

Planning Guide 05/2003 Edition

simodrive & masterdrive

AC Servomotors

1FK6

SIMODRIVE 611/Masterdrive MC

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SIMODRIVE 611 MASTERDRIVES MC

AC Servomotors 1FK6

Planning Guide

| | |
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SIMODRIVE® Documentation

Printing history

Brief details of this edition and previous editions are listed below.

The status of each edition is shown by the code in the "Remarks" column.

Status code in the "Remarks" column:

- A** New documentation
- B** Unrevised reprint with new Order No.
- C** Revised edition with new status

If factual changes have been made on the page since the last edition, this is indicated by a new edition coding in the header on that page.

| Edition | Order No. for 1FK6 | Remark |
|----------------|---------------------------|---------------|
| 05.03 | 6SN1197-0AD05-0BP0 | A |

This Manual is included in the documentation available on CD-ROM (**DOCONCD**)

| Edition | Order No. | Remark |
|----------------|---------------------|---------------|
| 09.03 | 6FC5 298-7CA00-0BG3 | C |

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Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

We have checked that the contents of this document correspond to the hardware and software described. Nonetheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information contained in this document is reviewed regularly and any necessary changes will be included in the next edition. We welcome suggestions for improvement.

Subject to change without prior notice.

Foreword

Information on SIMODRIVE documentation

This document is part of the Technical Customer Documentation which has been developed for the SIMODRIVE system. All of the documents are available individually. You can obtain the complete list of documentation encompassing all Advertising Brochures, Catalogs, Overviews, Short Descriptions, Operating Instructions and Technical Descriptions with Order No., ordering address and price from your local Siemens office.

For reasons of transparency, this document does not include detailed information about all of the product types. Further, it cannot take into account every conceivable installation, operation or service/maintenance situation.

We would also like to point-out that the contents of this document are neither part of nor modify any prior or existing agreement, commitment or contractual relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein neither create new warranties nor modify the existing warranty.

Structure of the documentation for 1FK and 1FT motors

The complete Planning Guide for 1FK and 1FT motors can be ordered as hard copy.

Table Foreword-1 Planning Guide with General Section and 1FK and 1FT motors

| Title | Order No. (MLFB) | Language |
|------------------------------------|--------------------|----------|
| Drehstrom-Servomotoren 1FK und 1FT | 6SN1197-0AC20-0AP0 | German |
| 1FK and 1FT AC Servomotors | 6SN1197-0AC20-0BP0 | English |

The General Section and the individual motor series are also available separately.

Table Foreword-2 Planning Guide, individual sections

| Title | Order No. (MLFB) | Language |
|------------------------------------|--------------------|----------|
| AC Servomotors, General Section | 6SN1197-0AD07-0AP0 | German |
| AC Servomotors, 1FK7 Motor Section | 6SN1197-0AD06-0AP0 | German |
| AC Servomotors, 1FK6 Motor Section | 6SN1197-0AD05-0AP0 | German |
| AC Servomotors, 1FT6 Motor Section | 6SN1197-0AD02-0AP0 | German |
| AC Servomotors, 1FT5 Motor Section | 6SN1197-0AD01-0AP0 | German |

Hotline

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eMail: adsupport@siemens.com

If you have any questions regarding the documentation (suggestions, corrections), then please send a fax to the following number:

+49 (9131) 98–2176

Fax form: Refer to the feedback sheet at the end of the document

Definition of qualified personnel

For the purpose of this document and warning information on the product itself, "Qualified personnel" are those who are familiar with the installation, mounting, start-up and operation of the equipment and are appropriately qualified and trained for the function which they perform.

- Trained and authorized to energize/de-energize, circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- Trained in rendering first aid.

Explanation of the symbols

The following danger and warning concept is used in this document:



Danger

This symbol is always used if death, severe or substantial property **will** result if proper precautions are not taken.



Warning

This symbol is always used if death, severe or substantial property **can** result if proper precautions are not taken.



Caution

This symbol is always used if minor personal injury or material damage **can** result if proper precautions are not taken.

Caution

The warning note (without a warning triangle) means that material damage **can** occur if proper precautions are not taken.

Notice

This warning note indicates that an undesirable result or an undesirable status **can** occur if the appropriate information is not observed.

Note

In the sense of this document there is a possible advantage/benefit if the note text is observed.

Danger and warning information



Danger

- It is not permissible to commission the equipment until it has been clearly identified that the machine, in which the described components are to be installed, is in full compliance with the specifications in Directive 98/37/EC.
 - Only appropriately qualified personnel may commission SIMODRIVE units and AC motors.
 - This personnel must take into account the technical customer documentation belonging to the product and be knowledgeable and observe the specified information and instructions on the hazards and warnings.
 - When electrical equipment and motors are operated, then the associated electrical circuits are at hazardous voltage levels.
 - When the machine or system is operated, hazardous axis movements can occur.
 - All of the work carried-out in the electrical machine or system must be carried-out with it in a no-voltage condition.
 - SIMODRIVE drive units are designed for operation on low-ohmic, grounded line supplies (TN line supplies).
-



Warning

- The successful and safe operation of this equipment and motors is dependent on proper transport, storage, installation and mounting as well as careful operator control, service and maintenance.
 - For special versions of the drive units and motors, information and data in the catalogs and quotations additionally apply.
 - In addition to the information and instructions on hazards and warnings in the technical customer documentation supplied, the applicable national, local and machine/system-specific regulations and requirements must be carefully taken into consideration.
-



Caution

- The motors can have surface temperatures of over +80° C.
 - This is the reason that it is not permissible that temperature-sensitive parts and components – e.g. cables or electrical components – are in contact with the motor or fastened to the motor.
 - When connecting and routing connecting cables, the following must be carefully observed:
 - they may not be damaged
 - they may not be strained, and
 - they may not be able to be touched by rotating components.
-

Caution

- SIMODRIVE drive units with AC motors are subject to a voltage test, in compliance with EN 50178 as part of a routine test. While the electrical equipment of industrial machines is being subject to a voltage test in compliance with EN 60204-1, Section 19.4, all of the SIMODRIVE equipment connections must be disconnected/withdrawn in order to avoid damaging the SIMODRIVE equipment.
 - Motors should be connected-up according to the circuit diagram supplied. It is not permissible to directly connect the motors to the three-phase line supply. Motors will be destroyed if they are connected directly to the three-phase line supply.
-

Note

- SIMODRIVE equipment with AC motors fulfill, in the operational state and in dry operating areas, the Low-Voltage Directive 73/23/EEC.
 - SIMODRIVE equipment with AC motors fulfill, in the configurations which are specified in the associated AC Declaration of the Conformity, the EMC Directive 89/336/EEC.
-

ESDS information and instructions



Caution

ElectroStatic Discharge Sensitive devices (ESDS) are individual components, integrated circuits or boards which can be damaged by electrostatic fields or electrostatic discharge.

Handling ESDS boards:

- The human body, working area and packaging should be well grounded when handling ESDS components!
 - Electronic components may only be touched by people in ESDS areas with conductive flooring if
 - they are grounded through an ESDS wrist strap
 - they are wearing ESDS shoes or ESDS shoe grounding strips.
 - Electronic boards should only be touched when absolutely necessary.
 - Electronic boards may not come into contact with synthetic materials and clothing manufactured out of man-made fibers.
 - Electronic boards may only be placed down on conductive surfaces (table with ESDS surface, conductive ESDS foam rubber, ESDS packing bag, ESDS transport containers).
 - Electronic boards may not be brought close to data terminals, monitors or television sets (minimum clearance to screen > 10 cm).
 - Measuring work may only be carried out on the electronic boards if
 - the measuring device is grounded (e.g. via the protective conductor) or
 - for floating measuring equipment, the probe is briefly discharged before making measurements (e.g. a bare control housing is touched).
-

1FK6 Table of Contents



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Motor Description

1

1.1 Features

Applications

The 1FK6 series was essentially developed for applications on robots, gantries, loading axes, auxiliary axes, high-bay racking equipment, handling systems, rotary cycle machines, machine tools and woodworking.

The 1FK6 series is also suitable as feed motor for standard requirements.

A reliable drive system is created when 1FK6 motors are used in conjunction with Siemens drive converters.

Features

Depending on the shaft height, the 1FK6 series has standstill torques from 1.1 to 36 Nm at rated speeds from 3000 or 6000 RPM. The motors have a high overload capacity over the complete speed control range.

1.2 Order designation

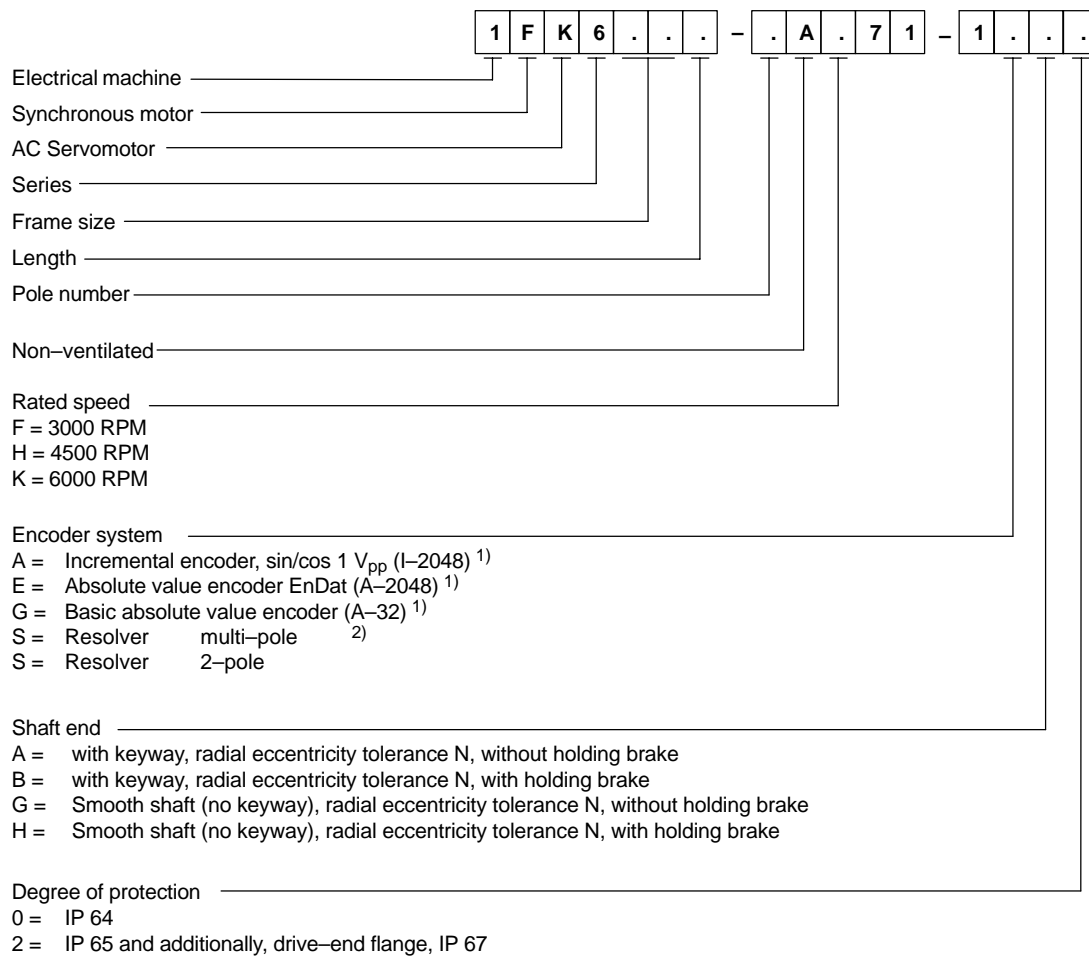
1.2 Order designation

Structure of the order designation

The order designation comprises a combination of digits and letters. It is subdivided into three hyphenated blocks.

The motor is defined in the 1st block. Additional features are described in the 2nd and 3rd blocks.

Explanation of order designation



1) Not for shaft height 36

2) The encoder pole number corresponds to that of the motor

1.3 Technical data, 1FK6 motor

Table 1-1 Features, 1FK6

| Technical features | Version |
|---|---|
| Motor type | Permanent-magnet synchronous motor; AC servomotor |
| Type of construction (acc. to EN 60034-7; IEC 60034-7) | IM B5 (IM V1, IM V3) |
| Degree of protection (acc. to EN 60034-5; IEC 60034-5) | IP 64, (option, refer to 1-2) |
| Cooling (acc. to EN 60034-6; IEC 60034-6) | Non-ventilated |
| Thermal motor protection (acc. to IEC and EN 60034-11) | KTY84 temperature sensor in the stator winding |
| Shaft end (acc. to DIN 748-3; IEC 60072-1) | Cylindrical; without keyway and without key tolerance field k6, (option, refer to Table 1-2) |
| Radial eccentricity, concentricity and axial eccentricity (acc. to DIN 42955; IEC 60072-1) | Tolerance N (normal) |
| Vibration severity (acc. to EN 60034-14; IEC 60034-14) | Stage N (normal) |
| Bearings | Roller bearings with permanent grease lubrication (lubrication over the bearing lifetime) |
| Sound pressure level, max. (acc. to EN 21680) | 1FK603: 55 dB (A) 1FK604: 55 dB (A) 1FK606: 65 dB (A) 1FK608: 70 dB (A) 1FK610: 70 dB (A) |
| Stator winding insulation (acc. to EN 60034-1; IEC 60034-1) | Temperature rise class F for a winding temperature rise of $\Delta T = 100$ K for an ambient temperature of 40 °C. For ambient temperatures > 40 °C, the power must be reduced (de-rated) (refer to the documentation "General Section"). |
| Installation altitude above sea level (acc. to IEC and EN 60034-1) | ≤ 1000 m above sea level, otherwise power de-rating 2000 m factor 0.94 2500 m factor 0.9 (refer to the documentation "General Section") |
| Magnetic materials | Rare earth materials |
| Electrical connection | Connector, which can be rotated for power and encoder signals |
| Speed encoder, integrated | Optical encoder: <ul style="list-style-type: none"> • Incremental encoder, sin/cos 1 V_{pp} (I-2048) • Basic absolute value encoder (A-32) ¹⁾ • Absolute value encoder, (A-2048, not for 1FK6032) ¹⁾ • Resolver, two-pole/multi-pole For more detailed information, refer to Chapter 3.2 |
| Rating plate | A rating plate is supplied loose for each motor |

1) When using an absolute encoder, the rated torque is reduced by 10%
(refer to Table 1-3 Technical data)

1.4 Technical information, options

1.4 Technical information, options

Table 1-2 Options

| Technical features | Version |
|---|---|
| Degree of protection (acc. to EN 60034-5; IEC 60034-5) | IP 65, in addition, IP67 for the drive end flange |
| Integrated/mounted components | <ul style="list-style-type: none"> • Fail-safe holding brake; Supply voltage 24V ± 10% (acc. to DIN 0580 7/79) • Planetary gearbox (prerequisite: smooth shaft – no keyway) |
| Shaft end (acc. to EN and IEC 60034–14) | Cylindrical; with keyway and key; Tolerance field k6 (half key balancing) |
| Paint finish | Anthracite (similar to RAL 7016) –Z option X09 |

1.5 Technical data

100 K values are specified in the table.

Table 1-3 Technical data, 1FK6

| n_N [RPM] | M_0 [Nm] | M_N [Nm] | M_N 4) [Nm] | Motor type 1FK6– | Motor current I_0 3) [A] | Rated drive converter current 3) [A] | Connect or size | Cross- section 1) [mm ²] | Cable type 6FX□002–5) |
|----------------|---------------|---------------|---------------------|---------------------|----------------------------------|--|--------------------|---|--------------------------|
| 6000 | 1.1 | 0.8 | – 6) | 032–6AK71 | 1.7 | 3 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 6000 | 1.6 | 0.8 | 0.72 | 040–6AK71 | 2.8 | 3 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 3.2 | 2.6 | 2.3 | 042–6AF71 | 2.8 | 3 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 6.0 | 4.0 | 3.6 | 060–6AF71 | 4.3 | 5 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 11.0 | 6.0 | 5.4 | 063–6AF71 | 7.9 | 9 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 8.0 | 6.8 | 6.1 | 080–6AF71 | 5.8 | 9 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 16.0 | 10.5 | 9.5 | 083–6AF71 | 10.4 | 18 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 18.0 | 12.0 | 10.8 | 100–6AF71 | 12.2 | 18 | 1 | 4 x 1.5 | 5□A01–1□□0 |
| 3000 | 27.0 | 15.5 | 14.0 | 101–6AF71 | 17.5 | 18 | 1.5 | 4 x 2.5 | 5□A31–1□□0 |
| 3000 | 36.0 | 16.5 | 14.9 | 103–6AF71 | 23.5 | 28 | 1.5 | 4 x 4 | 5□A41–1□□0 |

without brake cable: without overall shield
with overall shield
with brake cable: without overall shield
with overall shield

| | | |
|---|------|----|
| A | 5 m | AF |
| C | 10 m | BA |
| B | 15 m | BF |
| D | 18 m | BJ |
| | 25 m | CF |

Lengths 2)
(examples)

Cables are not included with the motors –
they must be separately ordered.

- 1) Dimensioned for I_{rms} (100 K); ambient temperature 40 °C; PVC-insulated cable; brake connection 2 x 1.5 mm²
- 2) Cables are supplied by the meter; length code, refer to documentation "General Section"
- 3) The specified values are RMS values
- 4) With absolute value encoder (due to the max. encoder temperature)
- 5) 8 = MOTION-CONNECT 800, 5 = MOTION-CONNECT 500; Technical data, refer to Catalog NC Z
- 6) It is not possible to mount/install absolute value encoders

1.6 Armature short-circuit braking

1.6 Armature short-circuit braking

The function description of the armature short-circuit braking is described in the documentation "General Section".

Dimensioning the braking resistors for optimum short-circuit braking

An optimum braking time is achieved by dimensioning the braking resistors. The braking torques which are obtained are listed in the following table. The data applies for braking from the rated speed. If a drive is braked from another speed, then the braking time **cannot** be linearly calculated. However, longer braking times cannot occur.

The resistor rating must be coordinated with the particular I^2t load capacity, refer to the documentation "General Section".

Table 1-4 Resistor braking for 1FK6

| Motor type | External brake resistor R_{opt} [Ω] | Average braking torque $M_{br rms}$ [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 |
| 1FK6032-6AK71 | 6.6 | 1.6 | 1.8 | 2.3 | 6.1 | 5.6 |
| 1FK6040-6AK71 | 3.8 | 2.0 | 2.5 | 3.1 | 9.6 | 8.8 |
| 1FK6042-6AF71 | 2.7 | 4.8 | 5.2 | 6.5 | 9.9 | 9.3 |
| 1FK6060-6AF71 | 3.6 | 6.5 | 8.0 | 9.9 | 12.7 | 11.6 |
| 1FK6063-6AF71 | 2.2 | 10.8 | 15.9 | 19.8 | 26.0 | 23.3 |
| 1FK6080-6AF71 | 3.4 | 7.1 | 10.4 | 12.9 | 16.7 | 15.1 |
| 1FK6083-6AF71 | 2.3 | 11.8 | 21.2 | 26.0 | 31.0 | 28.0 |
| 1FK6100-8AF71 | 1.8 | 14.1 | 25.0 | 31.0 | 38.0 | 35.0 |
| 1FK6101-8AF71 | 1.3 | 18.7 | 38.0 | 47.0 | 56.0 | 50.0 |
| 1FK6103-8AF71 | 1.0 | 23.3 | 52.0 | 65.0 | 77.0 | 69.0 |

1.7 Electrical connections



Warning

The motors are not designed to be connected directly to the line supply.

Connection assignment, power connector and signal connector at the motor

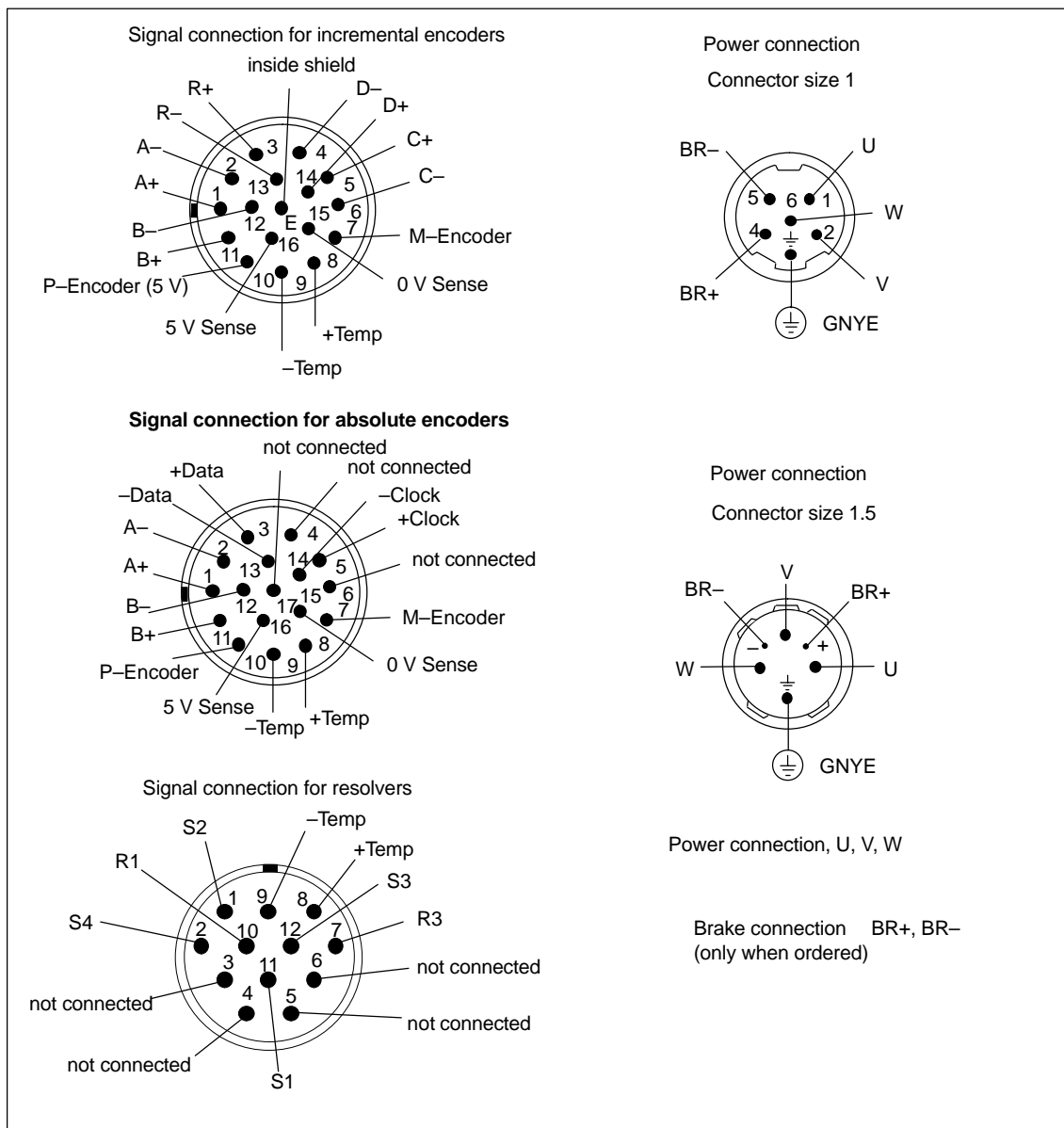


Fig. 1-1 Connection assignment: Power, brake, encoder and temperature sensor

1.7 Electrical connections

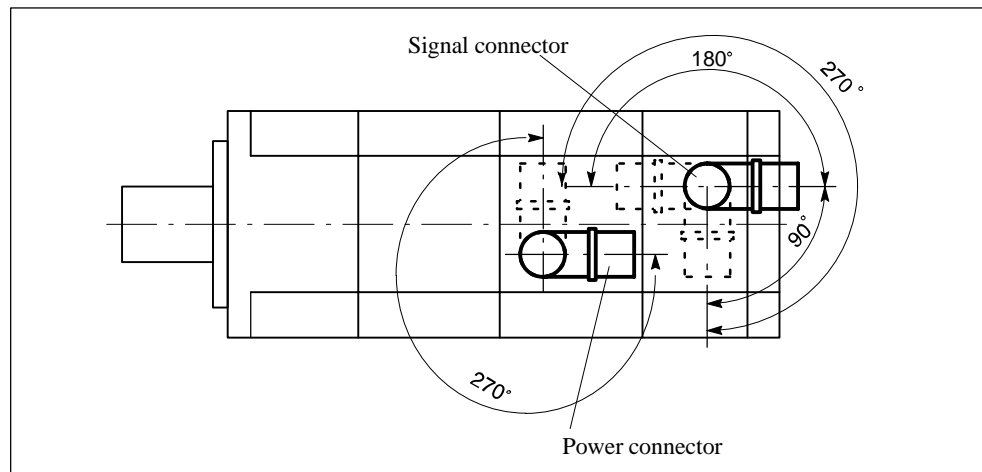
Power and signal connectors can be rotated

Fig. 1-2 Connectors can be rotated

- **Direction of rotation:**

- When supplied: Power and signal connector, NDE
- Power connector: 270°, clockwise
- Signal connector: Shaft heights 36 to 80: 180°, counter-clockwise
90°, clockwise
Shaft height 100: 90°, counter-clockwise
90°, clockwise

- **Torques when rotating:**

- Power connector: Size 1: $M_{\max} = 8 \text{ Nm}$
Size 1.5: $M_{\max} = 15 \text{ Nm}$
- Signal connector: $M_{\max} = 8 \text{ Nm}$

Connectors should be rotated using the matching mating connector located on the connector thread.

Note

- It is not permissible that the specified rotation range is exceeded.
- In order to guarantee the degree of protection, max. 10 revolutions are permissible.
- Do not exceed max. torques when rotating.
- Connecting cables must be secured against tension and bending.
- The motor connectors must then be secured so that they cannot rotate.
- It is not permissible to subject the connector to continuous force.

1.8 Drive-out coupling

For the ordering address, refer to the documentation "General Section" or the Internet www.ktr.com

Table 1-5 Assignment of the drive-out couplings to the motors

| Shaft height | Rotex GS Type | Torques which can be transferred with an 80 or 92 Sh-A-GS pinion | |
|--------------|---------------|--|------------------------|
| | | T _{KN} [Nm] | T _{Kmax} [Nm] |
| 36 | 14 | 7.5 | 15 |
| 48 | 19/24 | 10 | 20 |
| 63 | 24/28 | 35 | 70 |
| 80 | 28/38 | 95 | 190 |
| 100 | 38/45 | 190 | 380 |

It may be necessary to use other pinions (e.g. Shore hardness 80 SH-A). This must be optimally harmonized together with the mounted mechanical system.



Warning

The accelerating torque may not exceed the clamping torque of the coupling!

Notice

Under no circumstances can we guarantee the quality and correctness of third-party products. Please carefully observe the detailed text in the Foreword.



Note

- DC link voltages > 600 V occur when the motors are fed from drive converters connected to 480 V line supplies. The following restrictions apply:
 - Shaft heights 36, 48, 63 and 80 may only be utilized to $\Delta T = 60$ K.
 - Shaft height 100 may still be utilized to $\Delta T = 100$ K
 - For a description of the shift of the voltage limiting characteristics, refer to the documentation "General Section".
 - The specified thermal S3 limiting characteristics are referred to $\Delta T = 100$ K for a 1 min. duty cycle.
-

2.1 Speed–torque diagrams

2.1 Speed–torque diagrams

Table 2-1 1FK6032 Standard

| 1FK6032 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | –6AK71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 6000 | |
| Pole number | $2p$ | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 0.8 | |
| Rated current | I_N | A | 1.5 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 0.9 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 1.1 | |
| Standstill current (60K) | I_0 (60 K) | A | 1.4 | |
| Standstill current (100K) | I_0 (100 K) | A | 1.7 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 0.75 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 0.68 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 6000 | |
| Optimum power | P_{opt} | kW | 0.5 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 12000 | |
| Maximum torque | M_{max} | Nm | 4.5 | |
| Max. current | I_{max} | A | 7.3 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 0.67 | |
| Voltage constant | k_E | V/1000 RPM | 44 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 5.7 | |
| Rotating field inductance | L_D | mH | 13 | |
| Electrical time constant | T_{el} | ms | 2.3 | |
| Shaft torsional stiffness | c_t | Nm/rad | 6270 | |
| Mechanical time constant | T_{mech} | ms | 2.6 | |
| Thermal time constant | T_{th} | min | 25 | |
| Weight (with brake) | m | kg | 3.0 | |
| Weight (without brake) | m | kg | 2.9 | |

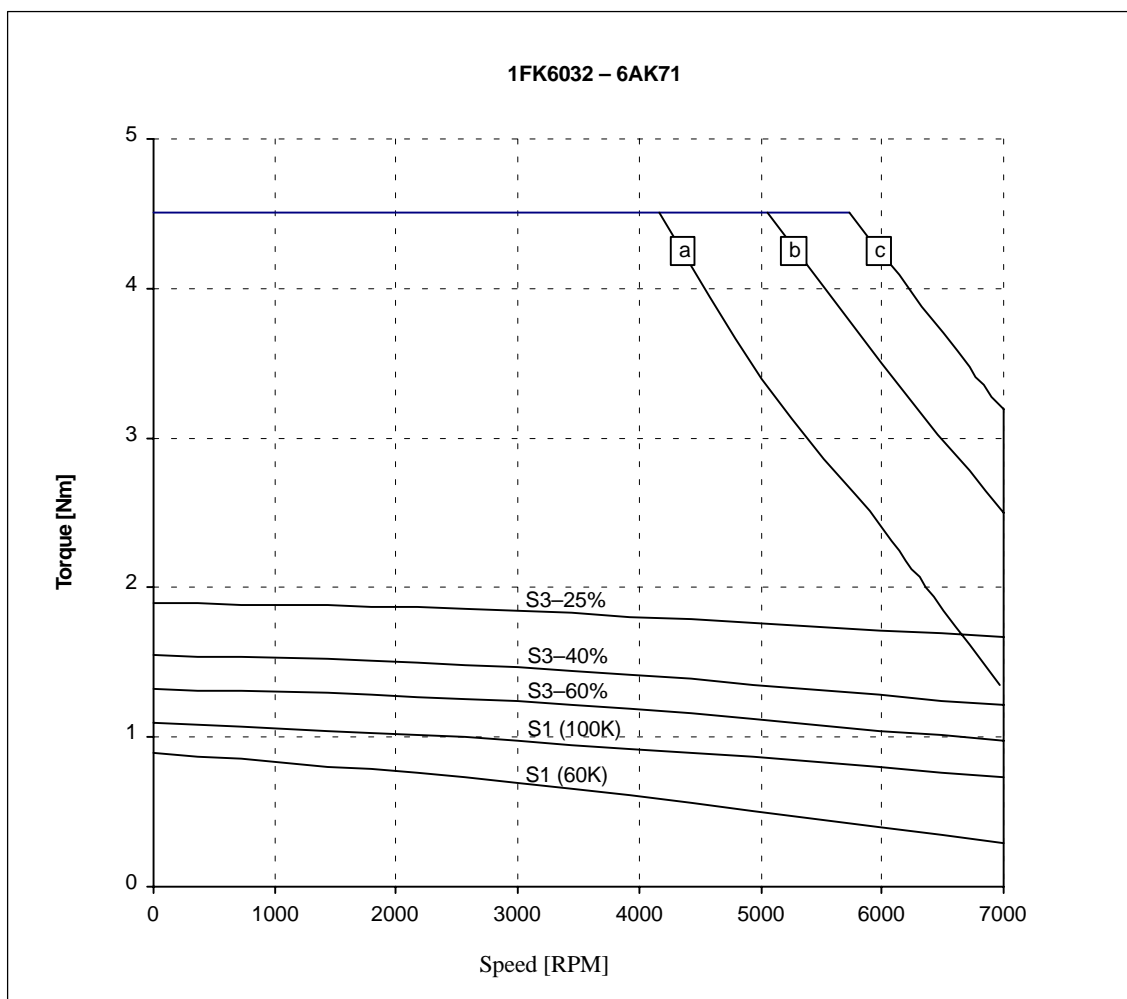


Fig. 2-1 Speed–torque diagram 1FK6032 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V\ (DC)$, $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V\ (DC)$ and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V\ (DC)$,
 $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V\ (DC)$, $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-2 1FK6040 Standard

| 1FK6040 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AK71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 6000 | |
| Pole number | 2p | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 0.8 | |
| Rated current | I_N | A | 1.75 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 1.3 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 1.6 | |
| Standstill current (60K) | I_0 (60 K) | A | 2.2 | |
| Standstill current (100K) | I_0 (100 K) | A | 2.8 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 2.10 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 1.84 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 6000 | |
| Optimum power | P_{opt} | kW | 0.5 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 8500 | |
| Maximum torque | M_{max} | Nm | 5.1 | |
| Max. current | I_{max} | A | 9.0 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 0.57 | |
| Voltage constant | k_E | V/1000 RPM | 37.5 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 2.75 | |
| Rotating field inductance | L_D | mH | 7.0 | |
| Electrical time constant | T_{el} | ms | 2.5 | |
| Shaft torsional stiffness | c_t | Nm/rad | 18100 | |
| Mechanical time constant | T_{mech} | ms | 4.7 | |
| Thermal time constant | T_{th} | min | 25 | |
| Weight (with brake) | m | kg | 4.1 | |
| Weight (without brake) | m | kg | 3.7 | |

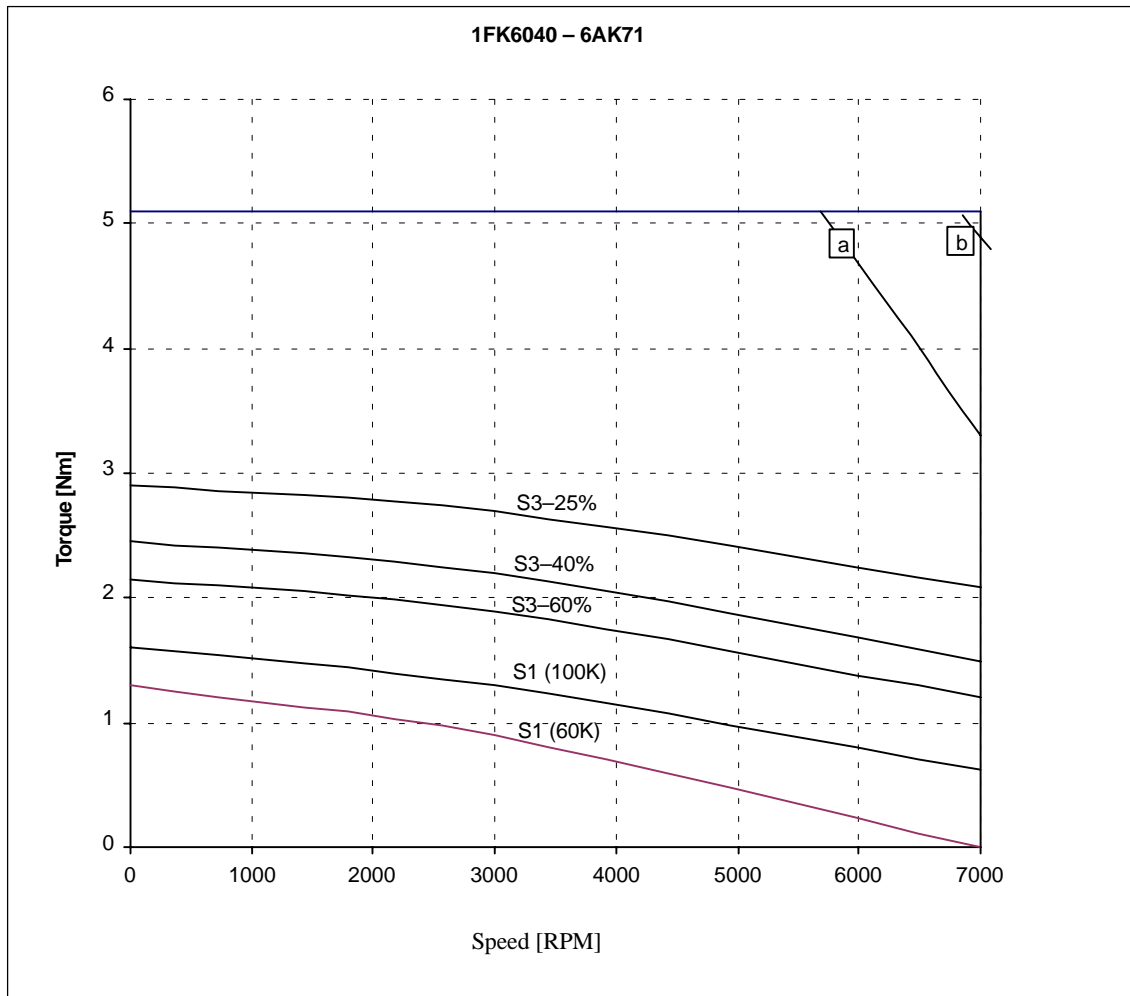


Fig. 2-2 Speed–torque diagram 1FK6040 Standard

- [a] MASTERDRIVES MC, $V_{DC \text{ link}}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC \text{ link}}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-3 1FK6042 Standard

| 1FK6042 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | 2p | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 2.6 | |
| Rated current | I_N | A | 2.4 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 2.65 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 3.2 | |
| Standstill current (60K) | I_0 (60 K) | A | 2.2 | |
| Standstill current (100K) | I_0 (100 K) | A | 2.8 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 3.52 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 3.30 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 0.82 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 8500 | |
| Maximum torque | M_{max} | Nm | 10.6 | |
| Max. current | I_{max} | A | 9.5 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.15 | |
| Voltage constant | k_E | V/1000 RPM | 76 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 3.65 | |
| Rotating field inductance | L_D | mH | 13.5 | |
| Electrical time constant | T_{el} | ms | 3.7 | |
| Shaft torsional stiffness | c_t | Nm/rad | 14700 | |
| Mechanical time constant | T_{mech} | ms | 2.7 | |
| Thermal time constant | T_{th} | min | 35 | |
| Weight (with brake) | m | kg | 5.4 | |
| Weight (without brake) | m | kg | 5.0 | |

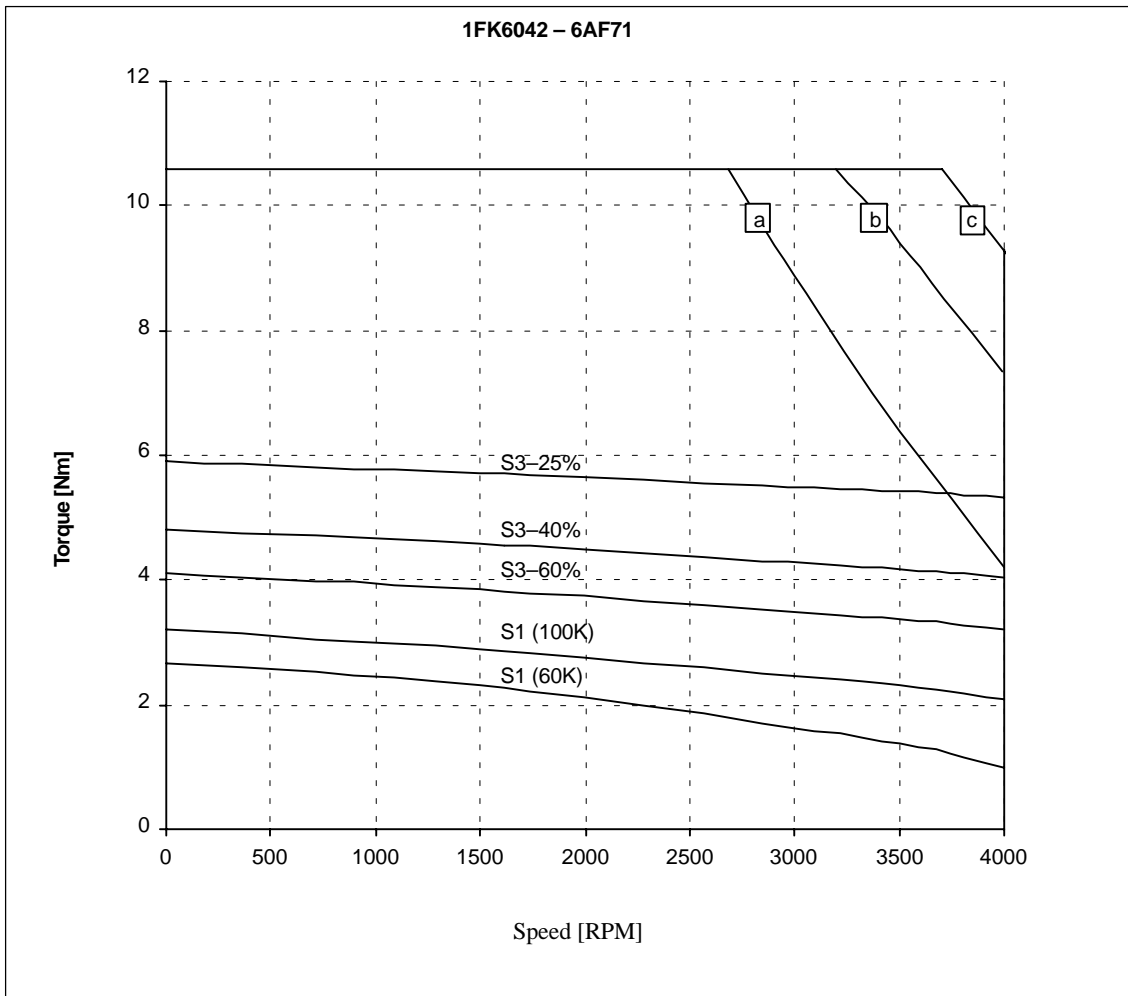


Fig. 2-3 Speed–torque diagram 1FK6042 Standard

- [a] MASTERDRIVES MC, $V_{DC \text{ link}}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC \text{ link}}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC \text{ link}}=600V$ (DC),
 $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-4 1FK6060 Standard

| 1FK6060 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | 2p | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 4.0 | |
| Rated current | I_N | A | 3.1 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 5.0 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 6.0 | |
| Standstill current (60K) | I_0 (60 K) | A | 3.5 | |
| Standstill current (100K) | I_0 (100 K) | A | 4.3 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 9.50 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 8.60 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 1.26 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 6600 | |
| Maximum torque | M_{max} | Nm | 17.7 | |
| Max. current | I_{max} | A | 14 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.39 | |
| Voltage constant | k_E | V/1000 RPM | 92 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 2.5 | |
| Rotating field inductance | L_D | mH | 13.0 | |
| Electrical time constant | T_{el} | ms | 5.2 | |
| Shaft torsional stiffness | c_t | Nm/rad | 39600 | |
| Mechanical time constant | T_{mech} | ms | 3.3 | |
| Thermal time constant | T_{th} | min | 30 | |
| Weight (with brake) | m | kg | 9.6 | |
| Weight (without brake) | m | kg | 9.0 | |

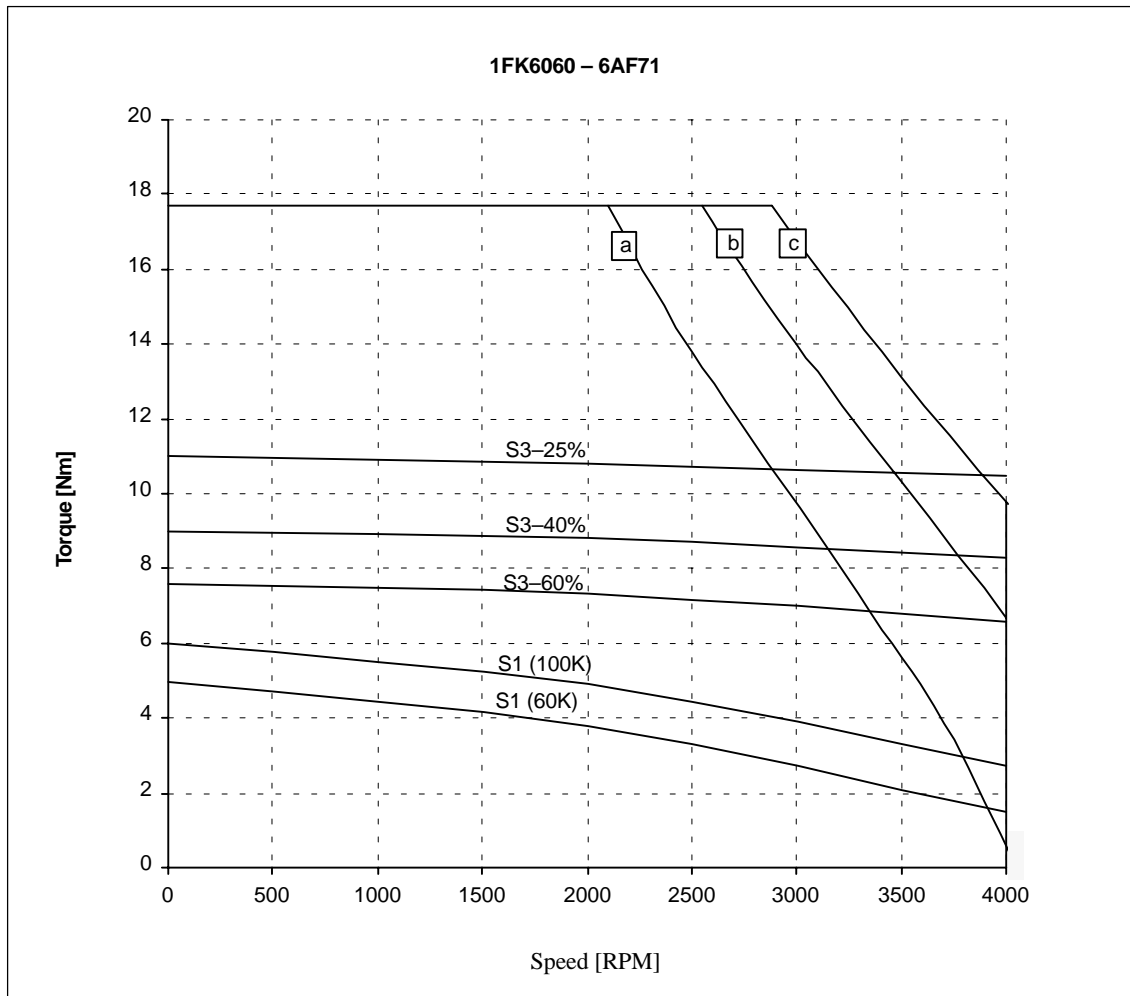


Fig. 2-4 Speed–torque diagram 1FK6060 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V\ (DC)$, $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V\ (DC)$ and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V\ (DC)$,
 $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V\ (DC)$, $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-5 1FK6063 Standard

| 1FK6063 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | 2p | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 6.0 | |
| Rated current | I_N | A | 4.7 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 9.1 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 11.0 | |
| Standstill current (60K) | I_0 (60 K) | A | 6.3 | |
| Standstill current (100K) | I_0 (100 K) | A | 7.9 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 17.0 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 16.1 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 1.89 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 6600 | |
| Maximum torque | M_{max} | Nm | 36 | |
| Max. current | I_{max} | A | 28 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.39 | |
| Voltage constant | k_E | V/1000 RPM | 92 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 0.83 | |
| Rotating field inductance | L_D | mH | 6.5 | |
| Electrical time constant | T_{el} | ms | 7.8 | |
| Shaft torsional stiffness | c_t | Nm/rad | 32900 | |
| Mechanical time constant | T_{mech} | ms | 2.1 | |
| Thermal time constant | T_{th} | min | 35 | |
| Weight (with brake) | m | kg | 13.8 | |
| Weight (without brake) | m | kg | 13.2 | |

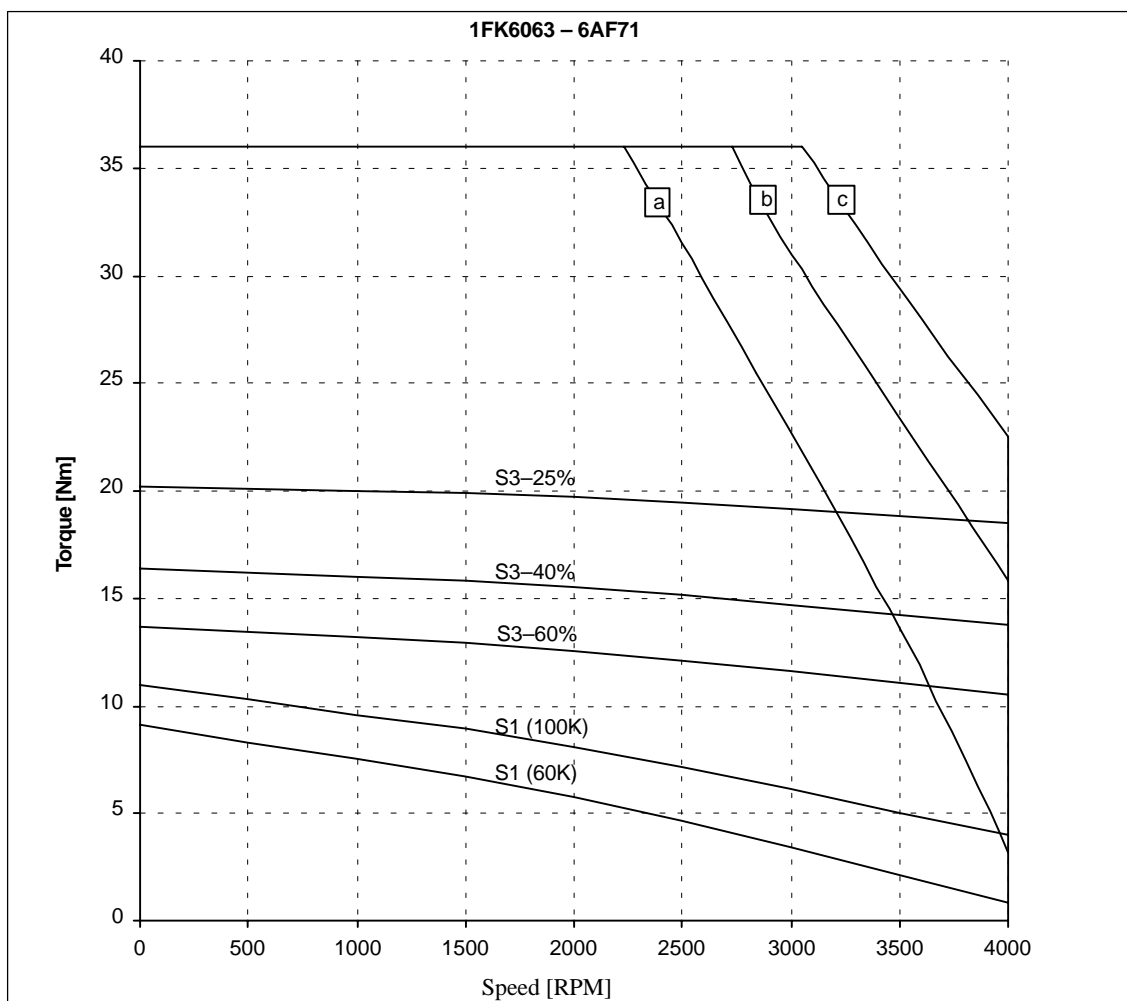


Fig. 2-5 Speed–torque diagram 1FK6063 Standard

- [a] MASTERDRIVES MC, $V_{DC \text{ link}}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC \text{ link}}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-6 1FK6080 Standard

| 1FK6080 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | $2p$ | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 6.8 | |
| Rated current | I_N | A | 5.2 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 6.6 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 8.0 | |
| Standstill current (60K) | I_0 (60 K) | A | 4.6 | |
| Standstill current (100K) | I_0 (100 K) | A | 5.8 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 18.0 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 15.0 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 2.14 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 5600 | |
| Maximum torque | M_{max} | Nm | 25 | |
| Max. current | I_{max} | A | 19 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.39 | |
| Voltage constant | k_E | V/1000 RPM | 92 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 1.3 | |
| Rotating field inductance | L_D | mH | 10 | |
| Electrical time constant | T_{el} | ms | 7.7 | |
| Shaft torsional stiffness | c_t | Nm/rad | 119000 | |
| Mechanical time constant | T_{mech} | ms | 3.0 | |
| Thermal time constant | T_{th} | min | 30 | |
| Weight (with brake) | m | kg | 13.7 | |
| Weight (without brake) | m | kg | 12.5 | |

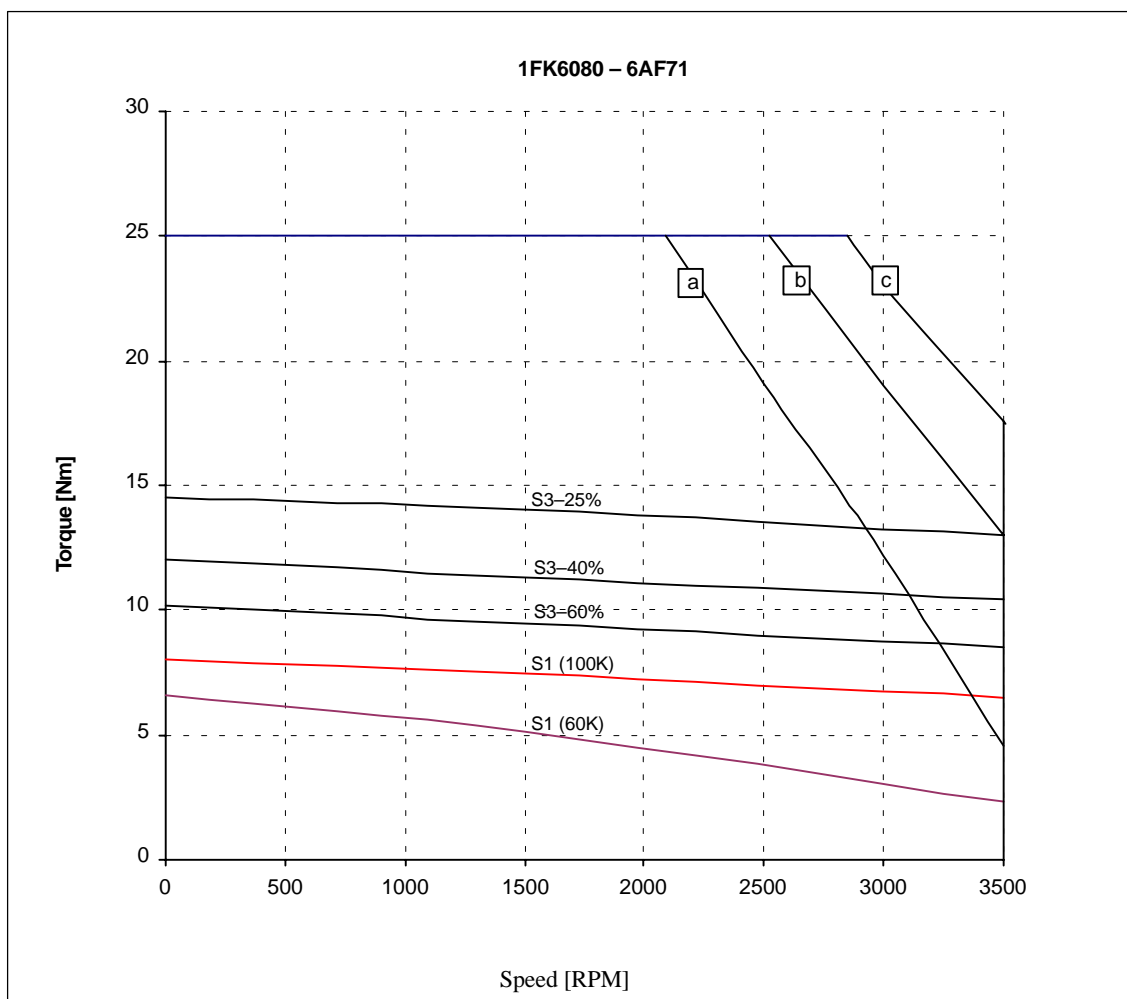


Fig. 2-6 Speed–torque diagram 1FK6080 Standard

- [a] MASTERDRIVES MC, $V_{DC \text{ link}}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC \text{ link}}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC \text{ link}}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-7 1FK6083 Standard

| 1FK6083 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -6AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | 2p | | 6 | |
| Rated torque (100K) | M_N (100 K) | Nm | 10.5 | |
| Rated current | I_N | A | 7.7 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 13.3 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 16 | |
| Standstill current (60K) | I_0 (60 K) | A | 8.3 | |
| Standstill current (100K) | I_0 (100 K) | A | 10.4 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 30.3 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 27.3 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 3.3 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 5600 | |
| Maximum torque | M_{max} | Nm | 50 | |
| Max. current | I_{max} | A | 36 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.54 | |
| Voltage constant | k_E | V/1000 RPM | 102 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 0.54 | |
| Rotating field inductance | L_D | mH | 6.0 | |
| Electrical time constant | T_{el} | ms | 11.1 | |
| Shaft torsional stiffness | c_t | Nm/rad | 100000 | |
| Mechanical time constant | T_{mech} | ms | 1.9 | |
| Thermal time constant | T_{th} | min | 35 | |
| Weight (with brake) | m | kg | 18.2 | |
| Weight (without brake) | m | kg | 17.0 | |

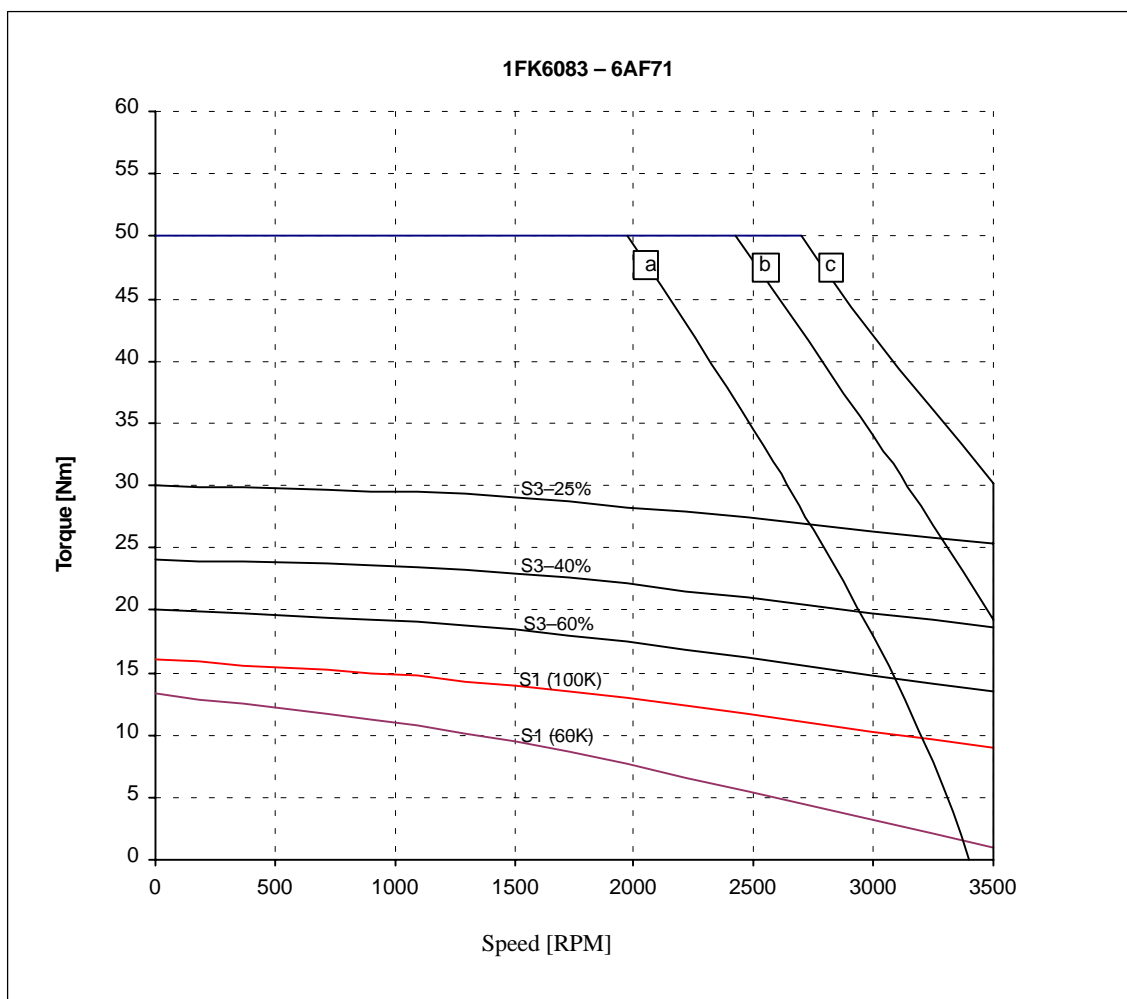


Fig. 2-7 Speed–torque diagram 1FK6083 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V$ (DC), $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-8 1FK6100 Standard

| 1FK6100 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -8AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | $2p$ | | 8 | |
| Rated torque (100K) | M_N (100 K) | Nm | 12.0 | |
| Rated current | I_N | A | 8.4 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 15 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 18 | |
| Standstill current (60K) | I_0 (60 K) | A | 9.8 | |
| Standstill current (100K) | I_0 (100 K) | A | 12.2 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 63.2 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 55.3 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 3.77 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 4300 | |
| Maximum torque | M_{max} | Nm | 55 | |
| Max. current | I_{max} | A | 42 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.48 | |
| Voltage constant | k_E | V/1000 RPM | 98 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 0.42 | |
| Rotating field inductance | L_D | mH | 3.5 | |
| Electrical time constant | T_{el} | ms | 8.3 | |
| Shaft torsional stiffness | c_t | Nm/rad | 176000 | |
| Mechanical time constant | T_{mech} | ms | 3.2 | |
| Thermal time constant | T_{th} | min | 35 | |
| Weight (with brake) | m | kg | 22.5 | |
| Weight (without brake) | m | kg | 21.0 | |

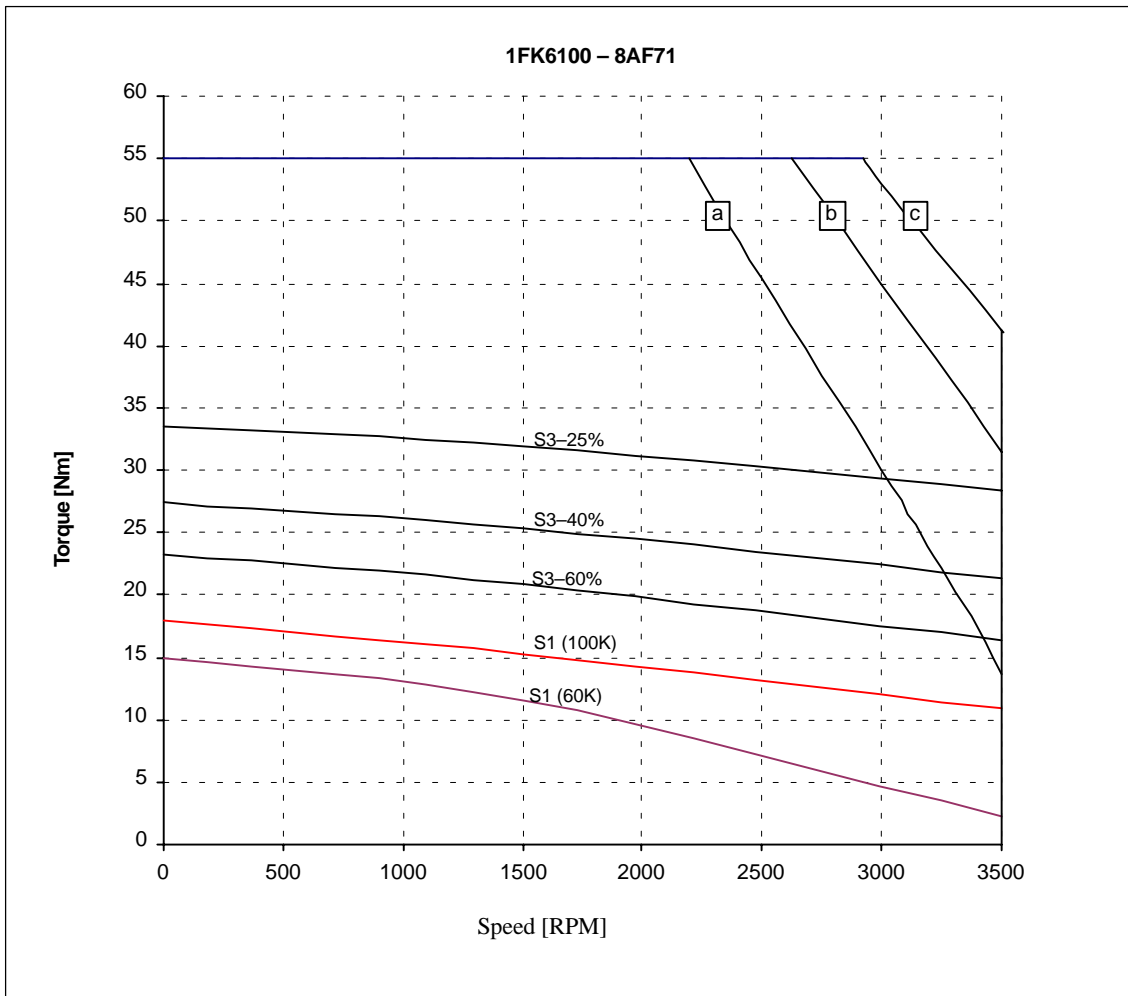


Fig. 2-8 Speed–torque diagram 1FK6100 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V\ (DC)$, $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V\ (DC)$ and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V\ (DC)$,
 $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V\ (DC)$, $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-9 1FK6101 Standard

| 1FK6101 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -8AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | $2p$ | | 8 | |
| Rated torque (100K) | M_N (100 K) | Nm | 15.5 | |
| Rated current | I_N | A | 10.8 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 22.4 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 27.0 | |
| Standstill current (60K) | I_0 (60 K) | A | 14.0 | |
| Standstill current (100K) | I_0 (100 K) | A | 17.5 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 92.8 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 79.9 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 4.87 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 4300 | |
| Maximum torque | M_{max} | Nm | 80 | |
| Max. current | I_{max} | A | 58 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.54 | |
| Voltage constant | k_E | V/1000 RPM | 102 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 0.24 | |
| Rotating field inductance | L_D | mH | 2.5 | |
| Electrical time constant | T_{el} | ms | 10.4 | |
| Shaft torsional stiffness | c_t | Nm/rad | 159000 | |
| Mechanical time constant | T_{mech} | ms | 2.4 | |
| Thermal time constant | T_{th} | min | 40 | |
| Weight (with brake) | m | kg | 28 | |
| Weight (without brake) | m | kg | 26 | |

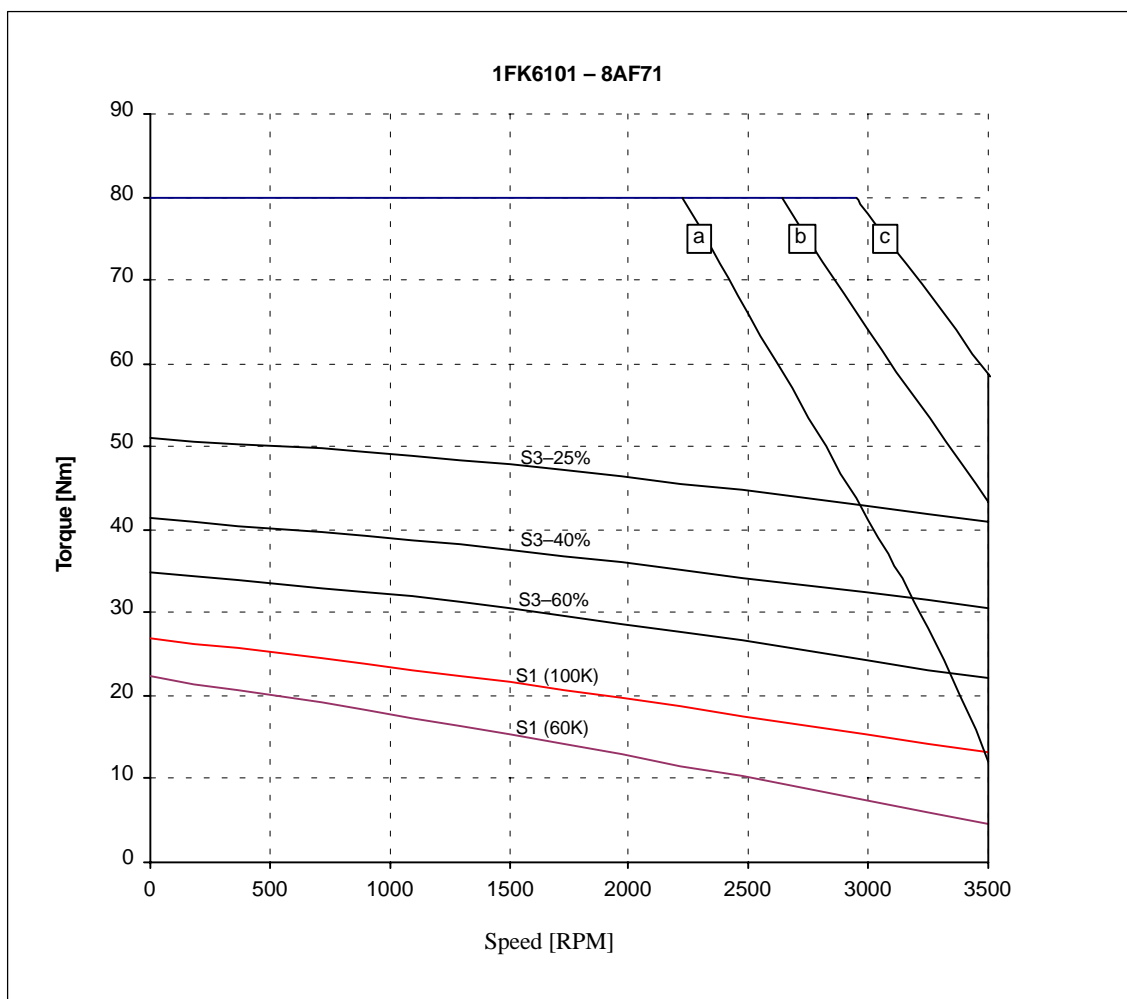


Fig. 2-9 Speed–torque diagram 1FK6101 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V$ (DC), $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V$ (DC) and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V$ (DC), $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V$ (DC), $V_{mot}=425V_{rms}$

2.1 Speed–torque diagrams

Table 2-10 1FK6103 Standard

| 1FK6103 | | | | |
|-----------------------------------|---------------|----------------------------|--------|--|
| Technical data | Code | Units | -8AF71 | |
| Engineering data | | | | |
| Rated speed | n_N | RPM | 3000 | |
| Pole number | $2p$ | | 8 | |
| Rated torque (100K) | M_N (100 K) | Nm | 16.5 | |
| Rated current | I_N | A | 11.8 | |
| Standstill torque (60K) | M_0 (60 K) | Nm | 30 | |
| Standstill torque (100K) | M_0 (100 K) | Nm | 36.0 | |
| Standstill current (60K) | I_0 (60 K) | A | 18.9 | |
| Standstill current (100K) | I_0 (100 K) | A | 23.5 | |
| Moment of inertia (with brake) | J_{mot} | 10^{-4} kgm ² | 118 | |
| Moment of inertia (without brake) | J_{mot} | 10^{-4} kgm ² | 105 | |
| Optimum operating point | | | | |
| Optimum speed | n_{opt} | RPM | 3000 | |
| Optimum power | P_{opt} | kW | 5.18 | |
| Limiting data | | | | |
| Max. permissible speed (mech.) | n_{max} | RPM | 4300 | |
| Maximum torque | M_{max} | Nm | 107 | |
| Max. current | I_{max} | A | 78 | |
| Physical constants | | | | |
| Torque constant | k_T | Nm/A | 1.53 | |
| Voltage constant | k_E | V/1000 RPM | 101 | |
| Winding resistance at 20°C | $R_{ph.}$ | Ohm | 0.15 | |
| Rotating field inductance | L_D | mH | 1.8 | |
| Electrical time constant | T_{el} | ms | 12.0 | |
| Shaft torsional stiffness | c_t | Nm/rad | 144000 | |
| Mechanical time constant | T_{mech} | ms | 2.0 | |
| Thermal time constant | T_{th} | min | 45 | |
| Weight (with brake) | m | kg | 32 | |
| Weight (without brake) | m | kg | 30 | |

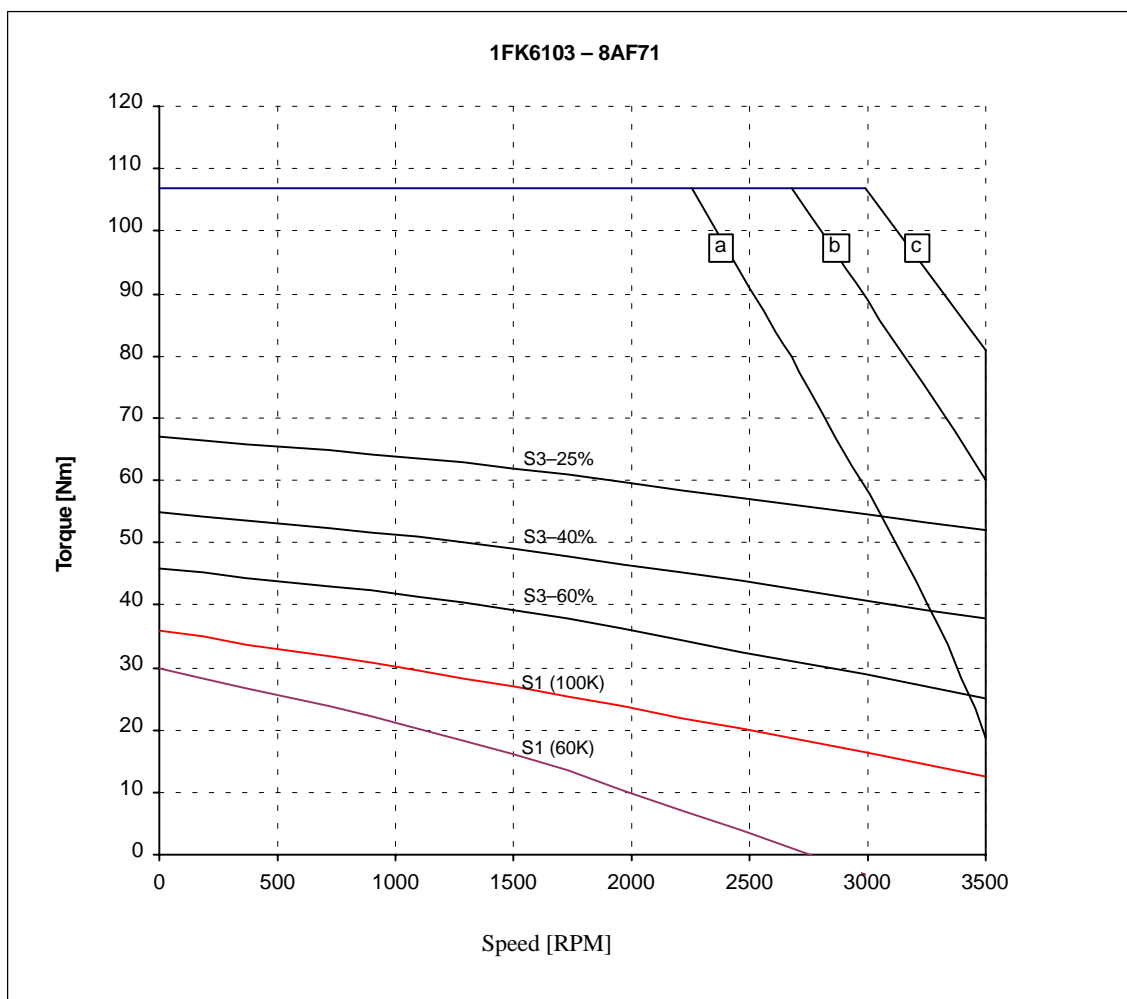


Fig. 2-10 Speed–torque diagram 1FK6103 Standard

- [a] MASTERDRIVES MC, $V_{DC\ link}=540V\ (DC)$, $V_{mot}=340V_{rms}$
 [b] SIMODRIVE 611 (UI), $V_{DC\ link}=540V\ (DC)$ and MASTERDRIVES MC (AFE), $V_{DC\ link}=600V\ (DC)$,
 $V_{mot}=380V_{rms}$
 [c] SIMODRIVE 611 (IR), $V_{DC\ link}=600V\ (DC)$, $V_{mot}=425V_{rms}$

2.2 Cantilever force diagrams

Cantilever force stressing

Point of application of cantilever forces F_Q at the shaft end

- for average operating speeds
- for a nominal bearing lifetime of 20 000 h

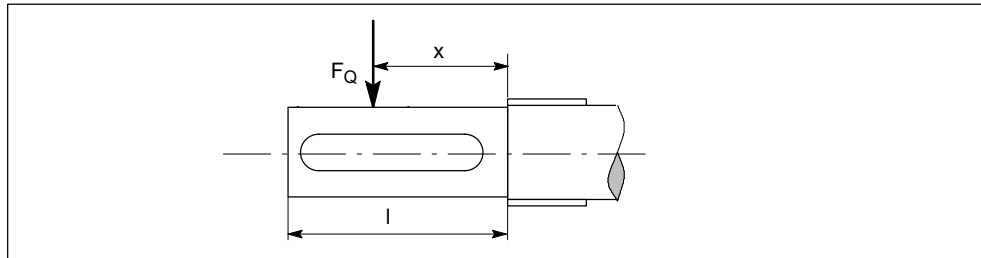


Fig. 2-11 Force application point at the DE shaft end

Dimension x : Distance between the point of application of force F_Q and the shaft shoulder in mm.

Dimension l : Length of the shaft end in mm.

Calculating the pre-tensioned belt force

$$F_R = 2 * M_0 * c/d_R$$

| | |
|------------|--|
| F_R [N] | Pre-tensioned belt force |
| M_0 [Nm] | Motor standstill torque |
| d_R | Effective diameter of the belt pulley |
| c | Pre-tension factor for the accelerating torque |
| | Experience values for toothed belts $c = 1.5$ to 2.2 |
| | Experience values for flat belts $c = 2.2$ to 3.0 |

When using other configurations, the actual forces, generated from the torque being transferred, must be taken into account.

$$F_R \leq F_{Qper}$$

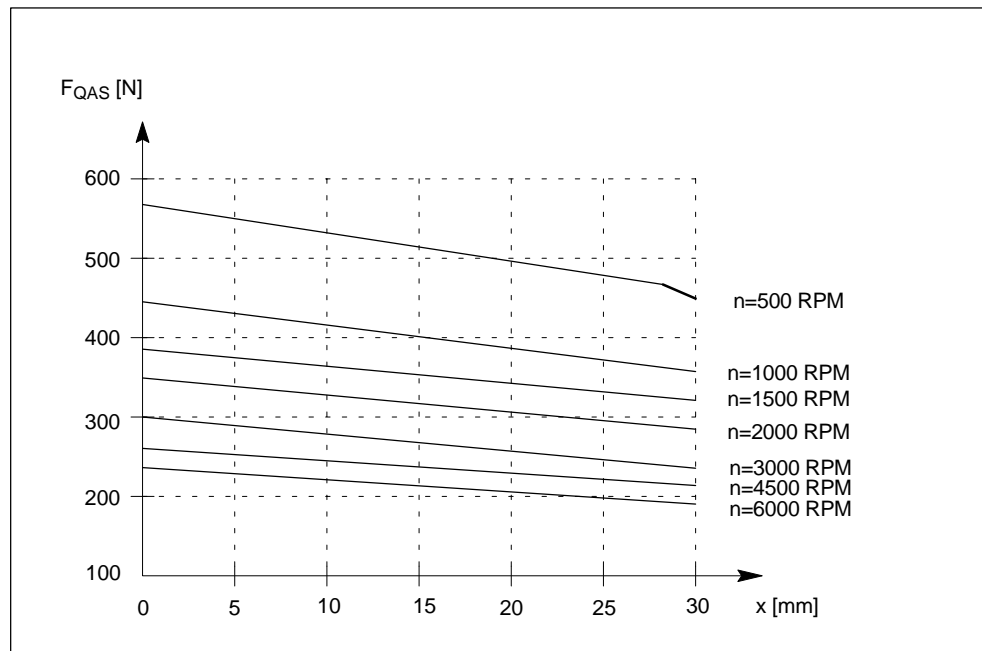
Cantilever force 1FK603 

Fig. 2-12 Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

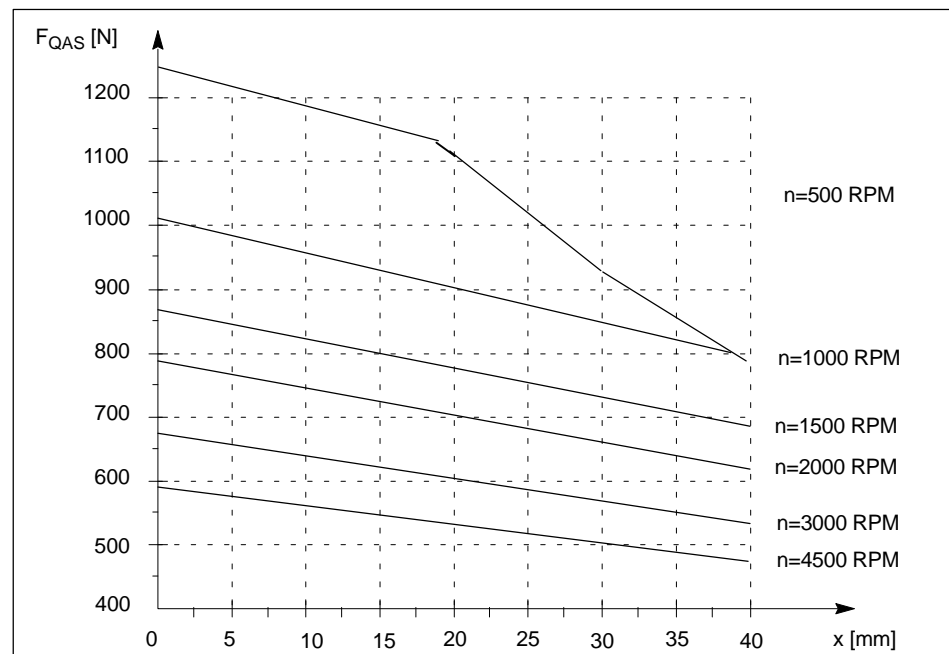
Cantilever force 1FK604 

Fig. 2-13 Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

2.2 Cantilever force diagrams

Cantilever force 1FK606

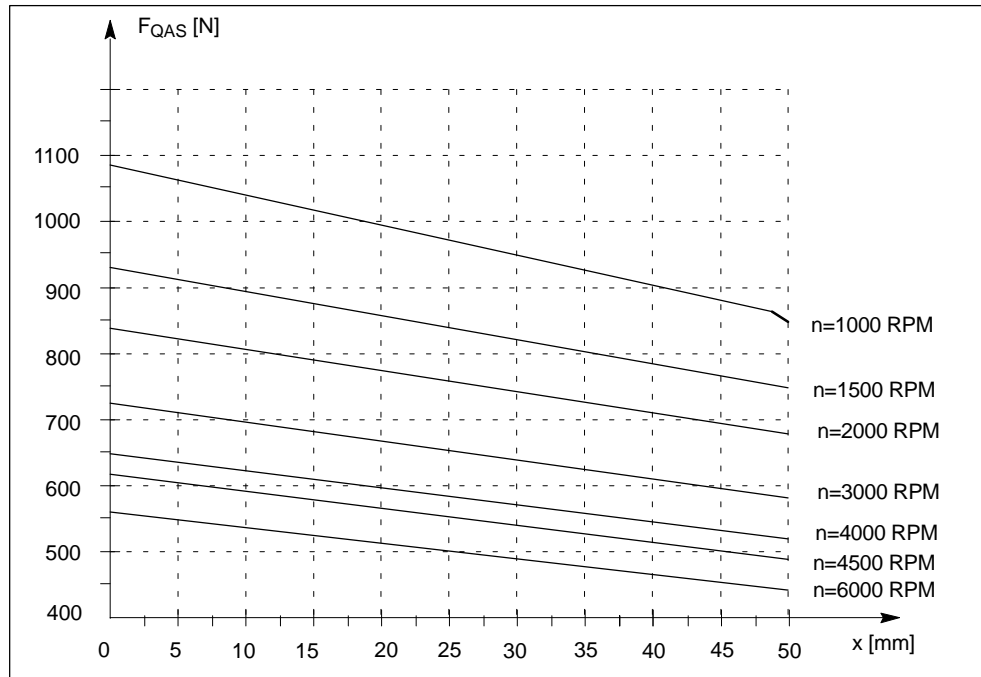


Fig. 2-14 Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force 1FK608

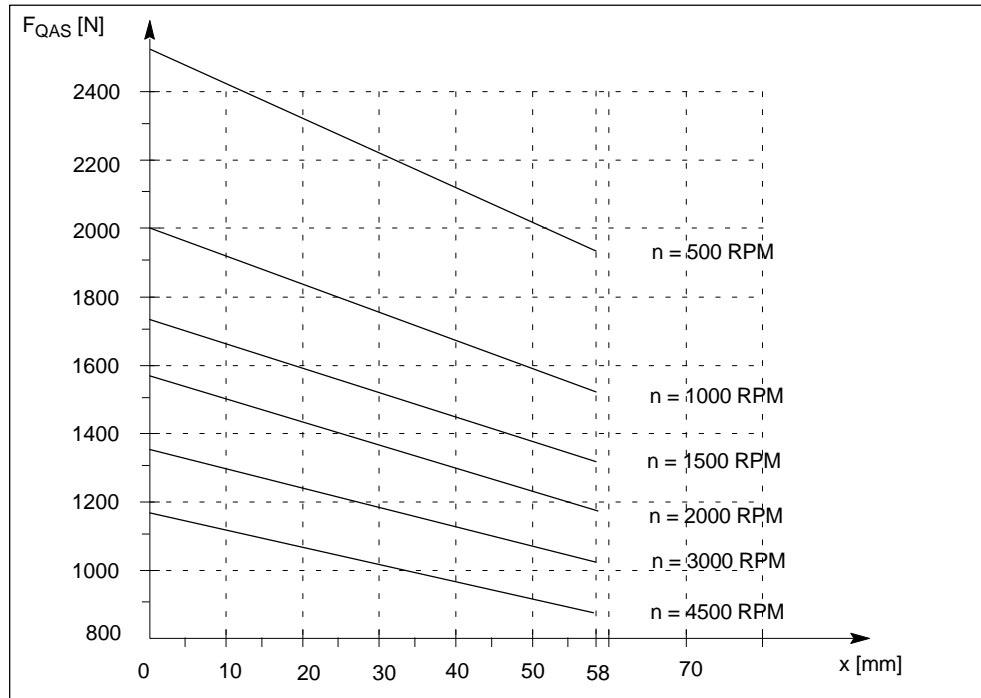


Fig. 2-15 Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force 1FK610□

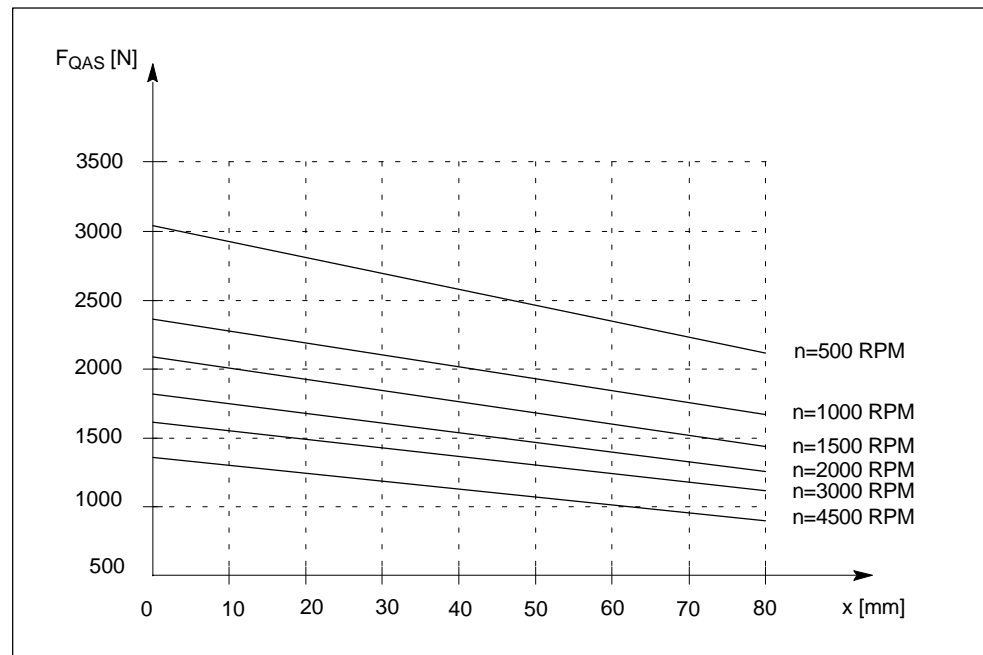


Fig. 2-16 Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

2.3 Axial forces

Axial force stressing



Warning

Axial forces are not permissible for motors with integrated holding brake!

When using, e.g. helical gearwheels as drive element, in addition to the radial force, the motor bearings are also subject to an axial force. For axial forces, the spring-loading of the bearings can be overcome so that the rotary moves corresponding to the axial bearing play present (up to 0.2 mm).

The permissible axial force can be approximately calculated using the following formula:

$$F_A = 0.35 * F_Q$$

Motor Components (Options)

3.1 Thermal motor protection

A temperature-dependent resistor is integrated as temperature sensor to monitor the motor temperature.

| | |
|-------------------------------|--|
| Type: | KTY 84 (PTC thermistor) |
| Resistance when cold (20° C): | approx. 580 Ω |
| Resistance when hot (100° C): | approx. 1000 Ω |
| Response temperature | Pre-alarm at 120° C Trip at 155° C ± 5° C |
| Connection: | via the encoder cable |

The change in the resistance of the KTY 84 is proportional to the winding temperature change (refer to Fig. 3-1).

The temperature is sensed and evaluated in the drive converter, whose closed-loop control takes into account the temperature characteristic of the motor resistances.

If a fault condition develops, an appropriate signal is output at the drive converter. When the motor temperature increases, a "Pre-alarm, motor overtemperature" signal is output which can be externally evaluated. If this signal is not observed, when the motor limiting temperature or the shutdown temperature is exceeded, the drive converter shuts down with the appropriate fault signal.



Warning

If the user carries-out an additional high-voltage test, then the ends of the temperature sensor cables must be short-circuited before the test!

The temperature sensor will be destroyed if the test voltage is connected to only one terminal of the temperature sensor.

The polarity must be carefully observed.

The temperature sensor is designed so that the DIN/EN requirement for "Protective separation" is fulfilled.

3.1 Thermal motor protection

**Caution**

The integrated temperature sensor protects the servomotors against overload conditions:

Shaft heights 36 and 48 to $2 * I_{0.60K}$ and speed ≤ 0
 from shaft height 63 to $4 * I_{0.60K}$ and speed ≤ 0

Sufficient protection is no longer provided for thermally critical load situations, e.g. a high overload condition at motor standstill. This is the reason that a thermal overload relay – as example – should be provided as additional protection.

If an overload condition of $4 * M_0$ lasts for longer than 4s, then additional motor protection must also be provided.

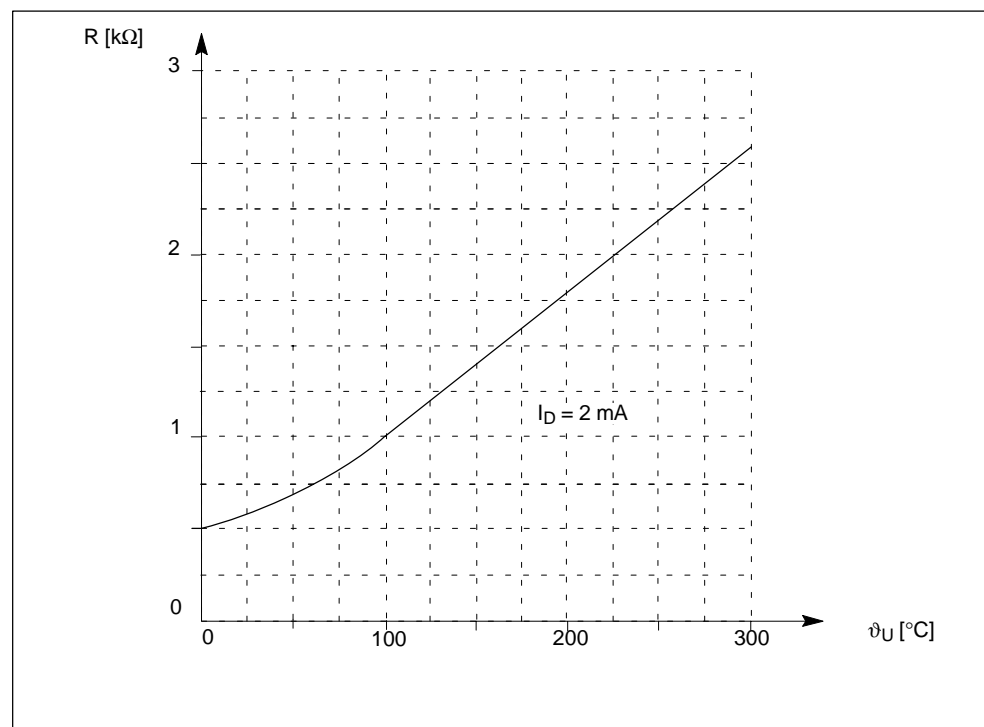


Fig. 3-1 Resistance characteristic of the KTY 84 as a function of the temperature

3.2 Encoders

Table 3-1 Overview of the encoders used

| Motor types | Increm. enc. sin/cos 1 Vpp (I-2048) | Abs. value enc. EnDat (A-2048) | Basic absolute value encoder (A-32) | Resolver 2-pole or multi-pole |
|-------------------------|---|--------------------------------------|---|-------------------------------------|
| Order No. 14th position | A | E | G | S, T |
| 1FK6 03□ | | | | X |
| 1FK6 04□ | X | X | X | X |
| 1FK6 06□ | X | X | X | X |
| 1FK6 08□ | X | X | X | X |
| 1FK6 10□ | X | X | X | X |

Notice

When an encoder is replaced, the position of the encoder system with respect to the motor EMF must be adjusted. Only qualified personnel should replace an encoder.

3.2 Encoders

3.2.1 Incremental encoders

- Function:
- Angular measuring system for commutation
 - Speed actual value sensing
 - Indirect increm. meas. system for the pos. control loop
 - One zero pulse (reference mark) per revolution

Table 3-2 Technical data, incremental encoder sin/cos 1V_{pp}

| Features | Incremental encoders sin/cos 1V _{pp} | Incremental encoders sin/cos 1V _{pp} (low shaft height) |
|----------------------------|--|---|
| Mech. limiting speed | 15,000 RPM | 12,000 RPM |
| Operating voltage | 5V ± 5% | 5V ± 5% |
| Current drain | max. 150 mA | max. 200 mA |
| Resolution, incremental | 2048 | 2048 |
| Incremental signals | 1 V _{pp} | 1 V _{pp} |
| Accuracy | ± 40" | ± 80" |
| C–D track (rotor position) | Available | Available |

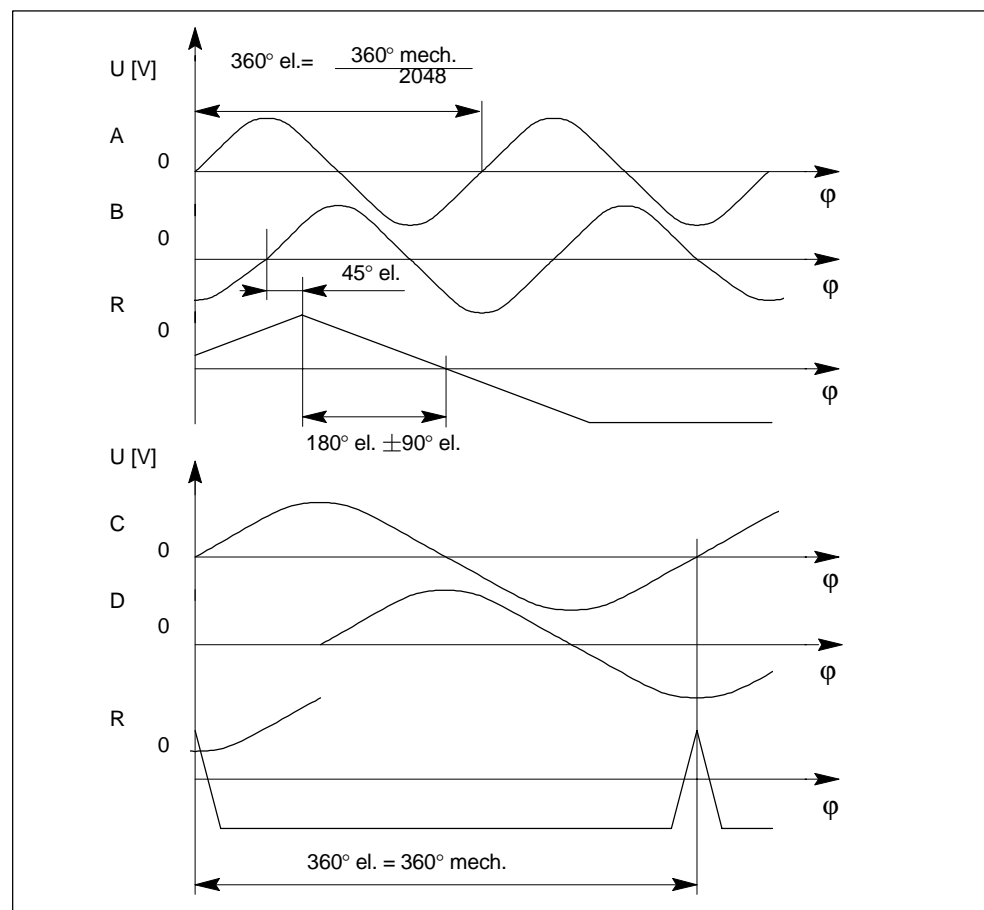
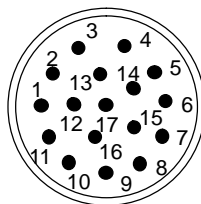


Fig. 3-2 Signal sequence and assignment for a positive direction of rotation (clockwise rotation when viewing the drive end)

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

| PIN No. | Signal |
|---------|---------------|
| 1 | A+ |
| 2 | A- |
| 3 | R+ |
| 4 | D- |
| 5 | C+ |
| 6 | C- |
| 7 | M-Encoder |
| 8 | +Temp |
| 9 | -Temp |
| 10 | P-Encoder |
| 11 | B+ |
| 12 | B- |
| 13 | R- |
| 14 | D+ |
| 15 | 0 V Sense |
| 16 | 5 V Sense |
| 17 | not connected |



When viewing the connector side (pins)

Connectors and cables

Mating connector:

6FX2003-0CE17 (socket)

Pre-assembled cable:

6FX□002-2CA31-□□□0



5 = MOTION-CONNECT® 500 ¹⁾

8 = MOTION-CONNECT® 800 ¹⁾

Cable length: max. 50 m

1) Technical data of the MOTION-CONNECT series, refer to Catalog NC Z

2) Length code, refer to Catalog NC Z

3.2 Encoders

3.2.2 Absolute value encoders

- Function:
- Angular measuring system to impress the current
 - Speed actual value sensing
 - Indirect measuring system for the position control loop

Table 3-3 Technical data, absolute value encoder

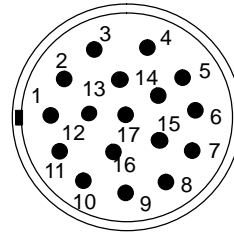
| Features | Absolute value encoder EnDat (A-2048) | Absolute value encoder EnDat (A-512) | Basic absolute value encoder (A-32) |
|--|--|---|-------------------------------------|
| Mech. limiting speed | 12000 RPM | 12000 RPM | 12000 RPM |
| Operating voltage | 5V ± 5% | 5V ± 5% | 5V ± 5% |
| Current drain | max. 300 mA | max. 300 mA | max. 300 mA |
| Resolution, incremental (periods per revolution) | 2048 | 512 | 32 |
| Resolution, absolute (coded revolutions) | 4096 | 4096 | 4096 |
| Incremental signals | 1 Vpp | 1 Vpp | 1 Vpp |
| Serial absolute position interface | EnDat | EnDat | EnDat |
| Accuracy | ± 40" | ± 80" | ± 400" |

Note

As a result of the reduced maximum operating temperature of absolute value encoders with respect to incremental encoders, the thermally permissible motor torque is reduced (refer to the technical data of the motors)!

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

| PIN No. | Signal |
|---------|---------------|
| 1 | A+ |
| 2 | A- |
| 3 | +Data |
| 4 | not connected |
| 5 | +Clock |
| 6 | not connected |
| 7 | M-Encoder |
| 8 | +Temp |
| 9 | -Temp |
| 10 | P-Encoder |
| 11 | B+ |
| 12 | B- |
| 13 | +Data |
| 14 | -Clock |
| 15 | 0 V Sense |
| 16 | 5 V Sense |
| 17 | not connected |



When viewing the plug-in side (pins)

Connectors and cables

Mating connector:

6FX2003-0CE17 (socket)

Pre-assembled cable:

6FX□002-2EQ10□□□0

└──┬──────────┬──┘
Length ²⁾

5 = MOTION-CONNECT® 500 ¹⁾
8 = MOTION-CONNECT® 800 ¹⁾

Cable length: max. 50 m

1) Technical data of the MOTION-CONNECT series, refer to Catalog NC Z

2) Length code, refer to Catalog NC Z

3.2 Encoders

3.2.3 Resolvers

- Function:
- Speed actual value sensing
 - Rotor position encoder for inverter control
 - Indirect increm. meas. system for the pos. control loop

Note

The limiting frequency of the drive converter must be carefully observed.

- SIMODRIVE 611U: Limiting frequency 432 Hz (before SW 4.1: 375 Hz)
- SIMODRIVE 611A: only possible for 2-pole resolvers

Table 3-4 Technical data, resolvers

| Features | Values |
|------------------------------|----------------------------|
| Mech. limiting speed | 15,000 RPM |
| Excitation voltage | 5 V (rms) up to 13 V (rms) |
| Excitation frequency | 4 kHz to 10 kHz |
| Current drain | < 80 mA (rms) |
| Angular accuracy (bandwidth) | |
| 2-pole | < 14' |
| multi-pole | < 4' |
| Pole number | 2, 4, 6 or 8 ¹⁾ |
| Ratio | 0.5 |

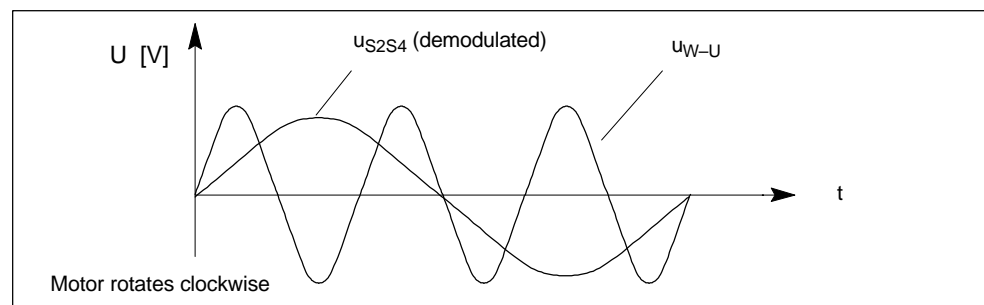
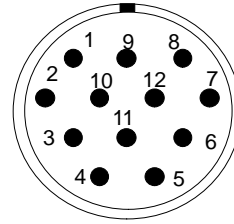


Fig. 3-3 Signal sequence and assignment for a positive direction of rotation (clockwise direction rotation when viewing the drive end)

1) Pole number is the same as the motor pole number

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

| PIN No. | Signal |
|---------|---------------|
| 1 | S2 |
| 2 | S4 |
| 3 | not connected |
| 4 | not connected |
| 5 | not connected |
| 6 | not connected |
| 7 | R3 |
| 8 | +Temp |
| 9 | -Temp |
| 10 | R1 |
| 11 | S1 |
| 12 | S3 |



When viewing the plug-in side (pins)

Connectors and cables

Mating connector:

6FX2003-0CE12 (socket)

Pre-assembled cable:

6FX□002-2CF02-□□□0

└──┬──┘
Length ²⁾

5 = MOTION-CONNECT® 500 ¹⁾
8 = MOTION-CONNECT® 800 ¹⁾

Cable length: max. 50 m

1) Technical data of the MOTION-CONNECT series, refer to Catalog NC Z

2) Length code, refer to Catalog NC Z

3.3 Holding brake

3.3 Holding brake

For a description of the function, refer to the documentation "General Section".

Table 3-5 Technical data of the holding brakes used for 1FK6 motors

| Motor type | Brake type | Holding torque M_4 [Nm] | DC current [A] | Opening time with varistor [ms] | Closing time with varistor [ms] | Highest switching work [J] |
|--------------------|------------|---------------------------|----------------|---------------------------------|---------------------------------|----------------------------|
| 1FK6032 | EBD 0.13BS | 1.1 | 0.4 | 30 | 10 | 13 |
| 1FK604□ | EBD 0.3B | 3.0 | 0.6 | 35 | 10 | 68 |
| 1FK606□ | EBD 0.8B | 9.0 | 0.7 | 55 | 15 | 318 |
| 1FK608□ | EBD 1.4BF | 18 | 0.9 | 100 | 30 | 535 |
| 1FK6100 | EBD 2BY | 20 | 0.9 | 100 | 50 | 1135 |
| 1FK6101 1FK6103 | EBD 3.8B | 36 | 0.9 | 180 | 25 | 1233 |

Principle braking characteristics

The holding torque M_4 [Nm] corresponds to the transmitted torque taking into account the max. solenoid temperature, fluctuations in the friction and the spread of characteristic data for the holding brakes.

3.4 Gearboxes

Planetary gearboxes (alpha company, LP series) – selection table for 1FK6 motors

Table 3-6 Technical data of the planetary gearboxes which can be used for 1FK6 motors

| Servo- motor non- ventilated Type | Planetary gearbox 1-stage torsional play ≤ 12 arcmin Type | Gearbox- weight approx. [kg] | Available gearbox ratios | | Max. perm. input speed ¹⁾ n_{G1} [RPM] | Max. perm. output torque ¹⁾ M_{G2} at $i = 5$ [Nm] M_{G2} at $i = 10$ [Nm] | | Max. perm. drive out shaft load ²⁾ F_r [N] | Moment of inertia gearbox J_G at $i = 5/10$ [10^{-4} kgm ²] |
|---|---|---|-----------------------------|------------|---|---|-----|---|---|
| | | | $i = 5$ | $i = 10$ | | | | | |
| 1FK603□ | LP070–M01 | 1.9 | X | X | 6000 | 32 | 29 | 1450 | 0.28 |
| 1FK604□ | LP090–M01 | 4.1 | X | X | 6000 | 80 | 72 | 2400 | 1.77 |
| 1FK606□ | LP120–M01 | 9 | X | X | 4800 | 200 | 180 | 4600 | 5.42 |
| 1FK608□ | LP155–M01 | 17.5 | X | X | 4000 | 400 | 320 | 7500 | 25.73 |
| 1FK6100 | | | | | | | | | |
| 1FK6101 | | | | | | | | | |
| 1FK6103 | | | | | | | | | |
| Code Gearbox shaft with keyway | | | V40 | V42 | | | | | |

Continuous duty S1

At the rated speed and rated torque, continuous duty is permissible. It is not permissible that a gearbox temperature of 90° C is exceeded.

Table 3-7 Continuous duty S1

| Planetary gearbox 1–stage torsional play ≤ 12 arcmin Type | Rated speed n_{N1} [RPM] | Max. perm. output torque M_{N2} [Nm] ¹⁾ | |
|--|-------------------------------|---|----------------------------|
| | | $i = 5$ | $i = 10$ |
| LP070–M01 | 3700 | 16 | 15 |
| LP090–M01 | 3400 | 40 | 35 |
| LP120–M01 | 2600 | 100 | 90 |
| LP155–M01 | 2000 | 290 | 170 |

The gearboxes can be mounted in any position.
The gearboxes have degree of protection IP 64.
Gearbox versions are available without keyway.

- 1) Values for positioning duty S5
(intermittent duty influenced by starting and electrical braking)
- 2) Referred to the center of the drive out shaft at 100 RPM

3.4 Gearboxes

Dimensions with gearbox, 1FK6 standard, shaft heights 36 to 80

Standard 1FK6 motor with planetary gearbox (alpha company, series LP).

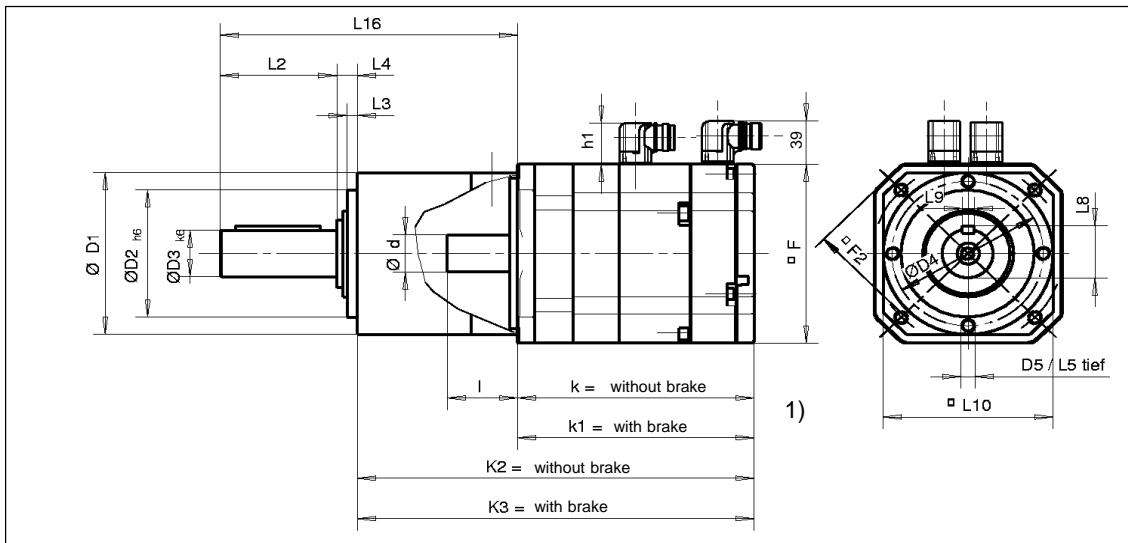


Fig. 3-4 Dimensions, standard 1FK6 motor, shaft height 36 to shaft height 80, with planetary gearbox

Dimensions with gearbox, standard 1FK6, only shaft height 100, series 1FK6100–103

Standard 1FK6 motor with planetary gearbox (alpha company, series LP).

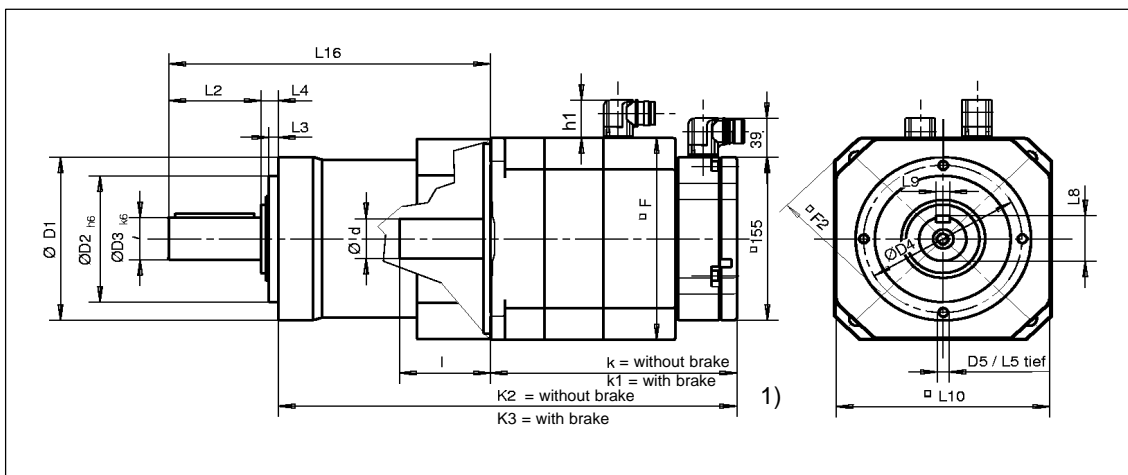


Fig. 3-5 Dimensions, standard 1FK6, series 1FK6100, shaft height 100, with planetary gearbox

Table 3-8 Dimensions, standard 1FK6 motor, shaft heights 36 to 100, with planetary gearbox
(dimension drawing for 1FK603□ to 1FK608□ refer to Fig. 3-4,
Dimension drawing for 1FK6100...103 refer to Fig. 3-5)

| Servomotor, standard version | | Planetary gearbox 1-stage | | | | | | | | | | | | | | without brake | | with brake | | |
|------------------------------------|------|------------------------------|-----------|------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|------------------|------------|------------|------------|------------|
| Type | Dim. | | Type | Dimensions | | | | | | | | | | | | | | | | |
| | h1 | □F | | ∅D1 | ∅D2 | ∅D3 | ∅D4 | D5 | L16 | L2 | L3 | L4 | L5 | L8 | L9 | L10 | K2 2) | K2 3) | K3 2) | K3 3) |
| 1FK6032 | 42 | 72 | LP070-M01 | 70 | 52 | 16 | 62 | M5 | 126 | 28 | 5 | 8 | 10 | 18 | 5 | 70 | 269 | — | 269 | — |
| 1FK6040 1FK6042 | 42 | 96 | LP090-M01 | 90 | 68 | 22 | 80 | M6 | 158 | 36 | 5 | 10 | 12 | 25 | 6 | 90 | 272 304 | 316 348 | 272 304 | 316 348 |
| 1FK6060 1FK6063 | 42 | 126 | LP120-M01 | 120 | 90 | 32 | 108 | M8 | 210 | 58 | 6 | 12 | 16 | 35 | 10 | 120 | 340 390 | 378 428 | 340 390 | 378 428 |
| 1FK6080 1FK6083 | 42 | 155 | LP155-M01 | 155 | 120 | 40 | 140 | M10 | 265 | 82 | 8 | 15 | 20 | 43 | 12 | 150 | 363 401 | 410 448 | 363 401 | 410 448 |
| 1FK6100 | 42 | 192 | LP155-M01 | 155 | 120 | 40 | 140 | M10 | 265 | 82 | 8 | 15 | 20 | 43 | 12 | 192 | 386 | 433 | 386 | 433 |
| 1FK6101 1FK6103 | 57 | | | | | | | | | | | | | | | | 412 438 | 459 485 | 412 438 | 459 485 |

- 1) Dimensions for k and k1, refer to Chapter 4, Dimension drawings
 2) with resolver
 3) with encoder



Dimension Drawings

4

Note

Siemens AG reserves the right to change the dimensions of motors without prior notice as part of ongoing improvements to the mechanical design. Dimensions drawings can go out-of-date.

Up-to-date dimension drawings can be requested at no charge from your local SIEMENS sales department.

1FK6 standard series

| | |
|---|-----------|
| 1FK6032 standard, with angled connector, Size 1 | 1FK6 4-64 |
| 1FK604□ standard, with angled connector, Size 1 | 1FK6 4-65 |
| 1FK606□ standard, with angled connector, Size 1 | 1FK6 4-66 |
| 1FK608□ standard, with connector, Size 1 | 1FK6 4-67 |
| 1FK610□ standard, with connector, Size 1 | 1FK6 4-68 |
| 1FK610□ standard, with connector, Size 1.5 | 1FK6 4-69 |

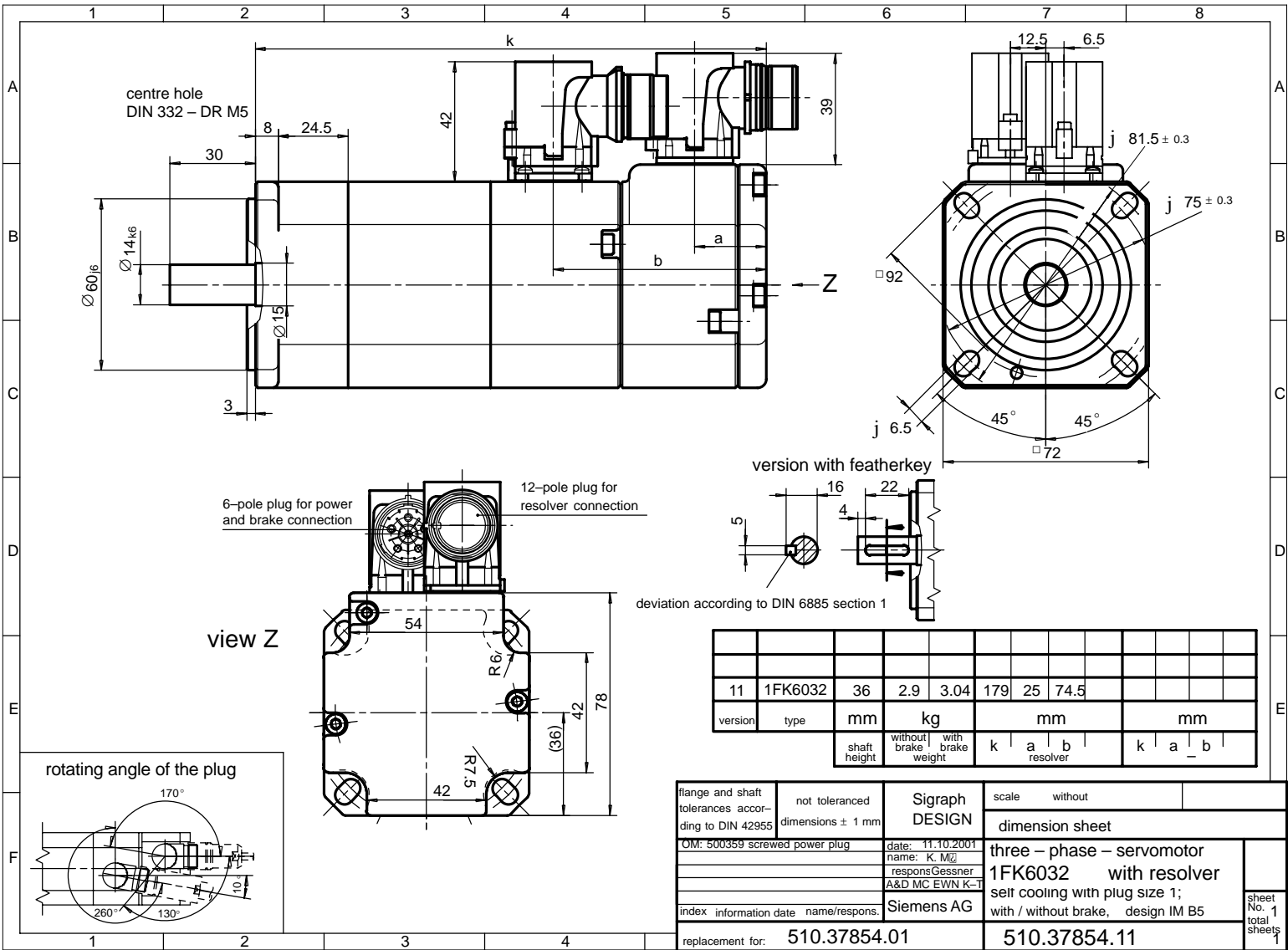


Fig. 4-1 1FK6032 standard, non-ventilated with angled connector, Size 1

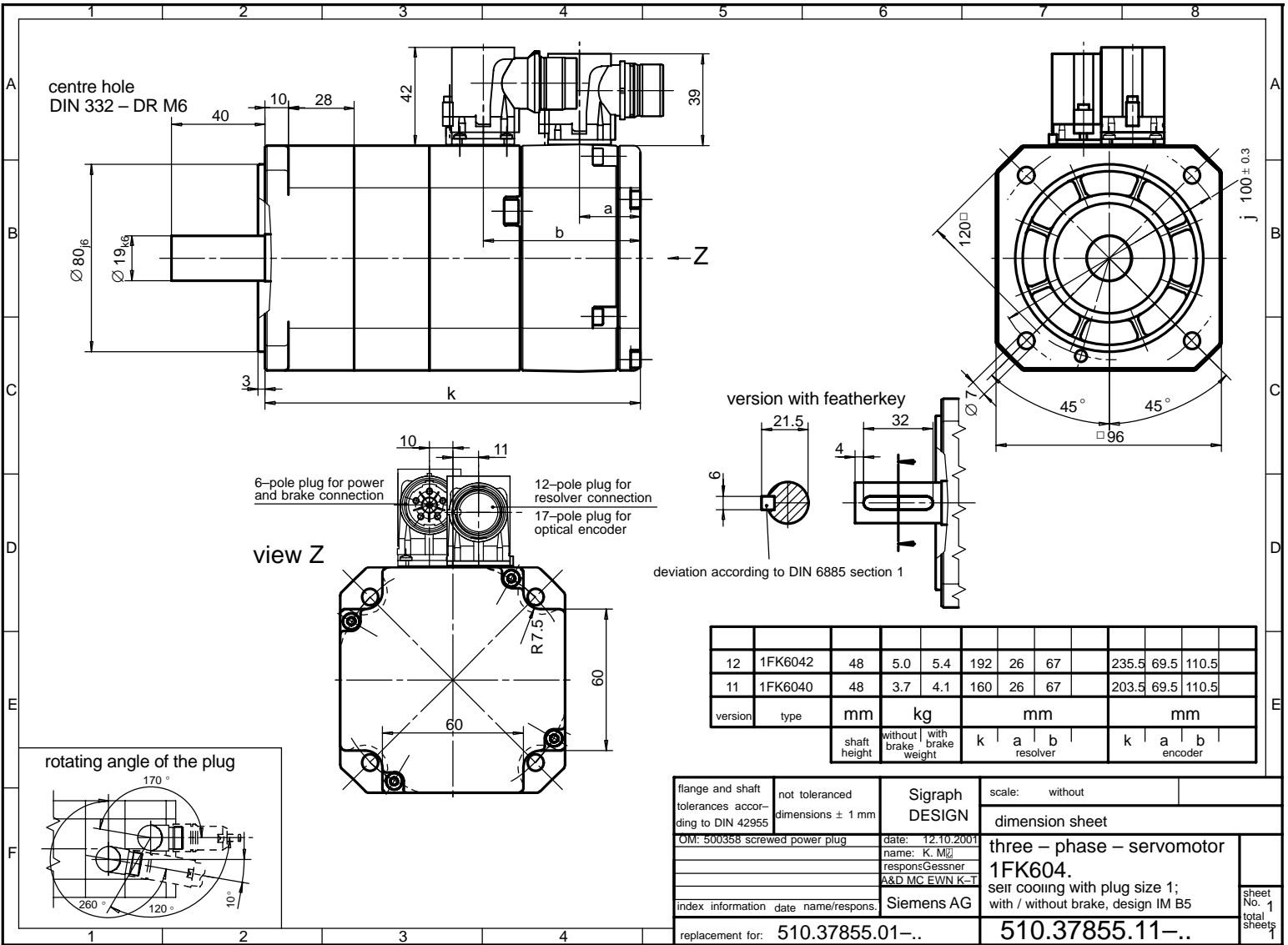


Fig. 4-2 1FK604□ standard, non-ventilated with angled connector, Size 1

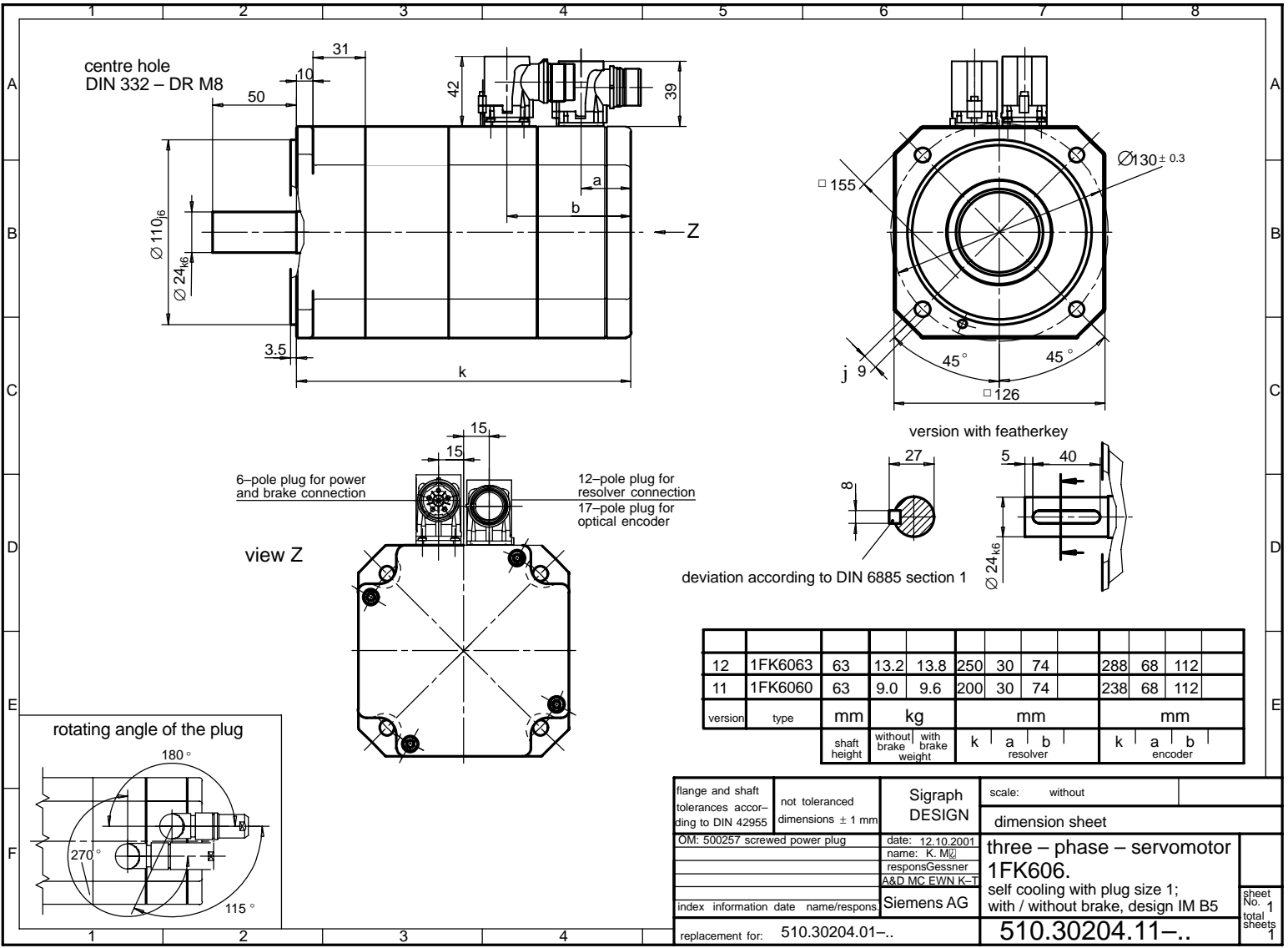


Fig. 4-3 1FK606□ standard, non-ventilated with angled connector, Size 1

1FK6/4-66

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AC Servomotors 1FK6 (PFK6) – 05.03 Edition

| | | | |
|--|--------------------------------------|--|------------------|
| flange and shaft tolerances according to DIN 42955 | not toleranced dimensions ± 1 mm | Sigraph DESIGN | scale: without |
| OM: 500257 screwed power plug | date: 12.10.2001 | name: K. M. | respons: Gessner |
| | | A&D MC EWN K-T | |
| index information date name/respons: | Siemens AG | three – phase – servomotor 1FK606, self cooling with plug size 1; with / without brake, design IM B5 | |
| replacement for: | 510.30204.01–.. | 510.30204.11–.. | |
| | | sheet No. 1 | total sheets 1 |

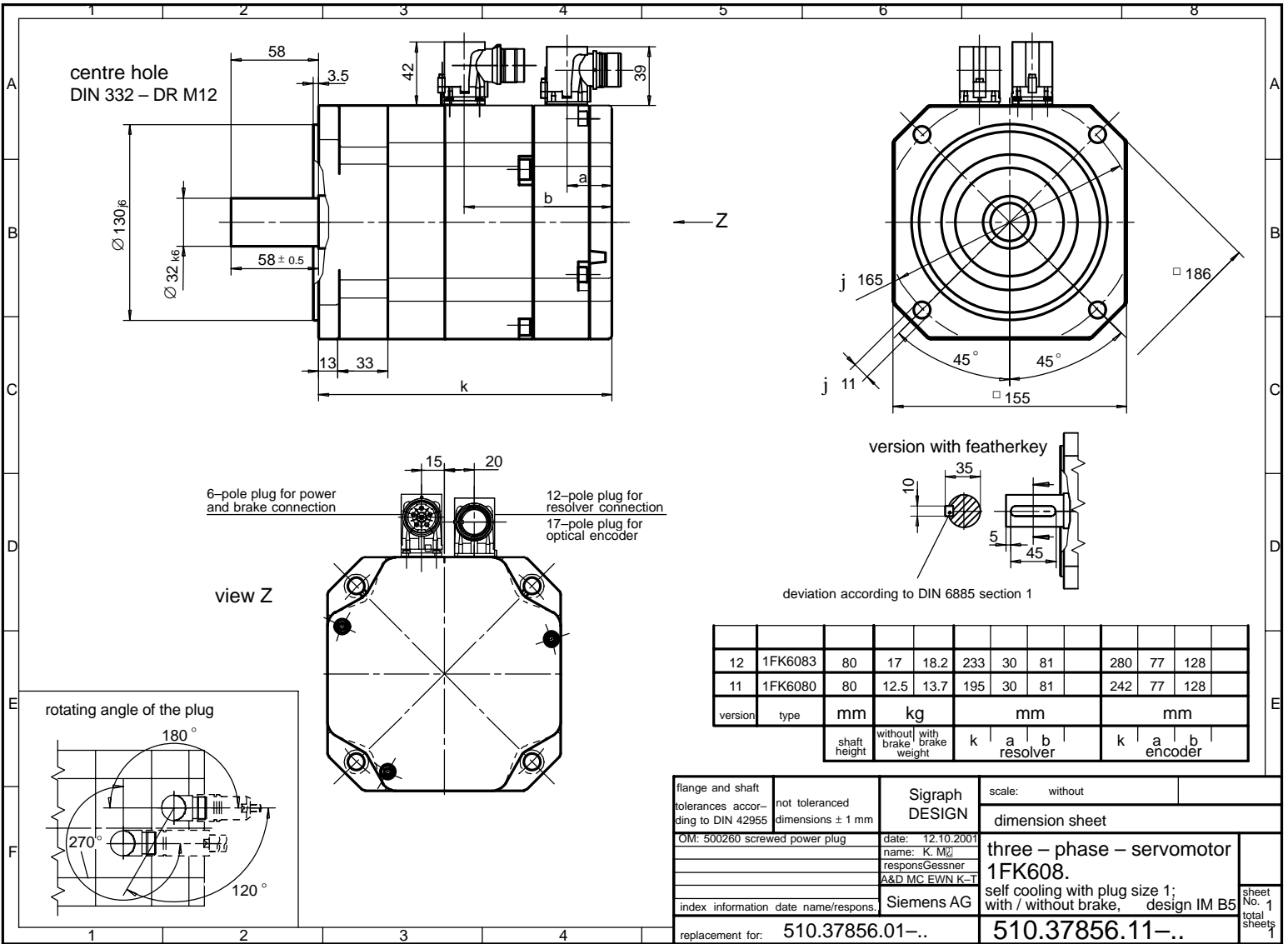


Fig. 4-4 1FK608 □ standard, non-ventilated with connector, Size 1

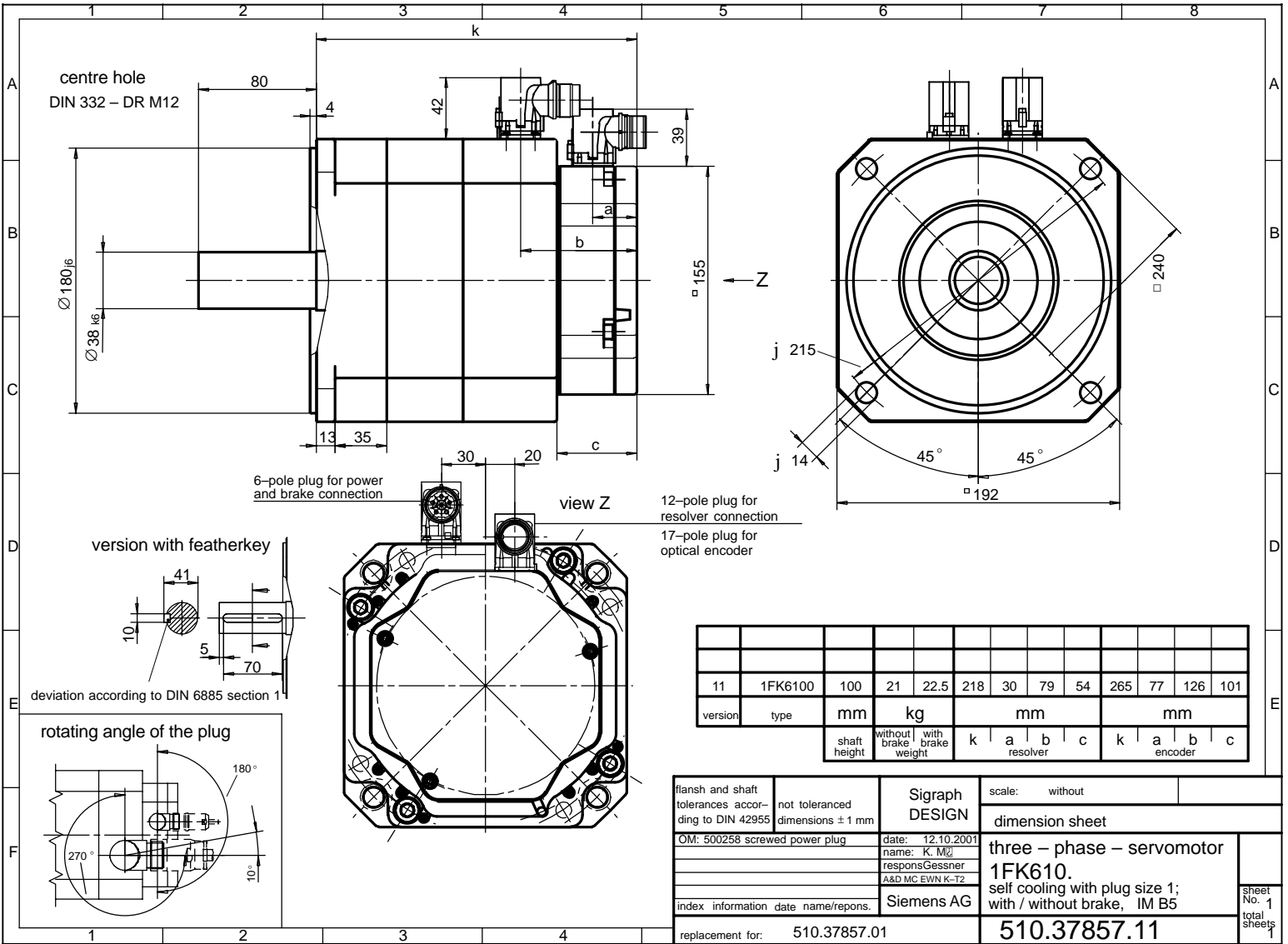


Fig. 4-5 1FK6100 □ standard, non-ventilated with connector, Size 1

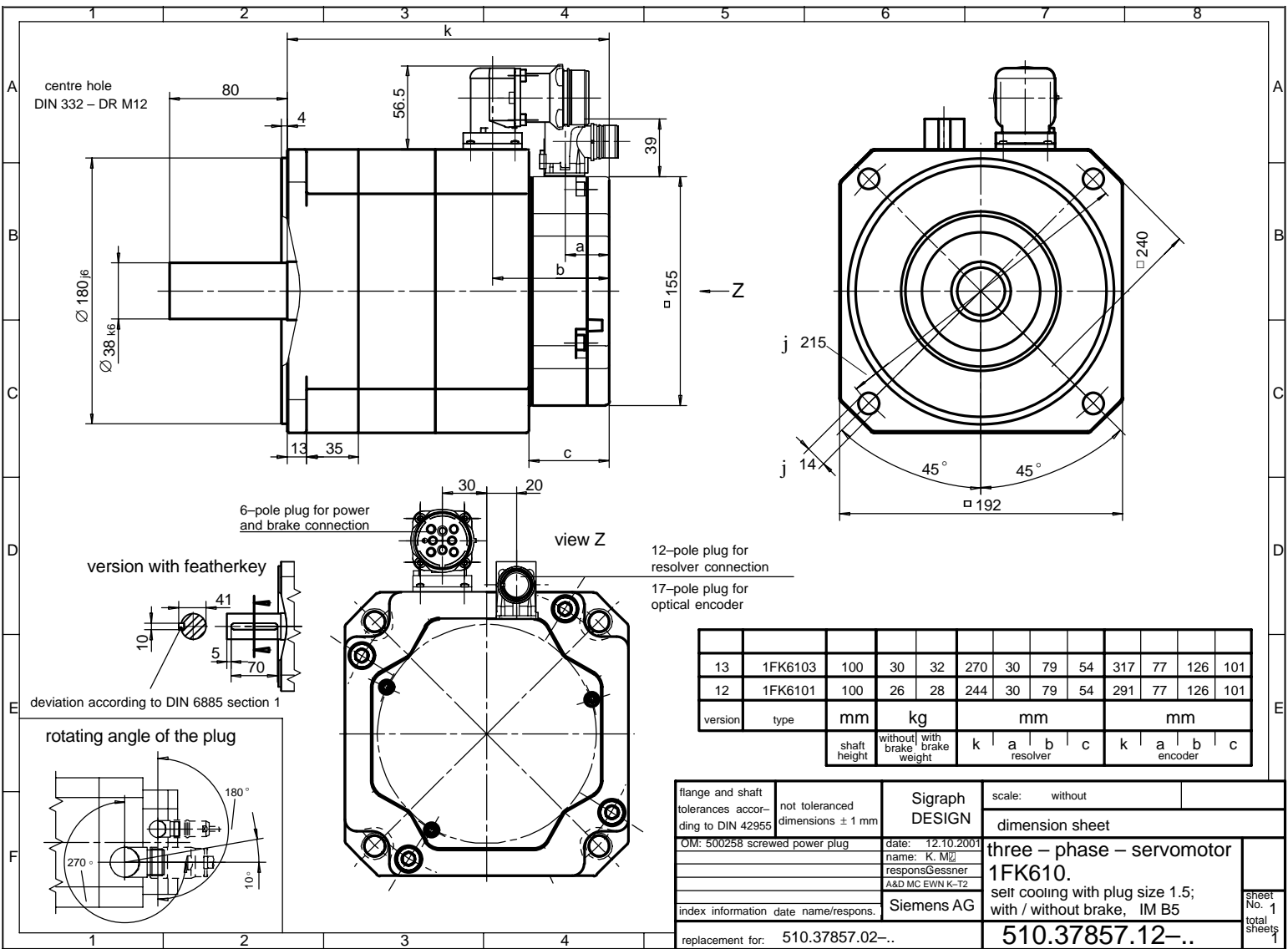


Fig. 4-6 1FK610□ standard, non-ventilated with connector size 1.5

References

General Documentation

/BU/ Catalog NC 60

Automation Systems for Machine Tools

Order No.: E86060–K4460–A101–A9

Order No.: E86060–K4460–A101–A9–7600 (English)

/ZI/ Catalog NC Z

Connection Technology and System Components for SIMATIC, SINUMERIK, MASTERDRIVES and SIMOTION

Order No.: E86060–K4490–A101–B1

Order No.: E86060–K4490–A101–B1–7600 (English)

Electronic Documentation

/CD1/ DOC ON CD

The SINUMERIK System

(includes all SINUMERIK 840D/810D and SIMODRIVE 611D documents)

Order No.: 6FC5298–6CA00–0BG3

Manufacture/Service Documentation

/PJM/ Planning Guide, AC Servomotors

SIMODRIVE 611, MASTERDRIVES MC

General Section, 1FT5, 1FT6, 1FK6, 1FK7

Order No.: 6SN1197–0AC20–0BP0

/PJAL/ Planning Guide, AC Servomotors

SIMODRIVE 611, MASTERDRIVES MC

AC servomotors, General Section

Order No.: 6SN1197–0AD07–0BP0

- /PFK7/ Planning Guide, AC Servomotors**
SIMODRIVE 611, MASTERDRIVES MC
AC Servomotors 1FK7
Order No.: 6SN1197-0AD06-0BP0
- /PFK6/ Planning Guide, AC Servomotors**
SIMODRIVE 611, MASTERDRIVES MC
AC Servomotors 1FK6
Order No.: 6SN1197-0AD05-0BP0
- /PFT5/ Planning Guide, AC Servomotors**
SIMODRIVE
AC Servomotors 1FT5
Order No.: 6SN1197-0AD01-0BP0
- /PFT6/ Planning Guide, AC Servomotors**
SIMODRIVE 611, MASTERDRIVES MC
AC Servomotors 1FT6
Order No.: 6SN1197-0AD02-0BP0
- /PPH/ Planning Guide, AC Induction Motors**
SIMODRIVE
AC Induction Motors for Main Spindle Drives
1PH2, 1PH4, 1PH7
Order No.: 6SN1197-0AC60-0BP0
- /PPM/ Planning Guide, Hollow Shaft Motors**
SIMODRIVE
Hollow Shaft Motors for Main Spindle Drives
1PM6 and 1PM4
Order No.: 6SN1197-0AD03-0BP0
- /PJFE/ Planning Guide, Synchronous Build-in Motors**
SIMODRIVE
AC Motors for Main Spindle Drives
Synchronous Build-in Motors 1FE1
Order No.: 6SN1197-0AC00-0BP4

/PJTM/ Planning Guide, Build-in Torque Motors

SIMODRIVE
Build-in Torque Motors 1FW6
Order No.: 6SN197-0AD00-0BP1

/PJLM/ Planning Guide, Motor Spindle

SIMODRIVE
ECO-Motor Spindle 2SP1
Order No.: 6SN1197-0AD04-0BP0

/PJLM/ Planning Guide, Linear Motors

SIMODRIVE
Linear Motors 1FN1 and 1FN3
Order No.: 6SN1197-0AB70-0BP3

/PJU/ Planning Guide, Drive Converters

SIMODRIVE 611
Drive Converters
Order No.: 6SN1197-0AA00-0BP5

/EMV/ Planning Guide, EMC Design Guidelines

SINUMERIK, SIROTEC, SIMODRIVE
Order No.: 6FC5297-0AD30-0BP1

Operating Instructions 1FK6

Bestell-Nr. / Order No.: 610.43430.21

Operating Instructions 1FK7

Bestell-Nr. / Order No.: 610.40700.21



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