configured converters.

⚠ WARNING
Danger of severe injuries caused by unexpected movements of the motor
Rotating and unexpected motor movement may cause death, serious injury and/or property damage. • Never work in the vicinity of rotating parts for a switched-on machine. • Keep persons away from rotating parts and areas where there is a danger of crushing.

NOTICE
Damage to components that are sensitive to electrostatic discharge
The DRIVE-CLiQ interface has direct contact to components that can be damaged/destroyed by electrostatic discharge (ESD). Encoder systems and temperature sensors are components that can be destroyed by electrostatic discharge (ESD). Components that are sensitive to electrostatic discharge can be damaged if you touch the connections with your hands or with electrostatically charged tools. • Carefully observe the information in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

8.1 Permissible line systems

In combination with the SINAMICS S120 drive system, the motors are generally approved for operation on TN and TT line supply systems - with grounded neutral point - and on IT line supply systems.

If you operate the drive system on IT line supply systems, then you must provide a protective device that shuts down the drive system when a ground fault occurs.

If you operate the motor with grounded line conductor, then you must use an isolating transformer with grounded neutral point (on the secondary) between the line supply and the drive system. In this way you avoid inadmissibly stressing the motor insulation.

8.2 Circuit diagram of the motor

The circuit diagram of the motor looks like this:

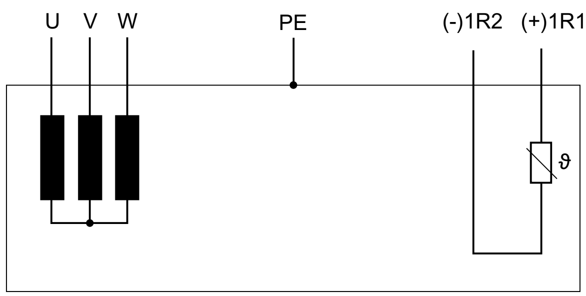


Figure 8-1 Circuit diagram of the motor

8.3 System integration

Note

System compatibility is guaranteed only if shielded power cables are used and the shield is conductively bonded over a large area to the metal motor terminal box (using metal EMC cable gland) or by using a power connector.

Ground open or unused conductors - or electric cables that can be touched. Contact the shields with ground potential over the greatest possible surface area. Connect the open-circuit motor cables to the terminals provided for this purpose. Open-circuit cables carry capacitive charges and can result in malfunctions.

Lead in permanently laid cables and conductors using EMC cable glands. The cable glands are screwed into the threaded holes of the terminal box.

Close off unused threads with a metal threaded plug.

Pre-assembled cables offer many advantages over cables assembled by customers themselves. In addition to having the security of knowing that they function perfectly and are high quality products, there are also some associated cost benefits when using prefabricated cables.

- Use the power and signal cables from the MOTION-CONNECT family.
- Observe the maximum cable lengths.

You can find information on the technical data of the cables in the Catalog, Chapter "MOTION-CONNECT connection system".

Cable installation

Note

Avoiding disturbing effects

Route signal cables separately from power cables in order to avoid disturbing effects (e.g. as a result of EMC).

Outer protective conductor or potential bonding conductor

Note

For 1FW328☐ and for 1FW3204-3* / 1FW3206-3* / 1FW3208-3*, there is an additional connection point on the frame to connect an outer protective conductor or potential bonding conductor.

Motor and cable protection

NOTICE

Damage due to cables being overloaded

If the electric power is transferred using several cables connected in parallel, then when one cable fails, the other motor cables could be overloaded.

- Provide each individual cable with an overcurrent protection device.

Current-carrying capacity for power and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2, C and E under continuous operating conditions in the table with reference to an ambient air temperature of 40 °C.

For other ambient temperatures, the values must be corrected by the factors from the Table "Derating factors".

Table 8-1 Cable cross section and current-carrying capacity

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type			
mm^2	B1 / A	B2 / A	C / A	E / A
Electronics (according to EN 60204-1)				
0.20	-	4.3	4.4	4.4
0.50	-	7.5	7.5	7.8
0.75	-	9	9.5	10
Power (according to EN 60204-1)				
0.75	8.6	8.5	9.8	10.4
1.00	10.3	10.1	11.7	12.4

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type			
mm²	B1 / A	B2 / A	C / A	E / A
1.50	13.5	13.1	15.2	16.1
2.50	18.3	17.4	21	22
4	24	23	28	30
6	31	30	36	37
10	44	40	50	52
16	59	54	66	70
25	77	70	84	88
35	96	86	104	110
50	117	103	125	133
70	149	130	160	171
95	180	165	194	207
120	208	179	225	240
Power (according to IEC 60364-5-52)				
150	-	-	259 [1)]	276[1)]
185	-	-	296 [1)]	315[1)]
> 185	Values must be taken from the standard			

1) Extrapolated values

Table 8-2 Derating factors for power and signal cables

Ambient air temperature / °C	Derating factor as stated in Table D1 according to EN 60204-1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

Note

Routing cables in humid/moist environments

If the motor is mounted in a humid environment, the power and signal cables must be routed as shown in the following figure.

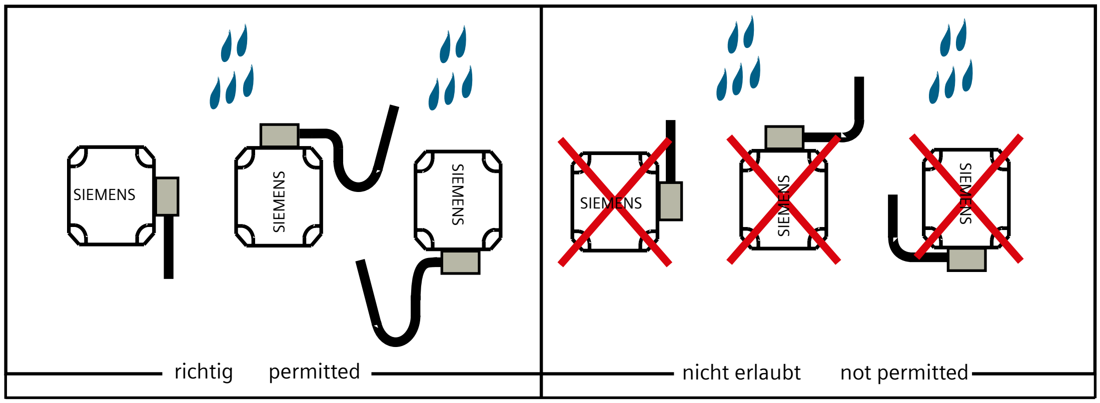
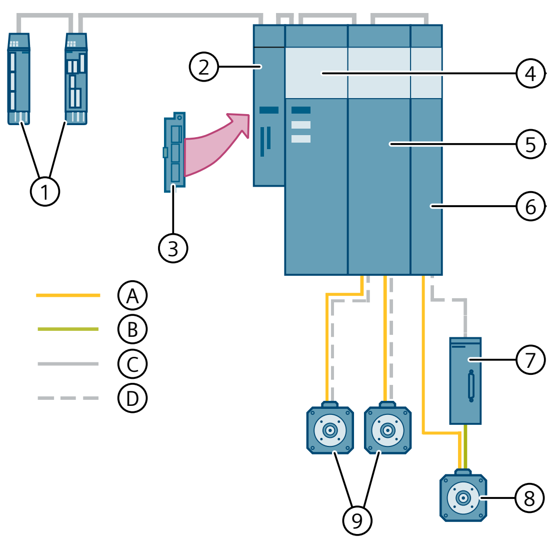


Figure 8-2 Principle of cable routing in a wet/moist environment

8.3.1 Connecting to the converter



1	Terminal Module	8	Motors without DRIVE-CLiQ interface
2	Control Unit	9	Motors with DRIVE-CLiQ interface
3	Operator control unit	A	MOTION-CONNECT power cable
4	Smart Line or Active Line Module	B	MOTION-CONNECT signal cable
5	Double Motor Module	C	DRIVE-CLiQ signal cable
6	Motor Module	D	MOTION-CONNECT DRIVE-CLiQ signal cable
7	Sensor Module		

Figure 8-3 SINAMICS S120 system overview

The complete torque motors can be operated in 4 quadrants. They can be connected to a controlled or uncontrolled infeed unit.

WARNING

Uncontrolled motor motion as a result of incorrect adjustment

The encoders are adjusted in the factory for SIEMENS drive converters. Another encoder adjustment may be required when operating the motor with a third-party converter.

Incorrect adjustment of the encoder regarding motor EMF can lead to uncontrolled motion which can cause injury and material damage.

- Only replace an encoder and adjust it if you are appropriately qualified to do so.
- When a belt-driven encoder is replaced, adjust the position of the encoder system with respect to the motor EMF.
- You must re-reference the system when replacing an absolute encoder.

Note

Replacing a coaxially mounted encoder

When replacing a coaxially mounted encoder, you do not have to adjust the encoder system. The position with respect to the motor EMF is ensured using mechanical components.

8.3.2 Power connection

NOTICE

Thermal cable damage

Cables can be thermally damaged if they are not suitable for the current that flows.

- Carefully observe the current which the motor draws for your particular application! Adequately dimension the connecting cables according to EN 60204-1 (see Table "Cable cross-section and current-carrying capacity").

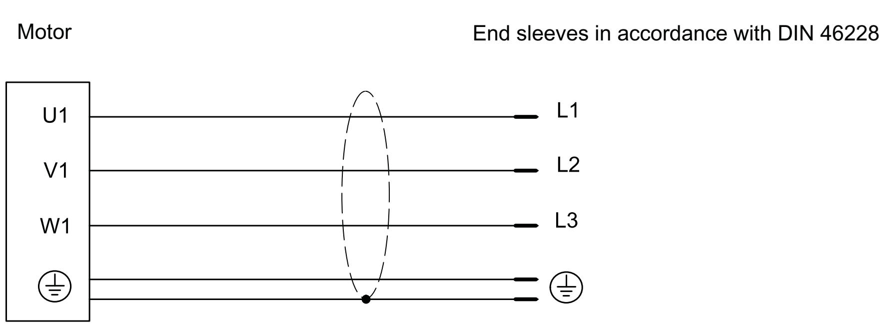


Figure 8-4 Power cable

Terminal box connection

For the type designation of the mounted terminal box - as well as details on the power connection - refer to Table "Cable cross-sections (Cu) and outer diameter of the connecting cables in the standard version". A circuit diagram to connect up the motor winding is provided in the terminal box when the motors are shipped.

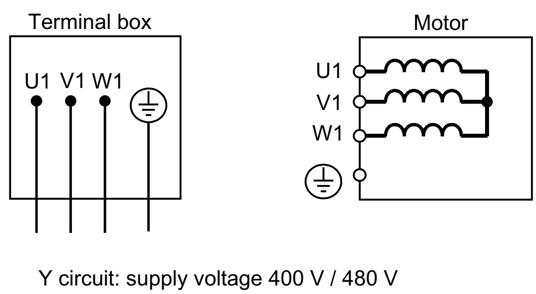
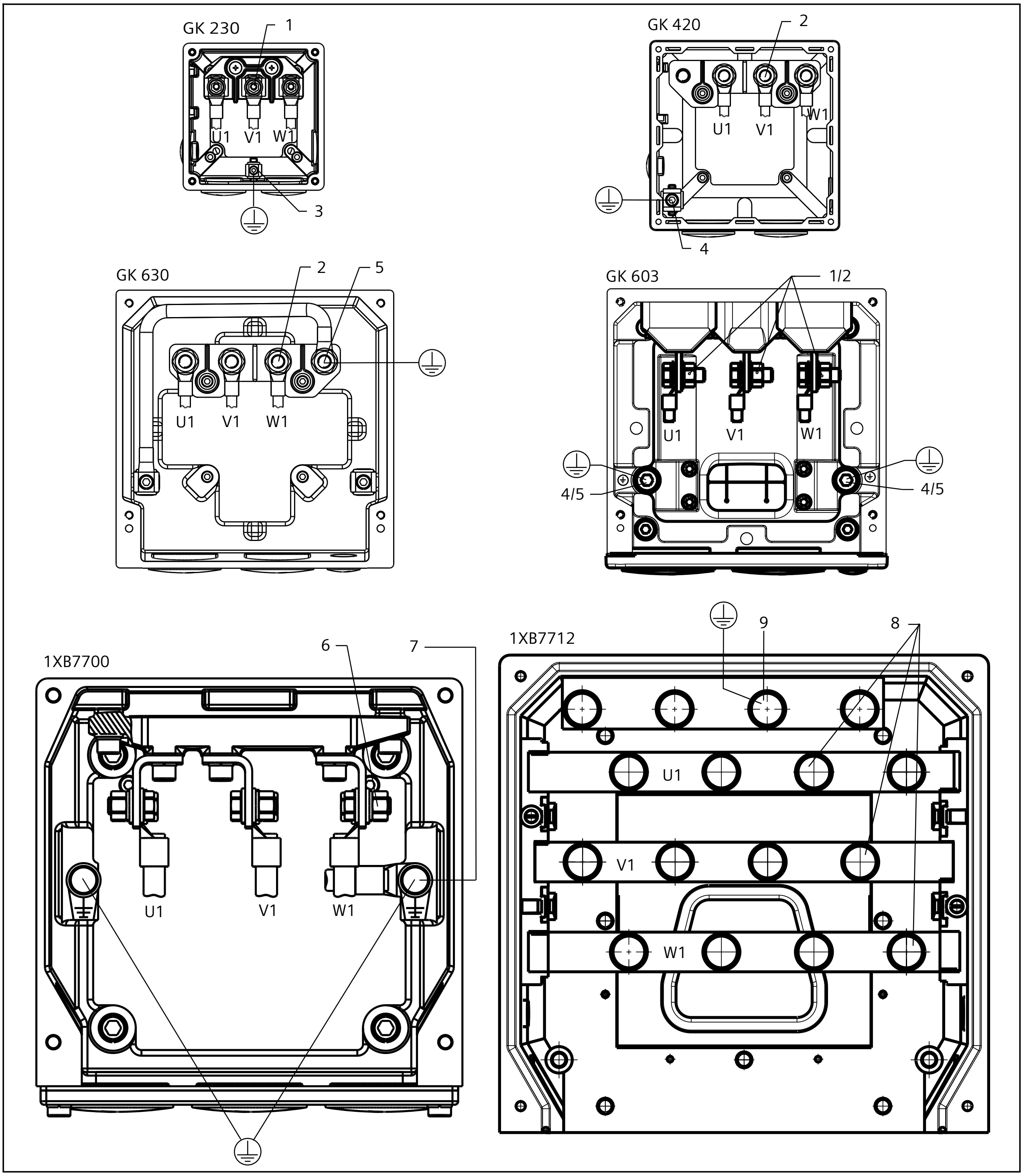


Figure 8-5 Circuit diagram

Note

Cable outlet direction

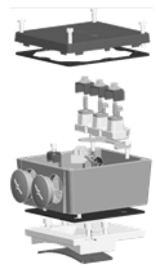
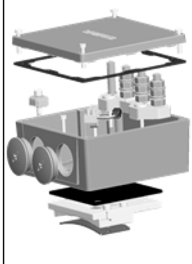
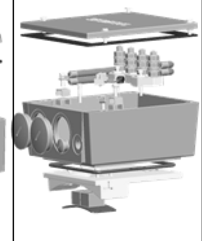
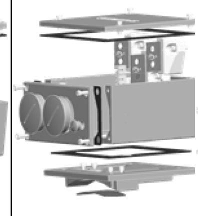
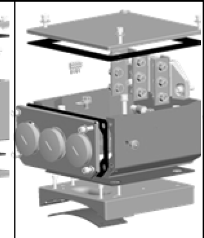
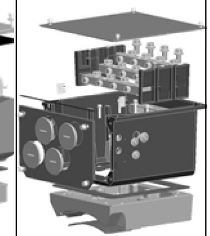
The connecting cables can be damaged if the direction of the cable outlet is not changed correctly. The direction of the cable outlet must not be changed since this renders all warranty claims null and void.



No.	Description	No.	Description	No.	Description
1	Connecting studs 3 x M5	4	M6 grounding screw	7	Grounding screws 2 x M12
2	Connecting studs 3 x M10	5	M10 grounding screw	8	Connecting studs 12 x M16
3	M4 grounding screw	6	Connecting studs 3 x M12	9	Grounding screws 4 x M16

Figure 8-6 Terminal assignment in the terminal boxes

Table 8-3 Terminal box specifications

	GK 230	GK 420	GK 630	GK 603	1XB7-700	1XB7-712
Diagram						
Dimensions L x W x H	122 x 117 x 62	162 x 162 x 74	210 x 210 x 117	210 x 212 x 123	306 x 306 x 160	317 x 370 x 226
Maximum permissible terminal current I	I ≤ 50 A	50 A < I < 105 A	105 A < I < 260 A	I ≤ 260 A	I ≤ 470 A	470 A < I < 830 A
Voltage AC / DC	400 ... 480 V	400 ... 480 V	400 ... 480 V	400 ... 480 V	400 ... 480 V	400 ... 480 V
Thread diameter to fix cables	M5	M10	M10	M5 / M10	M12	M16
Ground connection	M4	M6	M10	M6 / M10	M12	M16
Removable cable entry plate	No	No	No	Yes	Yes	Yes
Cable entry	2 x M32 x 1.5	2 x M40 x 1.5	2 x M50 x 1.5	2 x M63 x 1.5	3 x M75 x 1.5 *)	4 x M75 x 1.5
Maximum possible conductor cross-section	2 x 16 mm²	2 x 35 mm²	2 x 50 mm²	2 x 50 mm²	3 x 120 mm²	4 x 120 mm²

*) Option P01 Cable entry plate with 3 x M63 x 1.5 for 1XB7-700 terminal box

Table 8-4 Cable cross-sections (Cu) and outer diameter of the connecting cables in the standard version

Shaft height	Option [6)]	Maximum permissible terminal current I	Terminal box type	Terminal bolt diam. in mm	Thread for cable entry	Cable entry max. diam. / width A/F in mm	Max. conductor cross-section [1)] in mm²	Conductor diam. in mm
150	w/o	I ≤ 50 A	GK 230	5	2 x M32 x 1.5	46 / 40	2 x 16	11 - 24
	w/o	50 A < I < 105 A	GK 420	10	2 x M40 x 1.5	60 / 55	2 x 35	19 - 31
	w/o	105 A < I < 260 A	GK 630	10	2 x M50 x 1.5	68 / 60	2 x 50	27 - 38
	M02 [1)]	I ≤ 260 A	GK 603	5 / 10	2 x M63 x 1.5	81 / 75	2 x 50	11 - 38

Shaft height	Option [6]	Maximum permissible terminal current I	Terminal box type	Terminal bolt diam. in mm	Thread for cable entry	Cable entry max. diam. / width A/F in mm	Max. conductor cross-section [1] in mm²	Conductor diam. in mm
200	w/o [5]	I ≤ 50 A	GK 230	5	2 x M32 x 1.5	46 / 40	2 x 16	11 - 24
	w/o	50 A < I < 105 A	GK 420	10	2 x M40 x 1.5	60 / 55	2 x 35	19 - 31
	w/o [4]	105 A < I ≤ 260 A	GK 630	10	2 x M50 x 1.5	68 / 60	2 x 50	27 – 38
	M02 [1]	I ≤ 260 A	GK 603	5 / 10	2 x M63 x 1.5	81 / 75	2 x 50	11 – 38
	P01 [2]	260 A < I ≤ 470 A	1XB7-700	12	3 x M63 x 1.5	92 / 81	3 x 95	39 – 52
	w/o	260 A < I ≤ 470 A	1XB7-700	12	3 x M75 x 1.5	92 / 81	3 x 120	41 – 56
280	P01 [2]	I ≤ 470 A	1XB7-700	12	3 x M63 x 1.5	92 / 81	3 x 95	39 – 52
	w/o	I ≤ 470 A	1XB7-700	12	3 x M75 x 1.5	92 / 81	3 x 120	41 - 56
	P04 [3]	470 A < I ≤ 710 A	1XB7-712	16	4 x M63 x 1.5	92 / 81	4 x 95	39 - 52
	w/o	470 A < I ≤ 830 A	1XB7-712	16	4 x M75 x 1.5	105 / 95	4 x 120	41 - 56

1) Option M02: Terminal box GK 603 with removable front plate

2) Option P01: Cable entry plate 3 x M63 x 1.5 for terminal box 1XB7-700

3) Option P04: Cable entry plate 4 x M63 x 1.5 for terminal box 1XB7-712

4) 1FW3206-3❑P supplied as standard with 1XB7-700. Terminal box GK 630 is possible on request.

5) 1FW3201-3❑P supplied as standard with GK420

6) You must order the options separately.

Note

MOTION-CONNECT 500 power cables are available up to a cross-section of 120 mm² and MOTION-CONNECT 800PLUS up to 50 mm².

The listed cables are UL and/or CSA approved.

The approvals can be taken from the current catalog in Chapter "MOTION-CONNECT connection system".

8.3.3 Signal connection/motor protection

DRIVE-CLiQ is the preferred method for connecting the encoder systems to SINAMICS.

Motors with a DRIVE-CLiQ interface can be ordered for this purpose. Motors with a DRIVE-CLiQ interface can be directly connected to the associated motor module via the available MOTION-CONNECT DRIVE-CLiQ cables. The MOTION-CONNECT DRIVE-CLiQ cable is connected to the motor in degree of protection IP67. The DRIVE-CLiQ interface supplies power to the motor encoder via the integrated 24 V DC supply and transfers the motor encoder and temperature signals and the electronic type plate data, e.g. a unique identification number, rating data (voltage, current, torque) to the control unit. The MOTION-CONNECT DRIVE-CLiQ cable is used universally for connecting the various encoder types. These motors simplify commissioning and diagnostics, as the motor and encoder type are identified automatically.

8.3.3.1 Motor with DRIVE-CLiQ interface

Motors with DRIVE-CLiQ interfaces can be connected to the associated Motor Module directly via the MOTION-CONNECT DRIVE-CLiQ cables available. This means that data are transferred directly to the control unit.

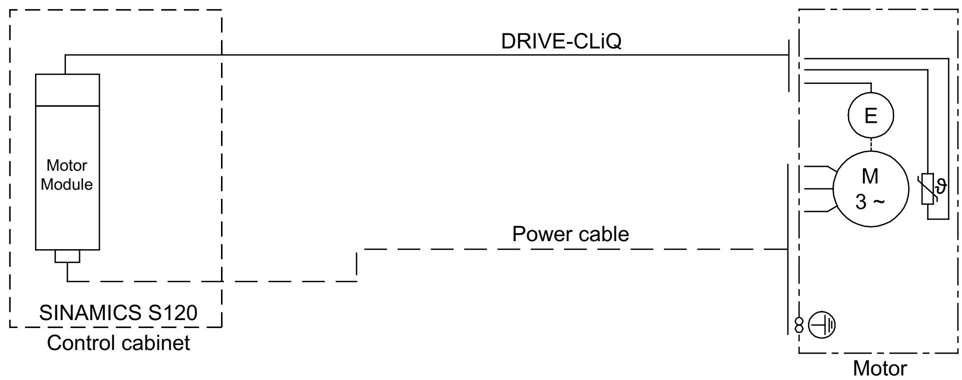


Figure 8-7 Connecting encoders using the DRIVE-CLiQ interface

8.3.3.2 Motor without DRIVE-CLiQ interface

If a motor is not equipped with a DRIVE-CLiQ interface, the speed encoder and temperature sensor are connected via a signal connector.

Motors that are not equipped with DRIVE-CLiQ require a Cabinet-Mounted Sensor Module (SMC) when operated with SINAMICS S120. The motor is connected to the SMC via a signal line. The SMC is connected to the Motor Module via a MOTION-CONNECT DRIVE-CLiQ cable.

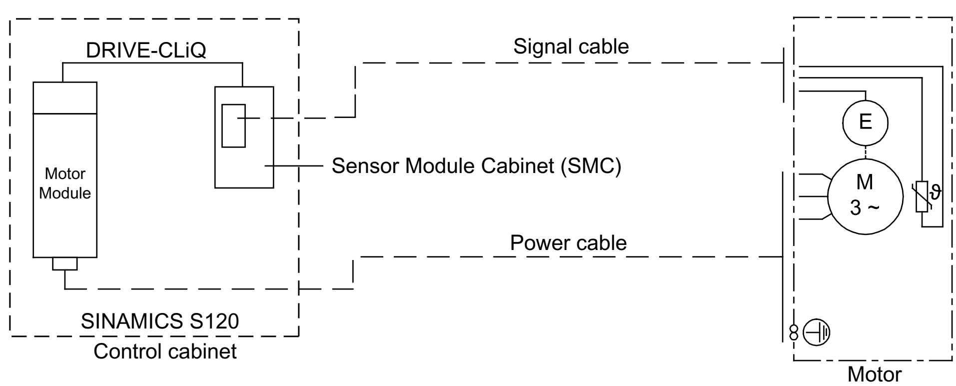


Figure 8-8 Connecting encoders without DRIVE-CLiQ interface

8.3.3.3 Connecting temperature sensors

Motor versions with 3x PTC

For special applications (e.g. when a load is applied with the motor stationary or for extremely low speeds), the temperature of all of the three motor phases must be additionally monitored using a 3 x PTC thermistor triplet (option A11).

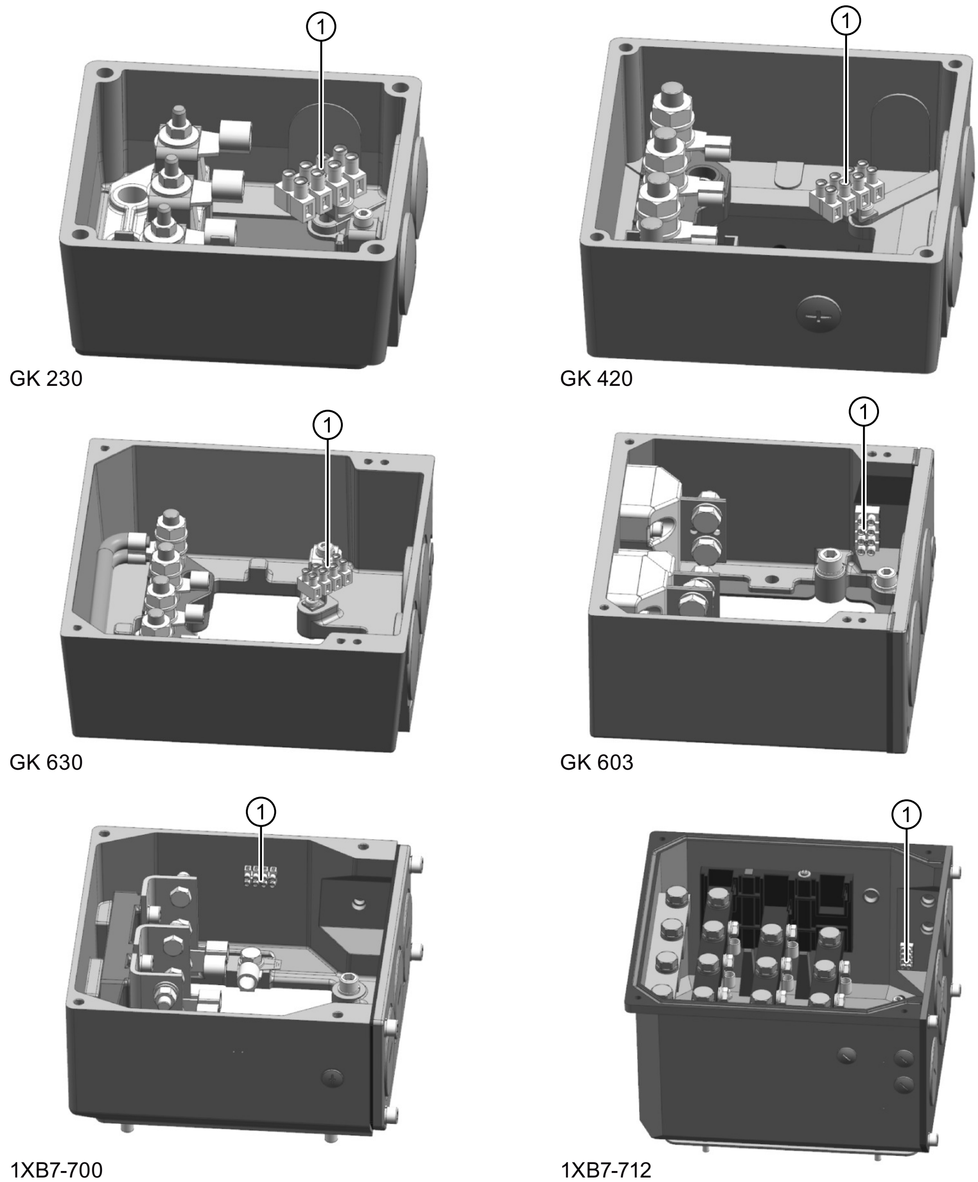
For motors without SMI (encoder without DRIVE-CLiQ interface and encoder with DQI encoder) and for motors with shaft height 280, the PTC thermistor triplet must be evaluated via an external trip unit (this is not included in the scope of delivery).

This means that the sensor cable is monitored for wire breakage and short-circuit by this unit. The motor must be switched into a no-torque condition when the response temperature is exceeded.

For motors of shaft heights 150 and 200 with SMI (encoder variants "D" = IC22DQ, "F" = AM22DQ, "U" = R15DQ), the PTC thermistor triplet is evaluated in the SMI and transmitted to the drive via DRIVE-CLiQ.

Note

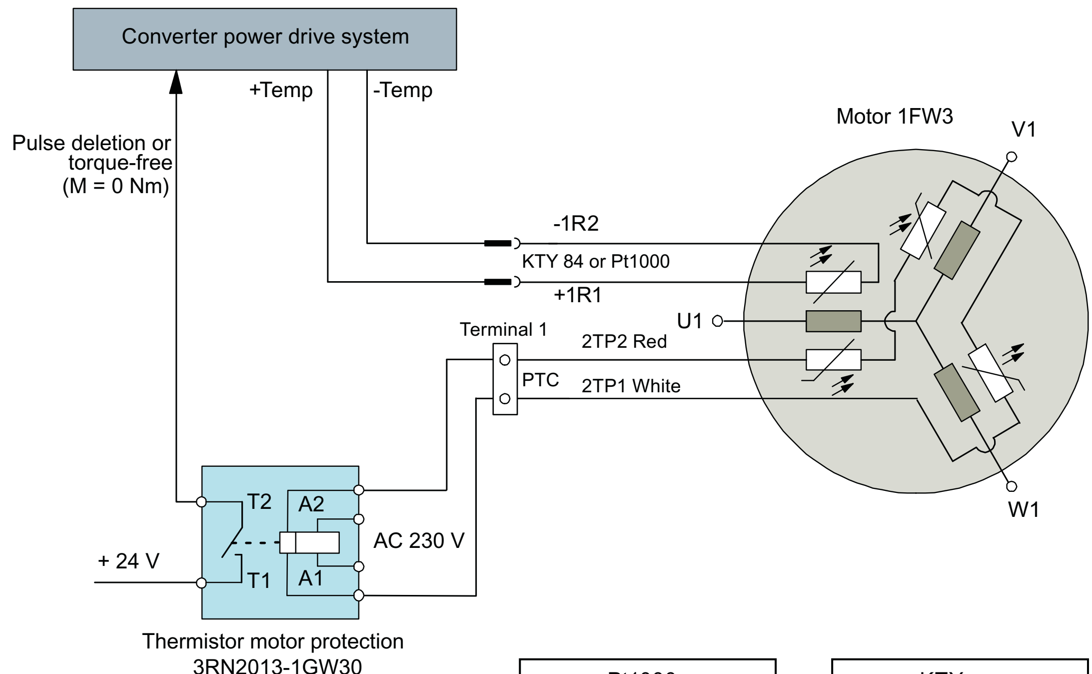
The PTC thermistors do not have a linear characteristic and are, therefore, not suitable to determine the instantaneous temperature. PTC characteristic to DIN VDE 0660 Part 303, DIN 44081, DIN 44082.



1 Terminal

Figure 8-9 Connection for 3 x PTC

Connection schematic for temperature sensors



Pt1000	
1R1	Yellow
1R2	Yellow

KTY	
+1R1	Brown
-1R2	White

Notes
- KTY 84: Ensure correct polarity.
- Pt1000/PTC*): Polarity-neutral
- Shutdown circuit: Check the shutdown circuit carefully to ensure that it correctly shuts down before the motor is actually commissioned.

*) PTC as option A11

Figure 8-10 Connection schematic for temperature sensors (without SMI)

8.3.4 Rotating the connector at the motor

Signal connector and integrated Sensor Module can be rotated to a limited extent.

Note

Observe the following when rotating the connectors:

- Do not exceed the permissible range of rotation.
- In order to maintain the degree of protection, max. 10 rotations are permissible.
- Keep to the maximum rotating torque. See Table "Maximum rotating torques that occur".
- Only rotate the connector with a mating connector that matches the connector thread.
- Secure the connection cables against tensile and bending stress.
- Secure the connector against rotating further.
- It is not permissible to subject the connector to continuous forces.

Table 8-5 Maximum rotating torques that occur

Connector	Max. rotating torques that occur / Nm
Signal connector	8
Integrated Sensor Module	8

Signal cable

The manufacturer mounts the plug-in connection for the signal cable (at the encoder terminal box).

- When connecting the connector, insert the coding groove into the socket connector until it is flush and tighten the screw cap by hand as far as it will go.

8.3.5 Shielding, grounding, and equipotential bonding

Important notes regarding shielding, grounding and equipotential bonding

The correct installation and connection of the cable shields and protective conductors is of crucial importance, not only for personal safety but also for noise emission and noise immunity.

WARNING

Risk of electric shock!

Hazardous touch voltages can be present at unused cores and shields if they have not been grounded or insulated.

- Connect the cable shields to the respective housings through the largest possible surface area. Use suitable clips, clamps or screw couplings to do this.
- Connect unused conductors of shielded or unshielded cables and their associated shields to the grounded enclosure potential at one end as minimum.
  Alternatively:
  Insulate conductors and their associated shields that are not used. The insulation must be able to withstand the rated voltage.

Further, unshielded or incorrectly shielded cables can lead to faults in the drive – particularly the encoder – or in external devices, for example.

Electrical charges that are the result of capacitive cross coupling are discharged by connecting the cores and shields.

NOTICE

Device damage as a result of leakage currents for incorrectly connected protective conductor

High leakage currents may damage other devices if the motor protective conductor is not directly connected to the power module.

- Connect the motor protective conductor (PE) directly at the power unit.

NOTICE

Device damage as a result of leakage currents for incorrect shielding

High leakage currents may damage other devices if the motor power cable shield is not directly connected to the power module.

- Connect the power cable shield at the shield connection of the power module.

Note

Apply the EMC installation guideline of the converter manufacturer. For Siemens converters, this is available under document order No. 6FC5297-☐AD30-0☐P☐.

NOTICE
Bearing currents/rotor ground currents Bearing currents/rotor ground currents cause premature wear of the bearings, increased noise levels and vibrations. • Avoid bearing currents/rotor ground currents by ensuring a good metallic connection between the motor and the customer's machine (enclosure and shaft). If you are unable to ensure a good metallic connection, contact your local Siemens office. • Only use shielded power and signal cables. Connect the cable shields at both ends to the respective housings through the largest possible surface area. You can find further information on the Internet at the following link: Bearing Currents in Converter Driven Induction Motors (https://support.industry.siemens.com/cs/document/22159801/bearing-currents-in-converter-driven-induction-motors?dti=0&pnid=13204&lc=en-WW)

Installation drawings/Dimension drawings 9

Note

Motor dimensions

Siemens reserves the right to change the motor dimensions as part of design improvements without prior notification. The dimension drawings provided in this documentation, therefore, may not necessarily be up to date.

You can request up-to-date dimension drawings at no charge.

9.1 Siemens Product Configurator - SPC

SP CONFIGURATOR

In the SP CONFIGURATOR - you can simply and quickly find

- dimension drawings
- 2D/3D CAD data

The SP CONFIGURATOR supports you when generating plant/system documentation regarding project-specific information.

Note

The 3D model in the SP CONFIGURATOR is a simplified representation that does not show all of the details.

You can find further information on the Internet at SP CONFIGURATOR (https://mall.industry.siemens.com/spice/cloudcm/dashboard):

9.2 Dimension drawings

9.2.1 Hollow shaft

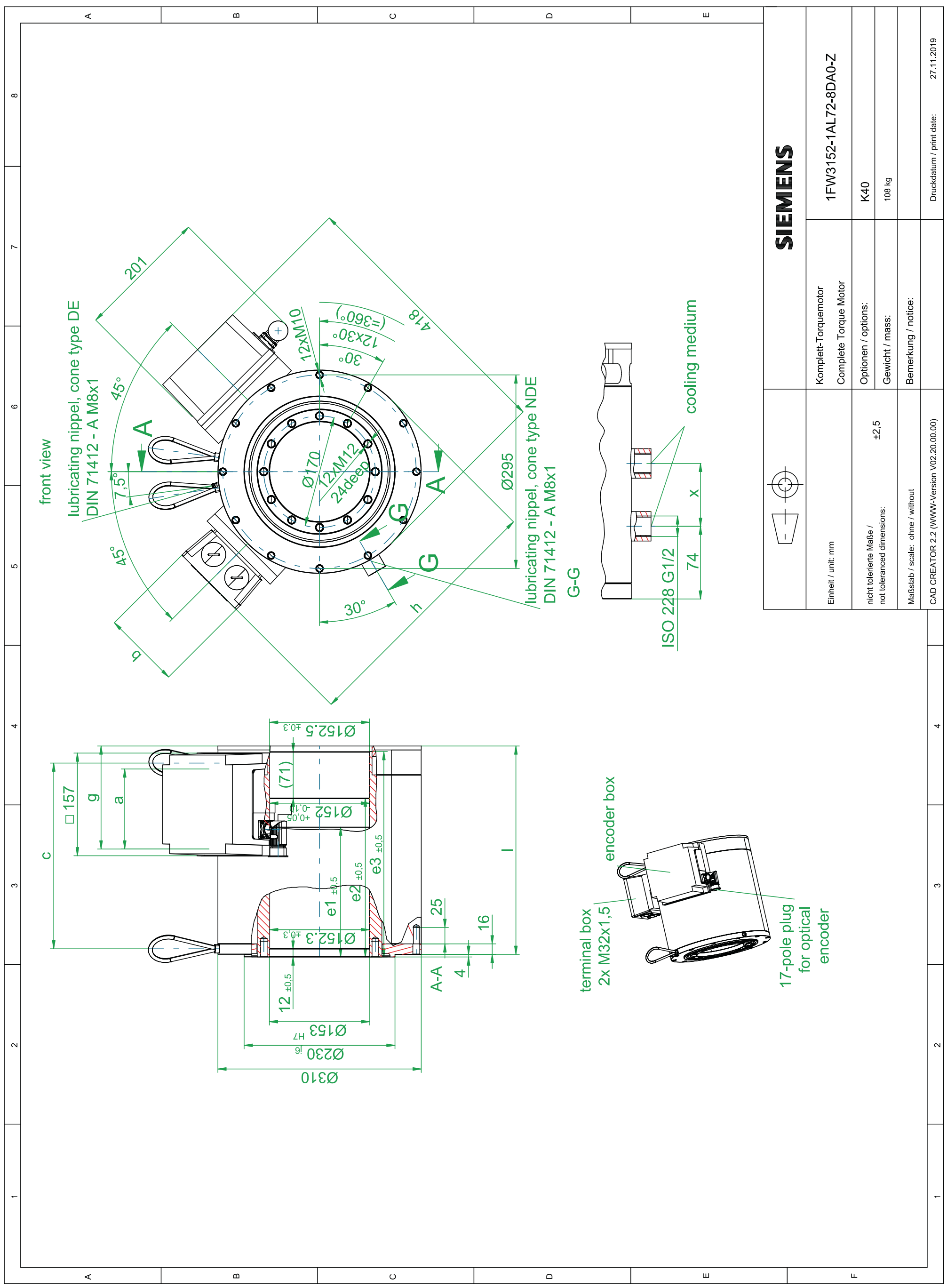


Figure 9-1 SH150, Hollow shaft

Table 9-1 Motor table

version	l	c	e_1	e_2	e_3	weight
	mm	mm	mm	mm	mm	kg
1FW3150	260.5	226	141	185	256	87
1FW3152	317.5	283	198	242	313	108
1FW3154	366.5	332	247	291	362	129
1FW3155	418.5	384	299	343	414	150
1FW3156	471.5	437	352	396	467	171

Table 9-2 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	393	159.5	122 x 117
gk 420	2x M40x1.5	410	177.0	162 x 162
gk 630	2x M50x1.5	427	225.5	210 x 210

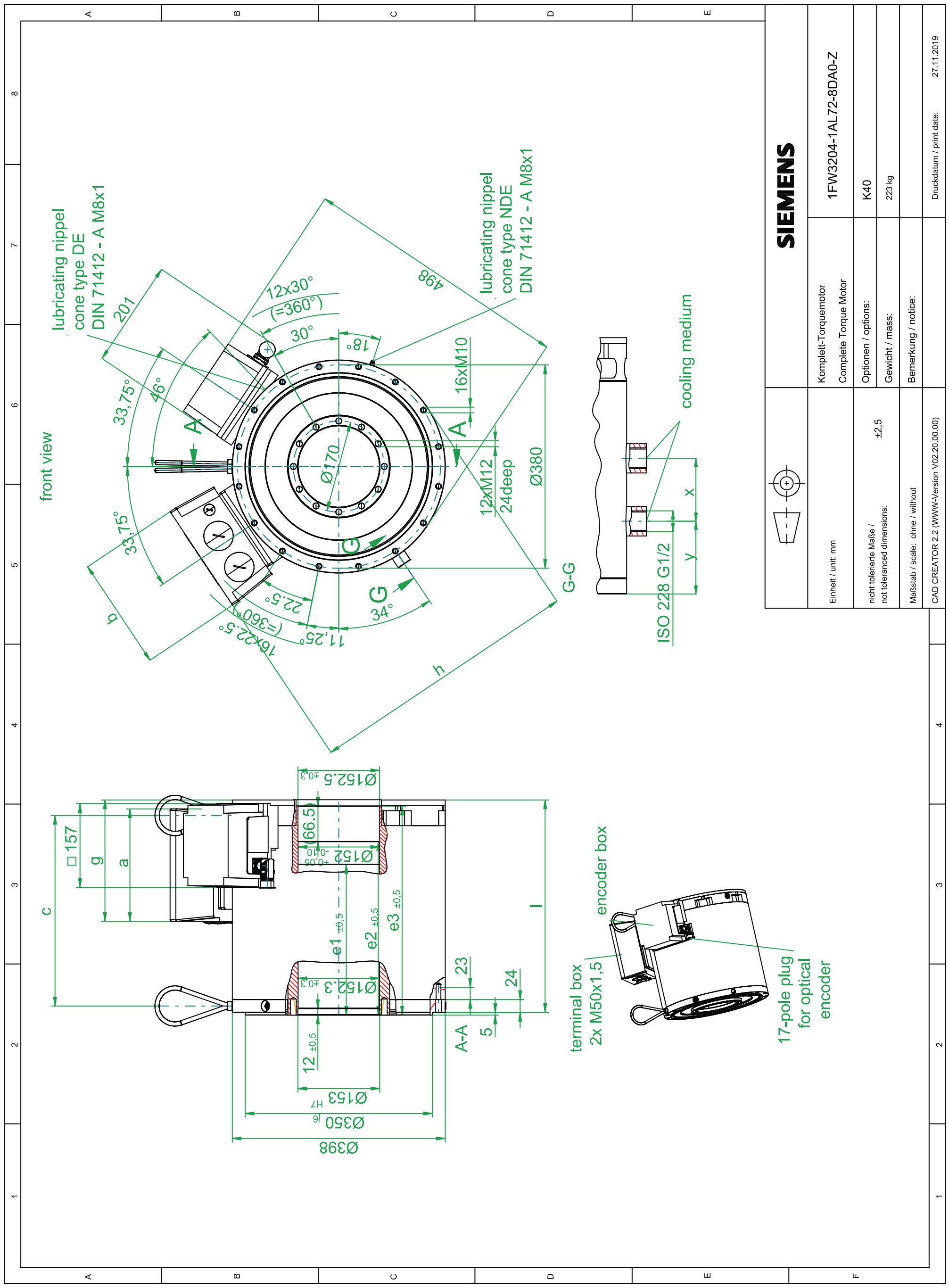


Figure 9-2 SH200, Hollow shaft

Table 9-3 Motor table

version	l	c	e_1	e_2	e_3	weight
	mm	mm	mm	mm	mm	kg
1FW3201	235.5	194.5	120	162.5	229.0	127
1FW3202	281.5	240.5	166	208.5	275.0	156
1FW3203	328.0	287.0	212	255.0	321.5	182
1FW3204	397.0	356.0	281	324.0	390.5	223
1FW3206	489.5	448.5	374	416.5	483.0	279
1FW3208	604.5	563.5	489	531.5	598.0	348

Table 9-4 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	475	158	122 x 117
gk 420	2x M40x1.5	490	175	162 x 162
gk 630	2x M50x1.5	508	226	210 x 210

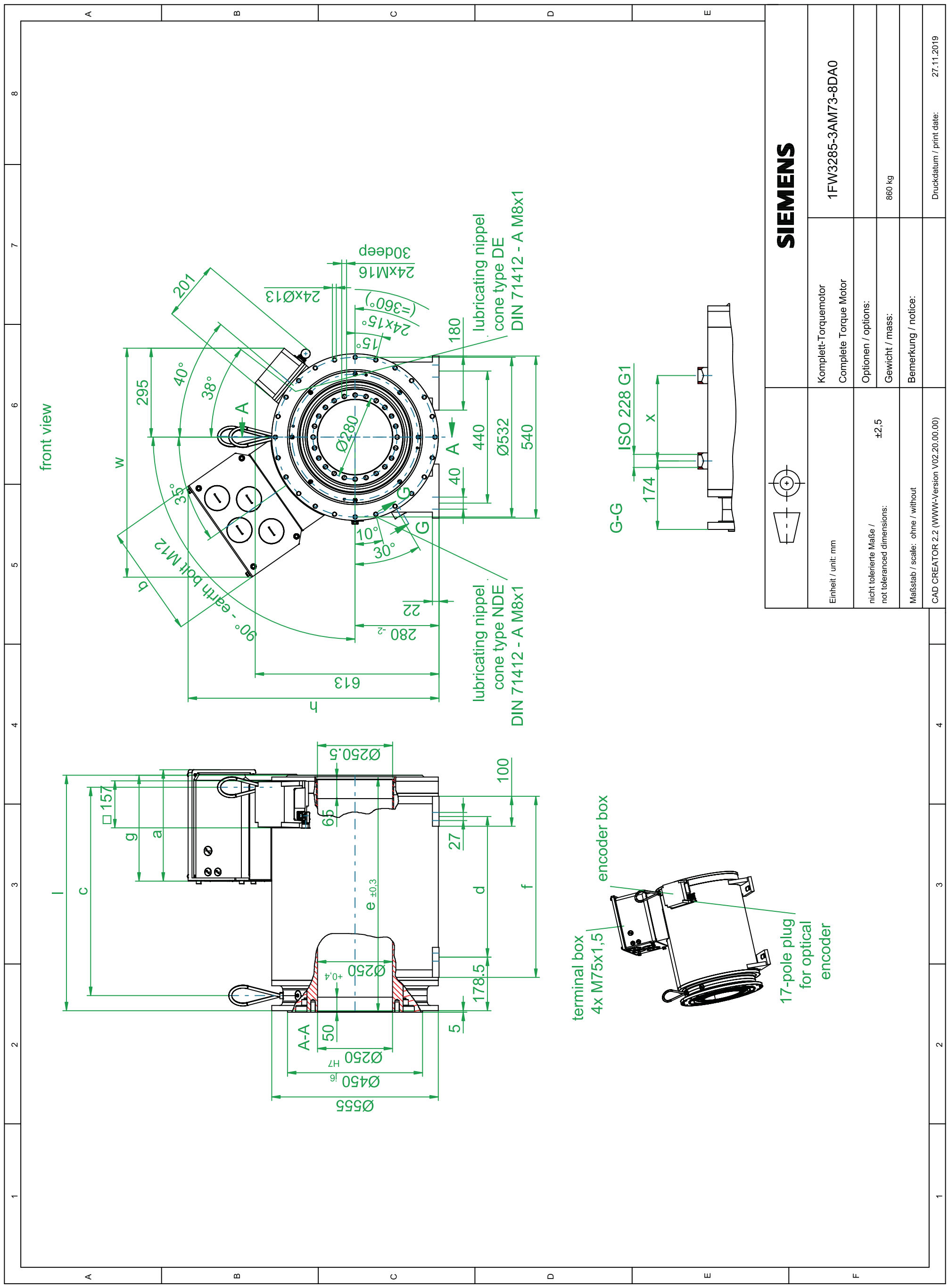


Figure 9-3 SH280, Hollow shaft

Table 9-5 Motor table

version	l	c	d	e	f	weight
	mm	mm	mm	mm	mm	kg
1FW3281	574.0	483.5	258.0	571.0	393.0	600
1FW3283	658.5	568.0	342.5	655.5	477.5	690
1FW3285	784.5	694.0	468.5	781.5	603.5	860
1FW3287	953.0	862.5	637.0	950.0	772.0	1030

Table 9-6 Table terminal box

version (cable outlet direction)	thread	h	W	g	a x b
		mm	mm	mm	mm x mm
1XB7-700	3x M75x1.5	743	684	363	306 x 306
1XB7-712 (axial DE)	4x M75x1.5	836	764	354	371 x 370
1XB7-712 (axial NDE)	4x M75x1.5	836	764	385	371 x 370
1XB7-712 (radial left)	4x M75x1.5	846	751	369	371 x 370
1XB7-712 (radial right)	4x M75x1.5	828	777	369	371 x 370

9.2.2 Solid shaft

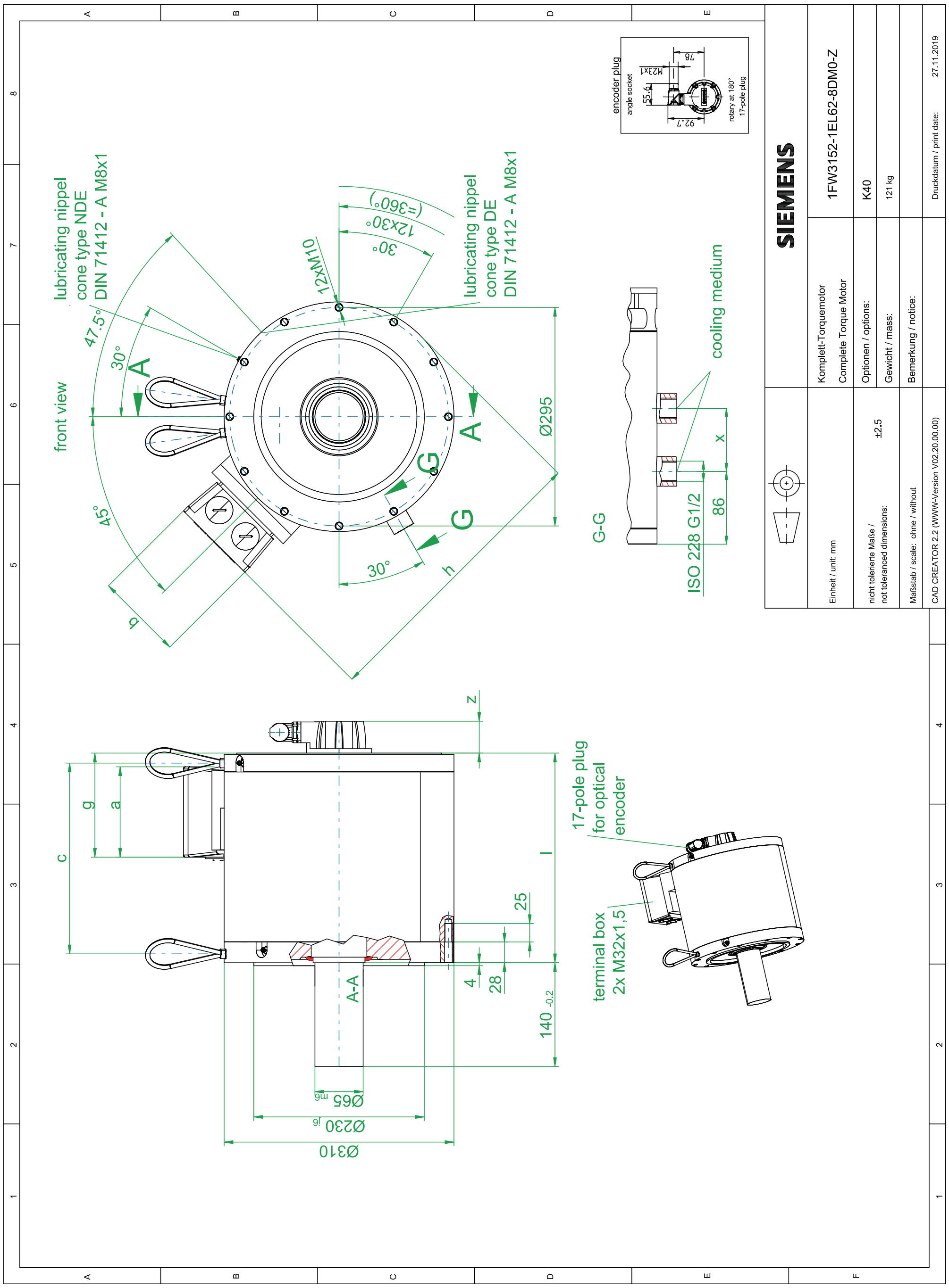


Figure 9-4 SH150, Solid shaft

Table 9-7 Motor table

version	l	c	z*	weight
	mm	mm	mm	kg
1FW3150	253.5	228.0	38 / 43	102
1FW3152	283.0	257.5	38 / 43	121
1FW3154	338.0	312.5	38 / 43	143
1FW3155	386.5	361.0	38 / 43	164
1FW3156	440.5	415.0	38 / 43	187

z* (z=38 for DQI / z=43 for angle socket); you can find additional dimensions in diagram "Encoder connection".

Table 9-8 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	393	140.5	122 x 117
gk 420	2x M40x1.5	409	158	162 x 162
gk 630	2x M50x1.5	427	206.5	210 x 210

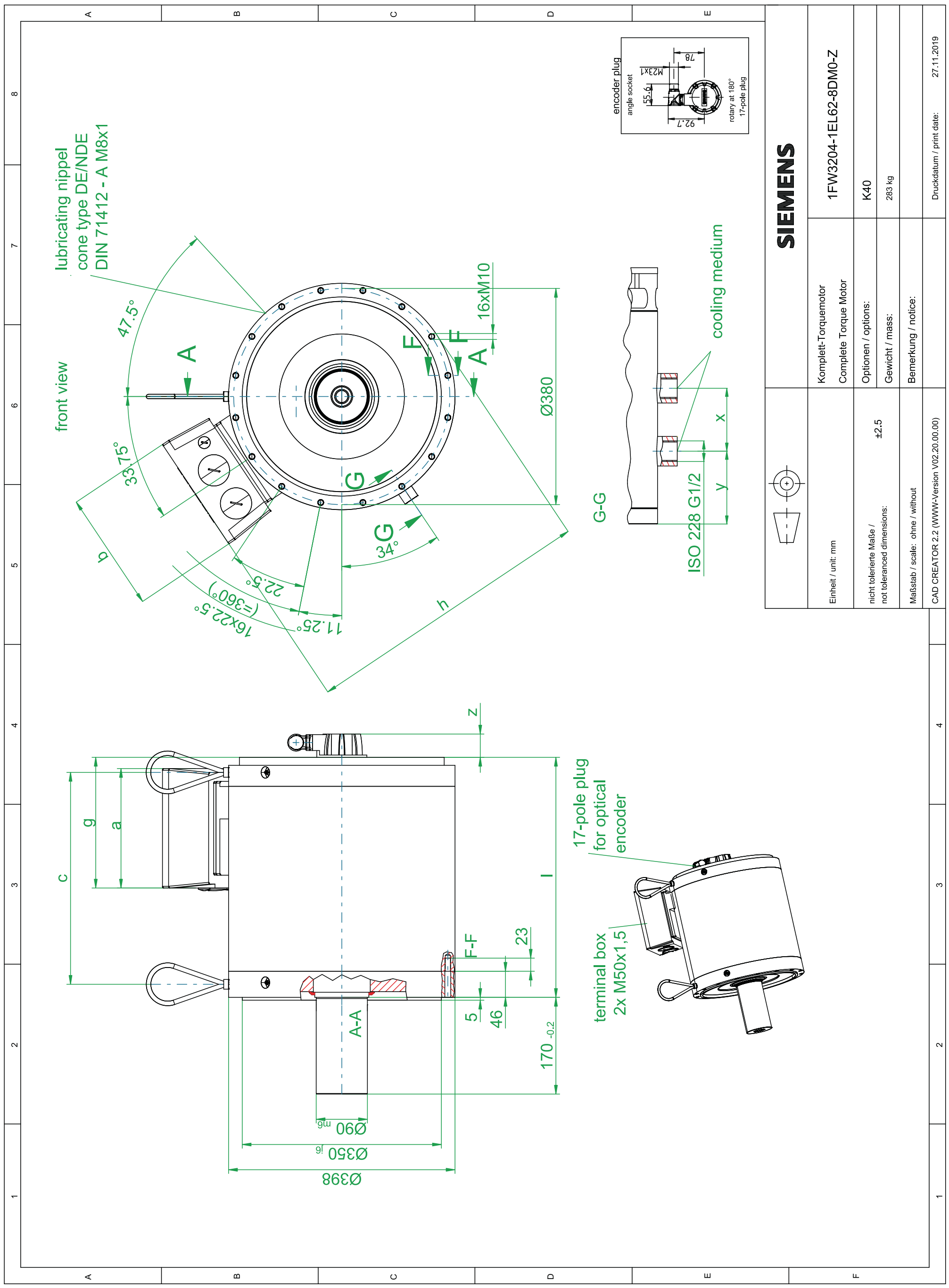


Figure 9-5 SH 200, Solid shaft

Table 9-9 Motor table

version	l	c	z*	HS	HT
	mm	mm	mm	weight / kg	
1FW3201	260.5	211	36 / 41	176	
1FW3202	306.5	257	36 / 41	207	
1FW3203	353	303.5	36 / 41	237	
1FW3204	422	372.5	36 / 41	283	
1FW3206	514.5	465	36 / 41	370	345
1FW3208	629.5	580	36 / 41	446	421

z* (z=36 for DQI / z=41 for angle socket), HS: High speed, HT: High Torque; you can find additional dimensions in the diagram "encoder connection".

Table 9-10 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	475	161	122 x 117
gk 420	2x M40x1.5	491	178.5	162 x 162
gk 630	2x M50x1.5	507	229.5	210 x 210
1XB7-700	3x M75x1.5	580	307	306 x 306

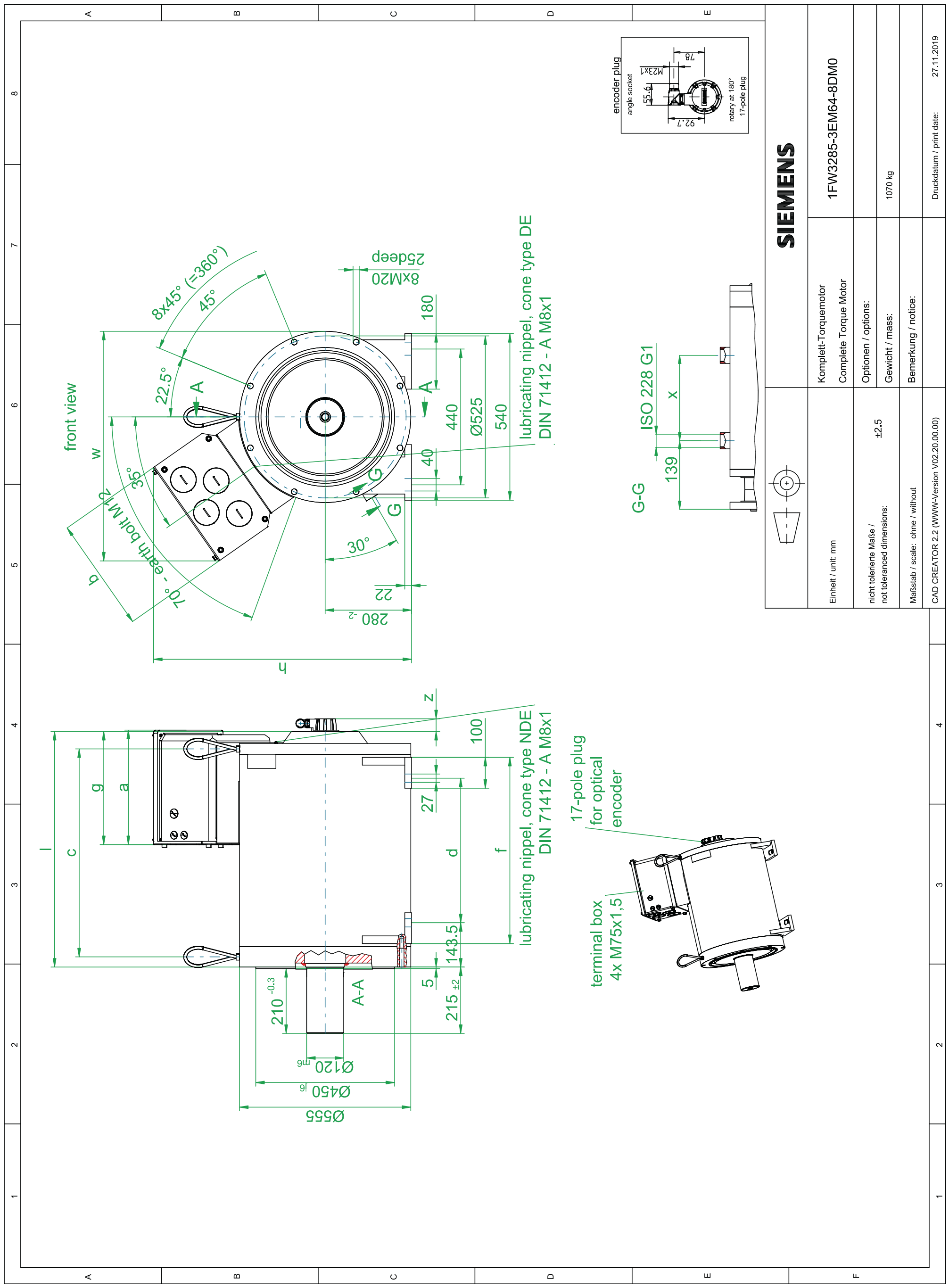


Figure 9-6 SH280, Solid shaft, IMB34

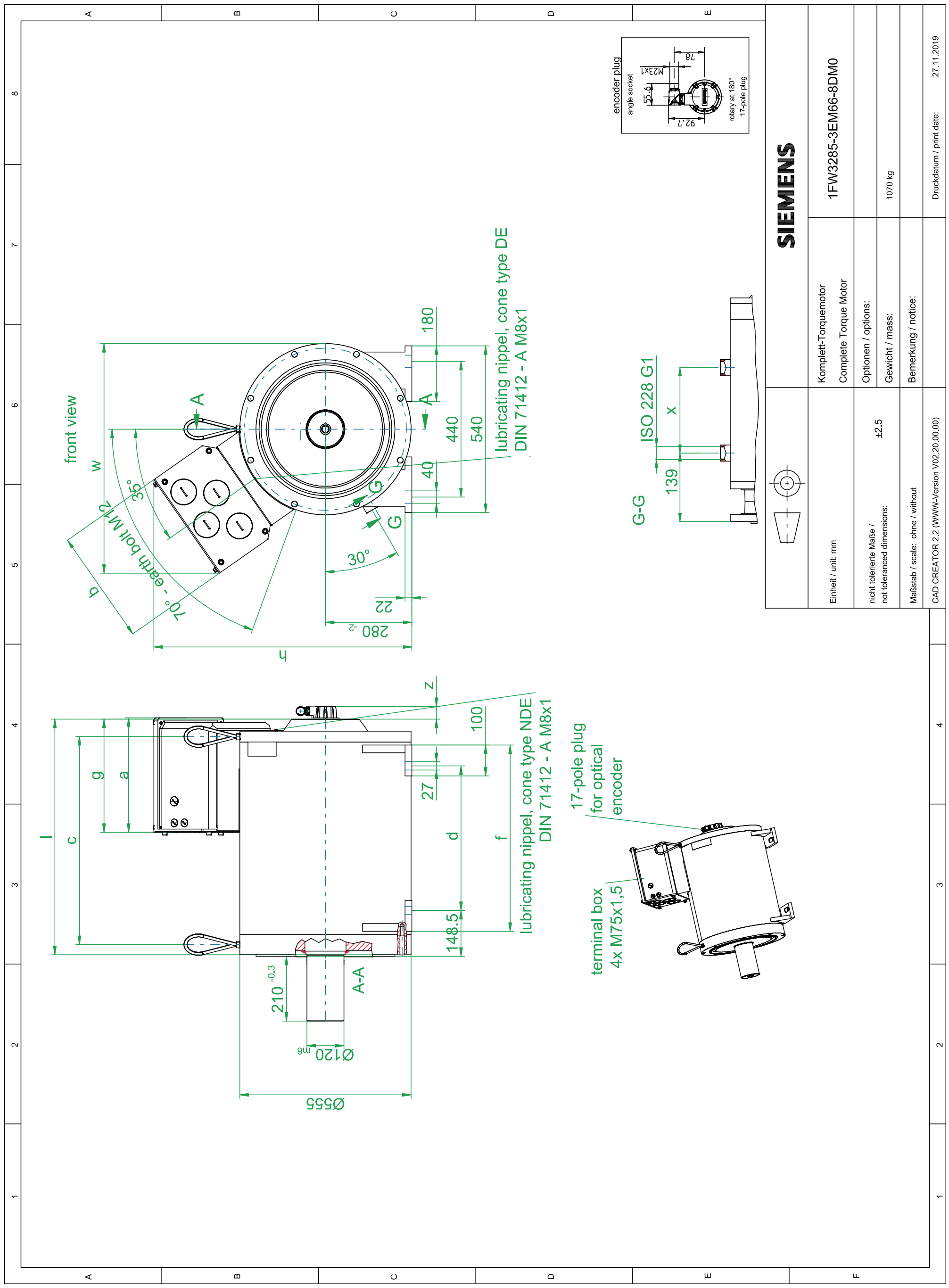


Figure 9-7 SH280, Solid shaft, IMB3

Table 9-11 Motor table

version	l	c	d	f	z*	weight
	mm	mm	mm	mm	mm	kg
1FW3281	553	463.5	258.0	393.0	36 / 41	750
1FW3283	637.5	548	342.5	477.5	36 / 41	880
1FW3285	763.5	674	468.5	603.5	36 / 41	1070
1FW3287	932	842.5	637.0	772.0	36 / 41	1300

z* (z=36 for DQI / z=41 for angle socket); you can find additional dimensions in the diagram "encoder connection".

Table 9-12 Table terminal box

version (cable outlet direction)	thread	h	W	g	a x b
		mm	mm	mm	mm x mm
1XB7-700	3x M75x1.5	742	665	377	306 x 306
1XB7-712 (axial DE)	4x M75x1.5	836	744	368	371 x 370
1XB7-712 (axial NDE)		836	744	399	
1XB7-712 (radial left)		846	731	383	
1XB7-712 (radial right)		828	764	383	

9.2.3 Plug-on shaft

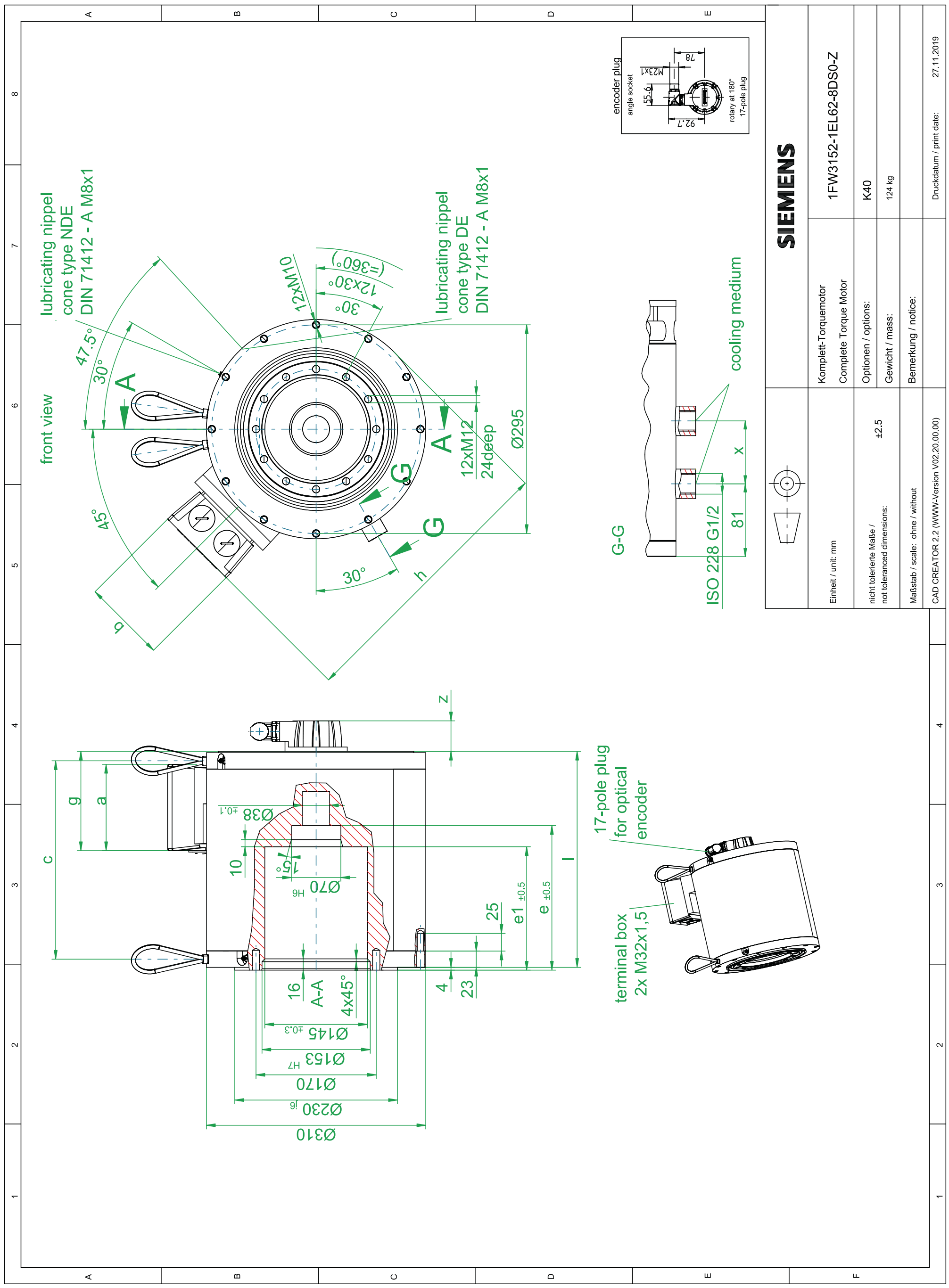


Figure 9-8 SH150, Plug-on shaft

Table 9-13 Motor table

version	l	c	e	e_1	z*	weight
	mm	mm	mm	mm	mm	kg
1FW3150	248.5	223.5	151.5	121.5	38 / 43	102
1FW3152	305.5	280.5	204.5	174.5	38 / 43	124
1FW3154	354.5	329.5	255	225	38 / 43	143
1FW3155	406.5	381.5	307	277	38 / 43	163
1FW3156	459.5	434.5	360	330	38 / 43	184

z* (z=38 for DQI / z=43 for angle socket); you can find additional dimensions in diagram "Encoder connection".

Table 9-14 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	393	140.5	122 x 117
gk 420	2x M40x1.5	409	158	162 x 162
gk 630	2x M50x1.5	427	206.5	210 x 210

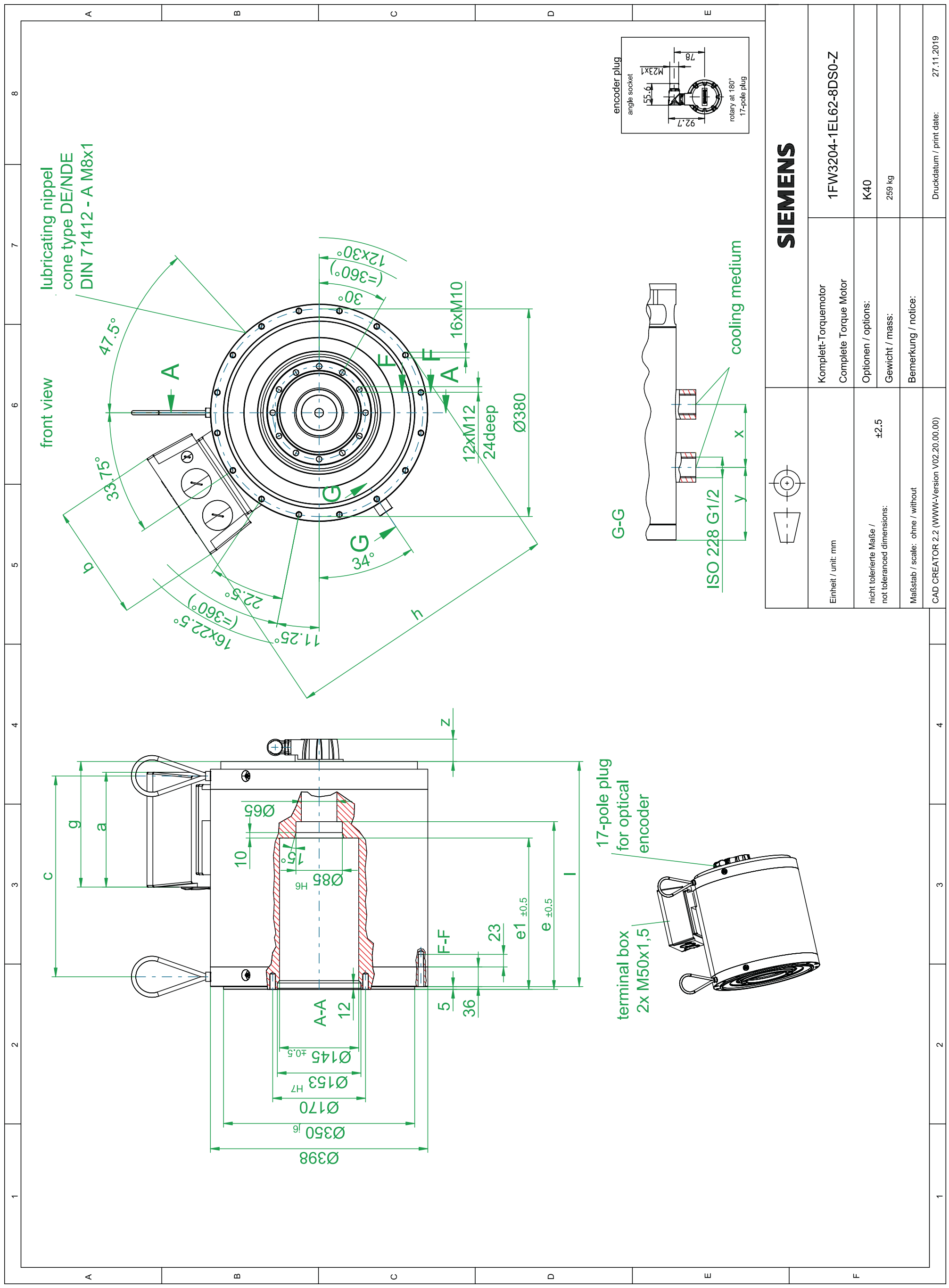


Figure 9-9 SH200, Plug-on shaft

Table 9-15 Motor table

version	l	c	e	e_1	z*	HS	HT
	mm	mm	mm	mm	mm	weight /kg	
1FW3201	250.5	206	145.5	115.5	36 / 41	159	
1FW3202	296.5	252	192	162	36 / 41	188	
1FW3203	343	298.5	238	208	36 / 41	215	
1FW3204	412	367.5	307	277	36 / 41	259	
1FW3206	504.5	460	400	370	36 / 41	342	317
1FW3208	619.5	575	514.5	484.5	36 / 41	412	387

z* (z=36 for DQI / z=41 for angle socket), HS: High speed, HT: High Torque; you can find additional dimensions in the diagram "encoder connection".

Table 9-16 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 230	2x M32x1.5	475	161	122 x 117
gk 420	2x M40x1.5	491	178.5	162 x 162
gk 630	2x M50x1.5	507	229.5	210 x 210
1XB7-700	3x M75x1.5	580	307	306 x 306

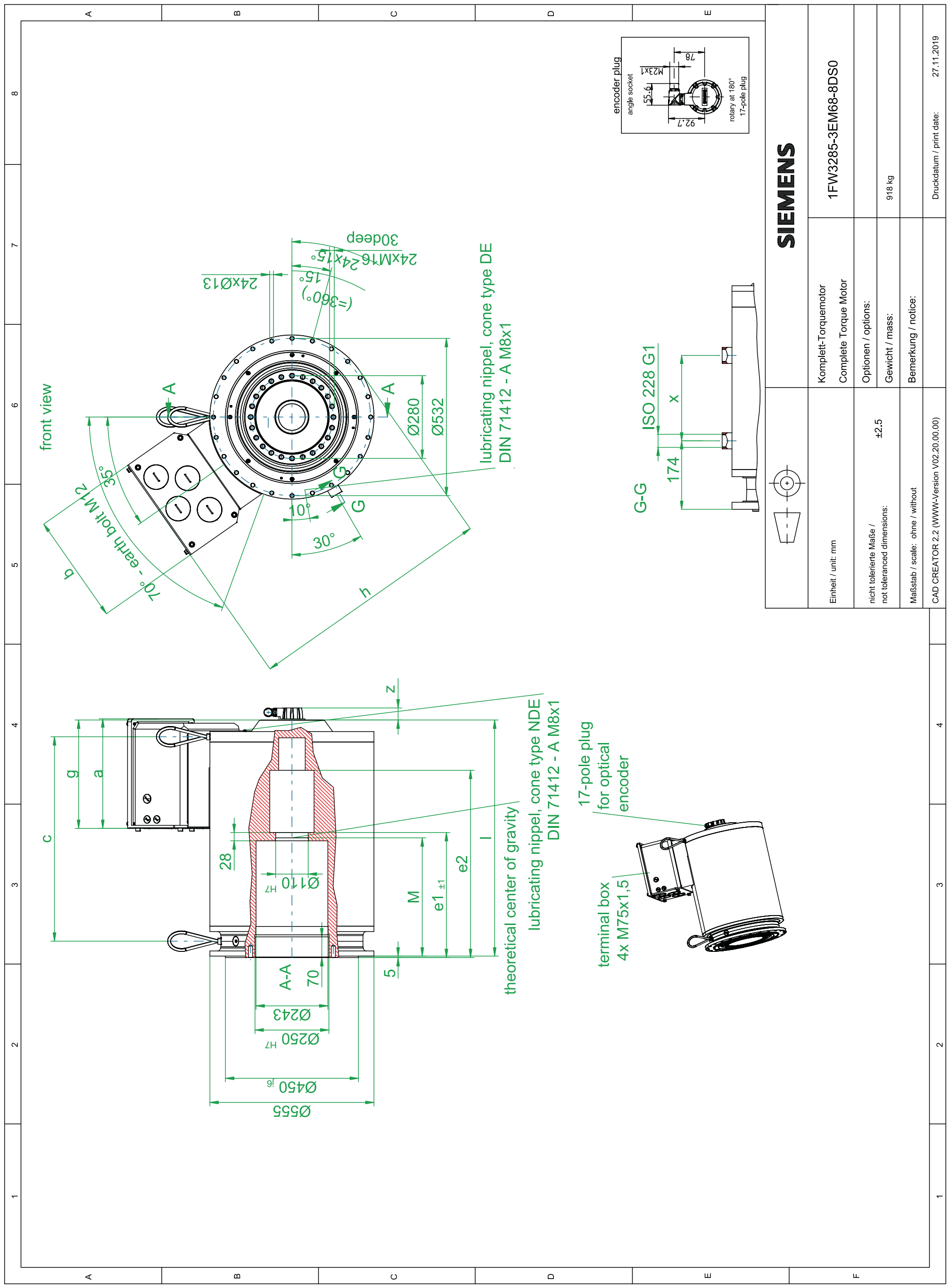


Figure 9-10 SH280, Plug-on shaft

Table 9-17 Motor table

version	l	c	e_1	e_2	M	z*	weight
	mm	mm	mm	mm	mm	mm	kg
1FW3281	588	481	313	423	292	36 / 41	666
1FW3283	672.5	565.5	358	507.5	335	36 / 41	767
1FW3285	798.5	691.5	423	633.5	400	36 / 41	918
1FW3287	967	860	508	802	485	36 / 41	1127

z* (z=36 for DQI / z=41 for angle socket); you can find additional dimensions in the diagram "encoder connection".

Table 9-18 Table terminal box

version (cable outlet direction)	thread	h	g	a x b
		mm	mm	mm x mm
1XB7-700	3x M75x1.5	737	377	306 x 306
1XB7-712 (axial DE)	4x M75x1.5	827	368	371 x 370
1XB7-712 (axial NDE)	4x M75x1.5	827	399	371 x 370
1XB7-712 (radial left)	4x M75x1.5	827	383	371 x 370
1XB7-712 (radial right)	4x M75x1.5	827	383	371 x 370

9.2.4 Heavy Duty

You can find further information on "Heavy Duty" in Chapter "Heavy Duty (Z option L03) (Page 152)".

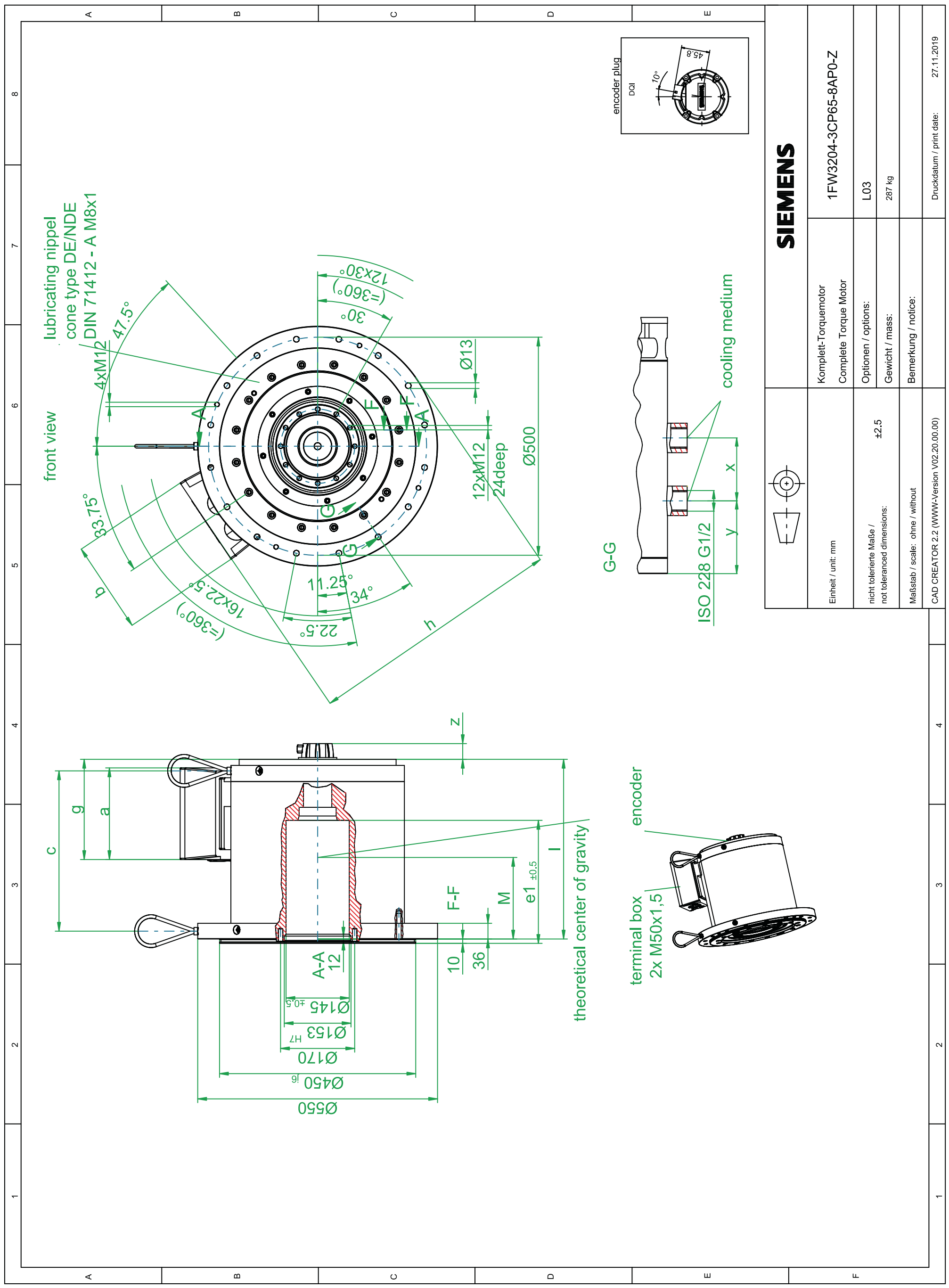


Figure 9-11 SH200, Heavy Duty

Table 9-19 Motor table

version	l	c	e_1	M	z*	weight
	mm	mm	mm	mm	mm	kg
1FW3202	296.5	252.0	167.0	131	36 / 41	214
1FW3203	343	298.5	213.0	154	36 / 41	246
1FW3204	412	367.5	282.0	187	36 / 41	287
1FW3206	504.5	460.0	375.0	238	36 / 41	365
1FW3208	619.5	575.0	489.5	295	36 / 41	436

z* (z=36 for DQI / z=41 for angle socket); you can find additional dimensions in the diagram "encoder connection".

Table 9-20 Table terminal box

version	thread	h	g	a x b
		mm	mm	mm x mm
gk 420	2x M40x1.5	567	178.5	162 x 162
gk 630	2x M50x1.5	583	229.5	210 x 210
1XB7-700	3x M75x1.5	656	307	306 x 306

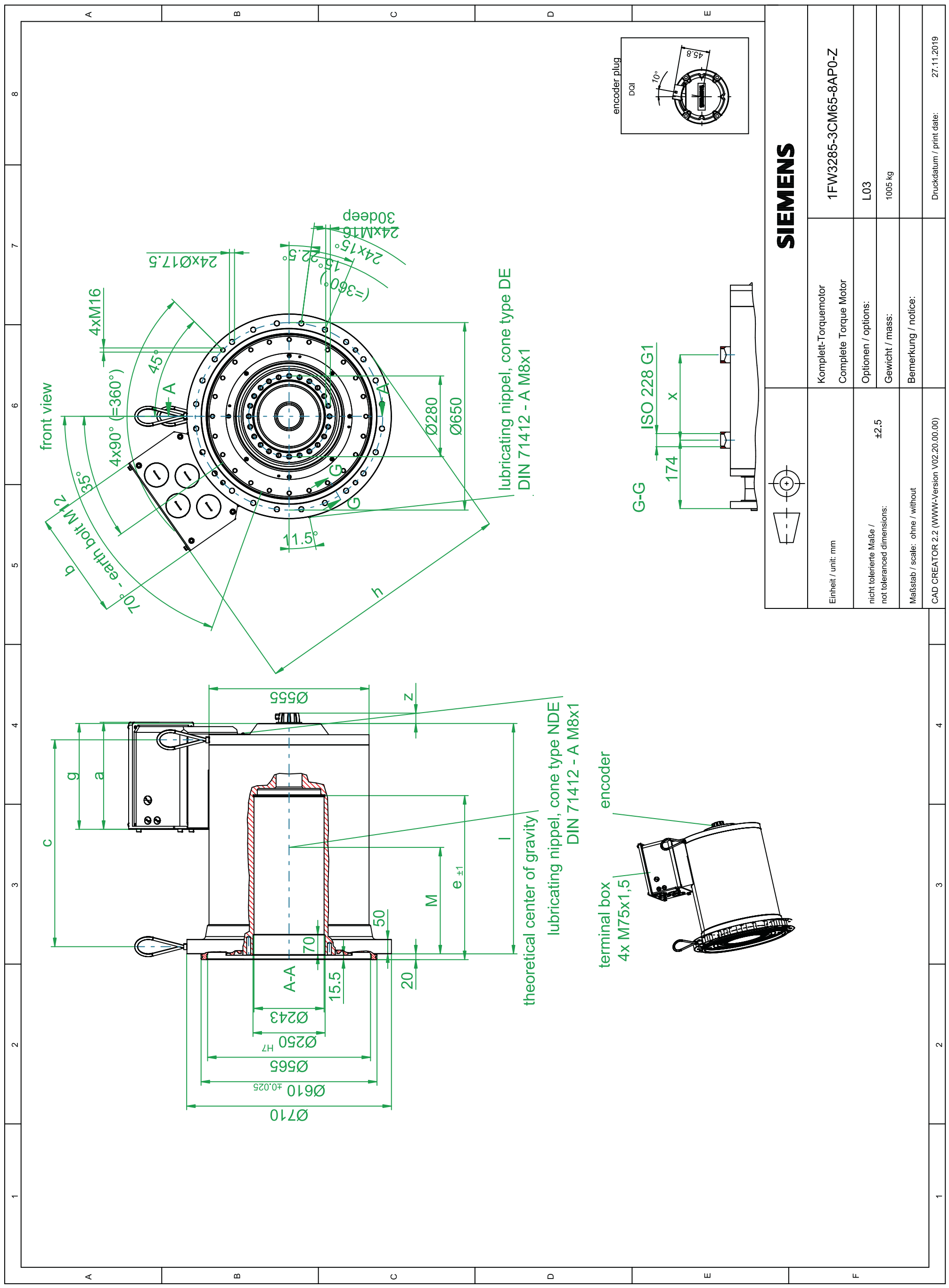


Figure 9-12 SH280, Heavy Duty

Table 9-21 Motor table

version	l	c	M	e	z*	weight
	mm	mm	mm	mm	mm	kg
1FW3281	588	506.5	262	358	36 / 41	755
1FW3283	672.5	591.0	304	442	36 / 41	854
1FW3285	798.5	717.0	369	568	36 / 41	1005
1FW3287	967	885.5	453	737	36 / 41	1207

z* (z=36 for DQI / z=41 for angle socket); you can find additional dimensions in the diagram "encoder connection".

Table 9-22 Table terminal box

version (cable outlet direction)	thread	h	g	a x b
		mm	mm	mm x mm
1XB7-700	3x M75x1.5	814	377	306 x 306
1XB7-712 (axial DE)	4x M75x1.5	905	368	371 x 370
1XB7-712 (axial NDE)	4x M75x1.5	905	399	371 x 370
1XB7-712 (radial left)	4x M75x1.5	905	383	371 x 370
1XB7-712 (radial right)	4x M75x1.5	905	383	371 x 370

9.2.5 Additional dimensions

Cooling liquid connections

Hollow shaft

Table 9-23 SH150

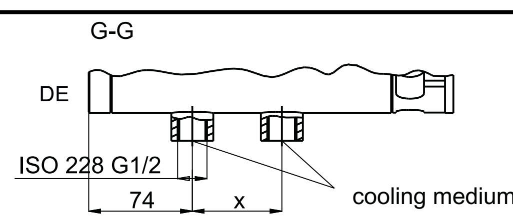
Version	x	Dimension sketch
	mm	
1FW3150	68	
1FW3152	125	
1FW3154	174	
1FW3155	226	
1FW3156	279	

Table 9-24 SH200

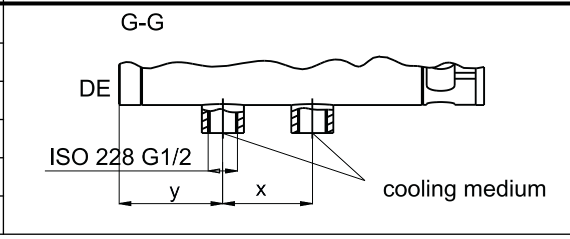
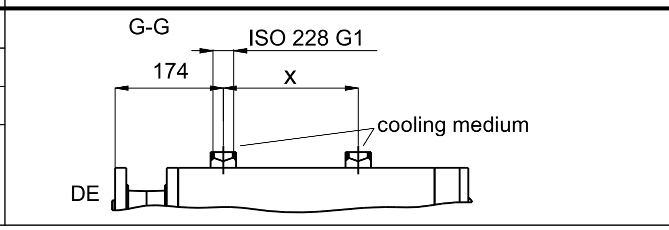
Version	x	y	Dimension sketch
	mm	mm	
1FW3201	48.5	67.5	
1FW3202	94.5	67.5	
1FW3203	137.0	69.5	
1FW3204	206.0	69.5	
1FW3206	298.5	69.5	
1FW3208	413.5	69.5	

Table 9-25 SH280

Version	x	Dimension sketch
	mm	
1FW3281	217.0	
1FW3283	301.5	
1FW3285	427.5	
1FW3287	596.0	

Solid shaft

Table 9-26 SH150

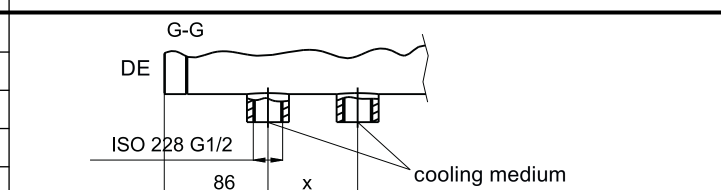
Version	x	Dimension sketch
	mm	
1FW3150	68.0	
1FW3152	97.5	
1FW3154	152.5	
1FW3155	201.0	
1FW3156	255.0	

Table 9-27 SH200

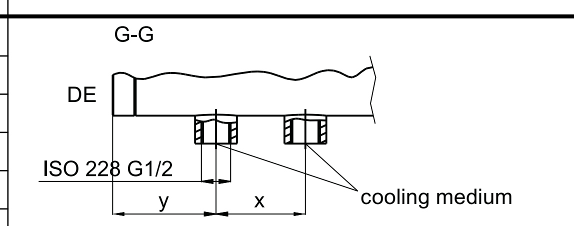
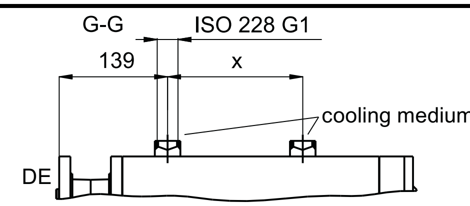
Version	x	y	Dimension sketch
	mm	mm	
1FW3201	48.5	89.5	
1FW3202	94.5	89.5	
1FW3203	137	91.5	
1FW3204	206	91.5	
1FW3206	298.5	91.5	
1FW3208	413.5	91.5	

Table 9-28 SH280

Version	x	Dimension sketch
	mm	
1FW3281	217.0	
1FW3283	301.5	
1FW3285	427.5	
1FW3287	596.0	



Plug-on shaft

Table 9-29 SH150

Version	x	Dimension sketch
	mm	
1FW3150	68	
1FW3152	125	
1FW3154	174	
1FW3155	226	
1FW3156	279	

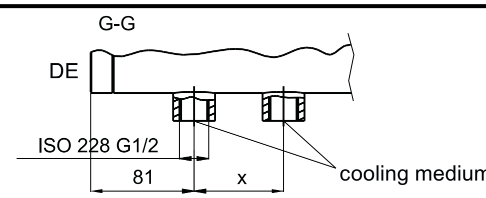


Table 9-30 SH200

Version	x	y	Dimension sketch
	mm	mm	
1FW3201	48.5	79.5	
1FW3202	94.5	79.5	
1FW3203	137	81.5	
1FW3204	206	81.5	
1FW3206	298.5	81.5	
1FW3208	413.5	81.5	

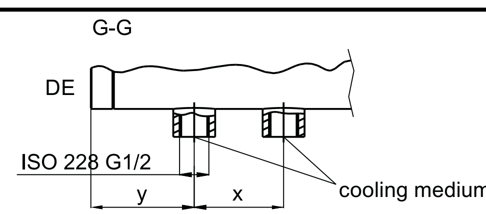
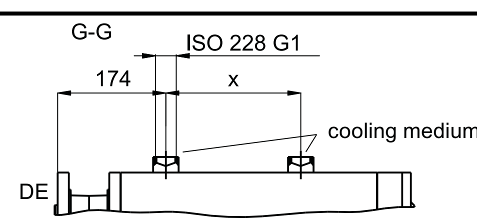


Table 9-31 SH280

Version	x	Dimension sketch
	mm	
1FW3281	217	
1FW3283	301.5	
1FW3285	427.5	
1FW3287	596	



Heavy Duty

Table 9-32 SH200

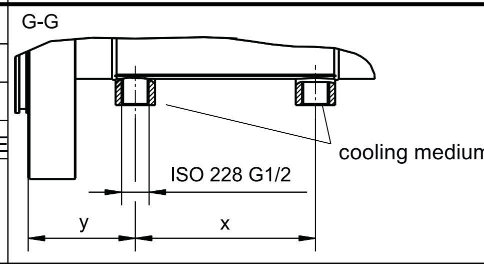
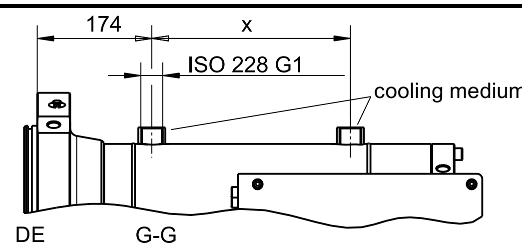
Version	x	y	Dimension sketch
	mm	mm	
1FW3202	94.5	79.5	
1FW3203	137	81.5	
1FW3204	206	81.5	
1FW3206	298.5	81.5	
1FW3208	413.5	81.5	

Table 9-33 SH280

Version	x	Dimension sketch
	mm	
1FW3281	217.0	
1FW3283	301.5	
1FW3285	427.5	
1FW3287	596.0	

Encoder connection

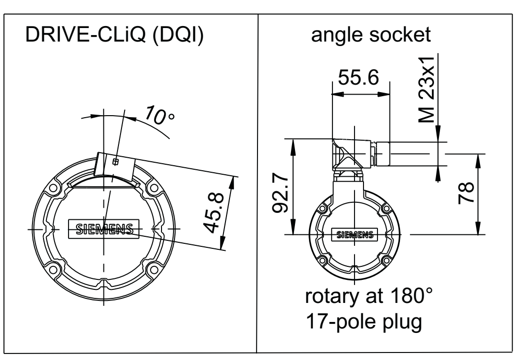


Figure 9-13 Direct encoder mounting

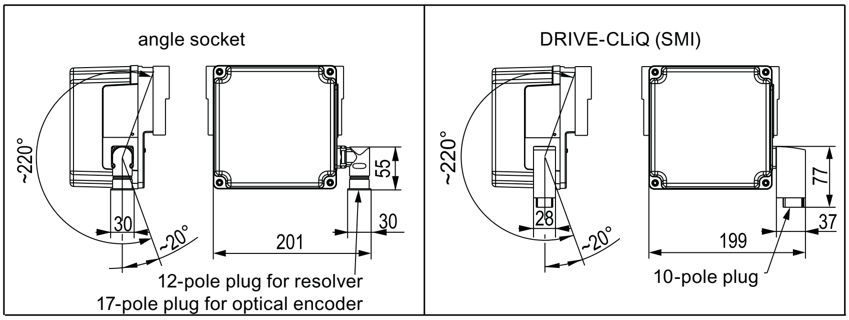
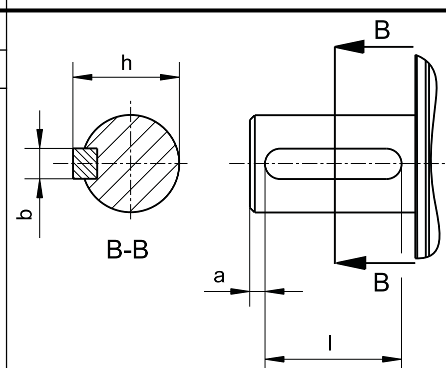


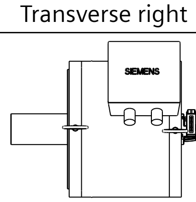
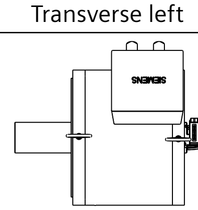
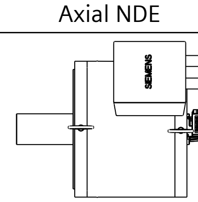
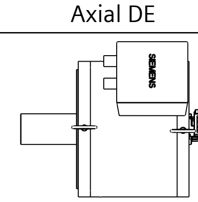
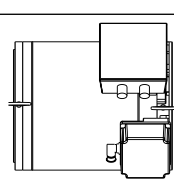
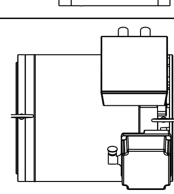
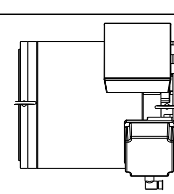
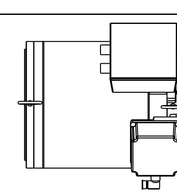
Figure 9-14 Belt-driven encoder

Shaft with feather key

Version	a	l	b	h	Dimension sketch
	mm	mm	mm	mm	
1FW315☐	10	110	18	69	
1FW320☐	10	140	25	95	
1FW328☐	15	180	32	127	

Feather key, tolerance according to DIN 6885-1

Cable outlet direction

Cable outlet direction (13th position in the Article No.)				
	1FW3□□□- □□□□□-**5**□□□	1FW3□□□- □□□□□-**6**□□□	1FW3□□□- □□□□□-**7**□□□	1FW3□□□- □□□□□-**8**□□□
	Transverse right	Transverse left	Axial NDE	Axial DE
For direct encoder mounting				
For belt-driven encoder				

Appendix A

A.1 Description of terms

Rated torque M_N

Thermally permissible continuous torque in S1 duty at the rated motor speed.

Rated speed n_N

The characteristic speed range for the motor is defined in the speed-torque diagram by the rated speed.

Rated current I_N

RMS motor phase current for generating the particular rated torque. Specification of the RMS value of a sinusoidal current.

Braking torque $M_{br\ rms}$

$M_{br\ rms}$ corresponds to the average braking torque for armature short-circuit braking that is achieved through the upstream braking resistor R_{opt}.

Braking resistance R_{opt}

R_{opt} corresponds to the optimum resistance value per phase that is switched in series external to the motor winding for the armature short-circuit braking function.

DE

Drive end

Cyclic inductance L_D

The cyclic inductance is the sum of the air gap inductance and leakage inductance relative to the single-strand equivalent circuit diagram. It consists of the self-inductance of a phase and the coupled inductance to other phases.

Torque constant k_T (value for a 100 K average winding temperature rise)

Quotient obtained from the static torque and static current.

Calculation: $k_T = M_{0,\ 100K} / I_{0,\ 100K}$

Note

This constant is not applicable when configuring the necessary rated and acceleration currents (motor losses!).

The steady-state load and the frictional torques must also be included in the calculation.

Electrical time constant T_{el}

Quotient obtained from the rotating field inductance and winding resistance. $T_{el} = L_D/R_{ph}$

Maximum speed n_{max}

The maximum permissible operating speed n_{max} is the lesser of the maximum mechanically permissible speed and the maximum permissible speed at the converter.

Maximum torque M_{max}

Torque that is generated at the maximum permissible current.

The maximum torque is briefly available for high-speed operations (dynamic response to quickly changing loads).

The maximum torque is limited by the closed-loop control parameters. If the current is increased, then the rotor will be de-magnetized.

Max. current $I_{max, RMS}$

This current limit is only determined by the magnetic circuit. Even if this is briefly exceeded, it can result in an irreversible de-magnetization of the magnetic material. Specification of the RMS value of a sinusoidal current.

Maximum permissible speed (mechanical) $n_{max\ mech.}$

The maximum mechanically permissible speed is $n_{max\ mech}$. It is defined by the centrifugal forces and frictional forces in the bearing.

Maximum permissible speed at converter $n_{max\ Inv}$

The maximum permissible speed during operation on a converter is $n_{max\ Inv}$. This is calculated by means of the voltage induced in the motor and the voltage strength of the converter.

Mechanical time constant T_{mech}

The mechanical time constant is obtained from the tangent at a theoretical ramp-up function through the origin.

$T_{mech} = 3 \cdot R_{ph} \cdot J_{mot}/k_T^2$ in s

J_{mot}	=	Servomotor moment of inertia in kgm^2
R_{ph}	=	Phase resistance of the stator winding in Ω
k_T	=	Torque constant in Nm/A

NDE

Non-drive end

Number of poles 2p

Number of magnetic north and south poles on the rotor. p is the number of pole pairs.

Voltage constant k_E (value at 20° C rotor temperature)

Value of the induced motor voltage at a speed of 1000 r/min and a rotor temperature of 20°C.

The phase-to-phase RMS motor terminal voltage is specified.

SMI

Sensor Module Integrated

Static torque M_0

Thermal limit torque at motor standstill corresponding to a utilization according to 100 K. At n = 0, this can be output for an unlimited length of time. M_0 is always greater than the rated torque M_N.

Static current I_0

Motor phase current for generating the particular static torque. Specification of the RMS value of a sinusoidal current.

Thermal time constant T_{th}

Defines the increase in the motor frame temperature when the motor load is suddenly increased (step function) to the permissible S1 torque. The motor has reached 63% of its final temperature after T_{th}.

Moment of inertia J_{mot}

Moment of inertia of rotating motor parts.

Shaft torsional stiffness c_T

This specifies the shaft torsional stiffness from the center of the rotor laminated core to the center of the shaft end.

Winding resistance R_{ph} at 20°C winding temperature

The resistance of a phase at a winding temperature of 20° C is specified. The winding has a star circuit configuration.

Efficiency η_{opt}

Maximum achievable efficiency along the S1 characteristic or below the S1 characteristic without field weakening current.

A.2 Environmental compatibility

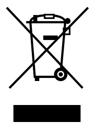
- Environmental aspects during development
  When selecting supplier parts, environmental compatibility was an essential criteria.
  Special emphasis was placed on reducing the envelope dimensions, mass and type variety of metal and plastic parts.
  Effects of paint-wetting impairment substances can be excluded (PWIS test)
- Environmental aspects for disposal
  Motors must be disposed of carefully taking into account domestic and local regulations in the normal recycling process or by returning to the manufacturer.
  The following must be taken into account when disposing of the motor:
  Oil according to the regulations for disposing of old oil (e.g. gear oil when a gearbox is mounted)
  Not mixed with solvents, cold cleaning agents of remains of paint
  Components that are to be recycled should be separated according to:
  - Electronics scrap (e.g. encoder electronics, sensor modules)
  - Iron to be recycled
  - Aluminum
  - Non-ferrous metal (gearwheels, motor windings)

A.2.1 Environmental compatibility during production

- Environmental aspects during production
  Supplier parts and the products are predominantly transported in re-usable packing.
  Transport for hazardous materials is not required.
  The packing materials themselves essentially comprises paperboard containers that are in compliance with the Packaging Directive 94/62/EC.
  Energy consumption during production was optimized.
  Production has low emission levels.

A.2.2 Device disposal

Recycling and disposal



For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

More information

Siemens:
www.siemens.com/simotics

Industry Online Support (service and support):
www.siemens.com/online-support

Industry Mall:
www.siemens.com/industrymall

Siemens AG
Digital Industries
Motion Control
Postfach 31 80
91050 ERLANGEN
Germany

Scan the QR code for additional information about SIMOTICS.