Planning Guide 10/2003 Edition

simodrive

AC Induction Motors
1PH2
SIMODRIVE 611

SIEMENS

SIEMENS

SIMODRIVE 611

AC Induction Motors 1PH2

Planning Guide

10.2003 Edition

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.	Remarks
10.03	6SN1197–0AC63–0BP0	**A**

This Manual is part of the documentation on CD–ROM **(DOCONCD)**

Edition	Order No.	Remark
03.04	6FC5 298–7CA00–0BG0	**C**

Additional information is available in the Internet under:
http://www.ad.siemens.de/mc

This publication was produced with Interleaf V 7

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, however, reviewed regularly and any necessary changes will be included in the next edition. We welcome suggestions for improvement.

Subject to change without prior notice.

Order No. 6SN1197–0AC63–0BP0
Printed in the Federal Republic of Germany

Siemens–Aktiengesellschaft

Foreword

Information on the documentation

This document is part of the technical customer documentation developed for SIMODRIVE. All publications are available individually. The documentation list, which includes all Advertising Brochures, Catalogs, Overview, Short Descriptions, Operating Instructions and Technical Descriptions with order number, ordering address and price can be obtained from your local Siemens office.

This document does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Furthermore, the contents of this document shall neither become part of nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligations 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 1PH and 1PL motors

The complete Planning Guides for 1PH and 1PL motors can be ordered in paper form.

Table Foreword-1 Planning Guide with General Section and 1PH and 1PL6 Motors

Title	Order No. (MLFB)	Language
1PH and 1PL6 AC Induction Motors	6SN1197–0AC61–0**A**P0	German
1PH and 1PL6 AC Induction Motors	6SN1197–0AC61–0**B**P0	English

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

Table Foreword-2 Planning Guide, individual documents

Title	Order No. (MLFB)	Language
AC Induction Motors, General Section	6SN1197–0AC62–0AP0	German
AC Induction Motors, 1PH2 Motor Section	6SN1197–0AC63–0AP0	German
AC Induction Motors, 1PH4 Motor Section	6SN1197–0AC64–0AP0	German
AC Induction Motors, 1PH7 Motor Section for SIMODRIVE	6SN1197–0AC65–0AP0	German
AC Induction Motors, 1PH7 Motor Section for SIMOVERT MASTERDRIVES VC/MC	6SN1197–0AC66–0AP0	German
AC Induction Motors, 1PL6 Motor Section for SIMOVERT MASTERDRIVES VC/MC	6SN1197–0AC67–0AP0	German

Start–up software

Start–up software is also available to start–up (commission) AC induction motors when connected to the SIMODRIVE drive converter system.

Order No. [MLFB] for the software	6SN1153–2AX10–□AB□5
Order No. [MLFB] for the documentation	6SN1197–0AA30–0□B□

Hotline

If you have any questions please contact the following Hotline:

A&D Technical Support	Tel.: +49 (180) 5050–222
	Fax: +49 (180) 5050–223
	eMail: adsupport@siemens.com

Please send any questions regarding the documentation (suggestions, corrections) to the following fax number:

+49 (9131) 98–2176

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

Definition of qualified personnel

For the purpose of this document and product labels, a qualified person is a person who is familiar with the installation, mounting, start–up and operation of the equipment and hazards involved. He or she must have the following qualifications:

- Trained and authorized to energize, de–energize, ground and tag 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 used in the document to indicate that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

This symbol is used in the document to indicate that death, severe personal injury or property damage **can** result if proper precautions are not taken.

Caution

This symbol is used in the document to indicate that minor personal injury or material damage **can** result if proper precautions are not taken.

Caution

This warning (without warning triangle) indicates that material damage **can** result if proper precautions are not taken.

Notice

This warning indicates that an undesirable situation or condition **can** occur if the appropriate instructions/information are not observed.

Note

In this document, it can be advantageous to observe the information provided in a Note.

Danger and warning information

Danger

- Start–up/commissioning is absolutely prohibited until it has been completely ensured that the machine, in which the components described here are to be installed, fully corresponds to the specifications of Directive 98/37/EC.
- Only appropriately qualified personnel may commission/start–up the SIMODRIVE drive units and the AC motors.
- This personnel must carefully observe the technical customer documentation belonging to this product and be knowledgeable about and carefully observe the danger and warning information.
- Operational electrical equipment and motors have parts and components which are at hazardous voltage levels.
- Hazardous axis motion can occur when working with the equipment.
- All work must be undertaken with the system in a no–voltage condition (powered–down).
- SIMODRIVE drive units are designed for connection to line supplies that are grounded through a low–ohmic connection (TN line supplies). For additional information please refer to the appropriate documentation on the drive converter systems.

Warning

- Perfect and safe operation of this equipment and motors assumes professional transport, storage, mounting and installation as well as careful operator control and servicing.
- The information provided in catalogs and quotations additionally applies to special versions of units and motors.
- In addition to the danger and warning information/instructions in the technical customer documentation supplied, the applicable domestic, local and plant–specific regulations and requirements must be carefully taken into account.

Caution

- The motors can have surface temperatures of over +100° C.
- This is the reason that no temperature–sensitive components, e.g. cables or electronic components may be in contact or be attached to the motor.
- When handling cables, please observe the following:
  - They may not be damaged
  - They may not be stressed
  - They may not come into contact with rotating components.

Caution

- Motors should be connected up according to the circuit diagram provided. It is not permissible to directly connect the motors to the three–phase line supply as this will destroy the motors.
- SIMODRIVE drive units with AC motors are subject, as part of the routine test, to a voltage test in accordance with EN 50178. While the electrical equipment of industrial machines is being subject to a voltage test in accordance with EN60204-1, Section 19.4, all SIMODRIVE drive unit connections must be disconnected/withdrawn in order to avoid damaging the SIMODRIVE drive units.

Note

- SIMODRIVE units with AC motors fulfill, when operational and in dry operating rooms, the Low–Voltage Directive 73/23/EEC.
- SIMODRIVE units with AC motors fulfill, in the configuration specified in the associated EC Declaration of Conformity, EMC Directive 89/336/EEC.

ESDS information

Caution

Electro**S**tatic **D**ischarge **S**ensitive devices (ESDS) are individual components, integrated circuits or boards which, when handled, tested or transported, can be destroyed by electrostatic fields or electrostatic discharge.

Handling ESDS boards:

- When handling components which can be destroyed by electrostatic discharge, it must be ensured that personnel, the workstation and packaging are well grounded!
- Electronic boards may only be touched by personnel in ESDS areas with conductive flooring if
  - they are grounded with an ESDS bracelet
  - they are wearing ESDS shoes or ESDS shoe grounding strips.
- Electronic boards should only be touched when absolutely necessary.
- Electronic boards would not be brought into contact with plastics and articles of clothing manufactured from man–made fibers.
- Electronic boards may only be placed 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 >10 cm).
- Measuring work may only be carried–out on the electronic boards, if
  - the measuring unit is grounded (e.g. via a protective conductor) or
  - for floating measuring equipment, the probe is briefly discharged before making measurements (e.g. a bare–metal control housing is touched).

Table of Contents

■

Space for your notes

Motor Description

1

1.1 Applications and features

Applications

The 1PH2 series was developed for the closed–loop speed controlled operation of main spindles for turning, milling, grinding and for machining centers.

The build–in motor is a compact drive solution where the motor power is transferred directly to the spindle without any mechanical transmission elements.

Fig. 1-1 1PH2 rotors and stators

Features

1PH2 motors are liquid–cooled induction motors which are supplied in the form of components. A complete motor spindle unit is obtained after the motor components have been mounted on the spindle.

This motor series has been adapted to the requirements of lathes, milling machines and machining centers. They differ as far as the following points are concerned:

1PH2 with sleeve

- The rotor with sleeve is completely machined. It does not have to be machined after mounting.
- Maximum speed: up to 10000 RPM.
- Rated torque: up to 750 Nm (S1 duty).
- The torque is mechanically transmitted to the spindle without any play and force–locked using a cylindrical stage press fit.
- The rotor with sleeve is pre–balanced and can be disassembled.

1PH2 without sleeve

- The rotor is completely machined. It does not have to be machined after mounting.
- This version does not have a sleeve which results in a lower moment of inertia and minimized accelerating times.
- Max. speed up to: 18000 RPM.
- Rated torque: up to 250 Nm (S1 duty).
- The torque is mechanically transmitted to the spindle without any play and force–locked using a cylindrical stage press fit.
- For motors without sleeve, it is not possible to disassemble the rotors without causing some damage.
- The rotor without sleeve is not balanced.
- The rotor can be mounted onto conventional spindles.
- Tool clamping systems, compressed air and cooling medium lines/pipes can be routed through the rotor.

Scope of supply

- Rotor which has been completely machined.
- Stator with winding, cooling jacket with spiral groove and O rings.

1.2 Technical design

Table 1-1 Version features

Technical feature	Design
Machine type	Induction motor with squirrel–cage rotor
Type of construction (similar to ISO)	Individual components: Stator, rotor, motor encoder (option)
Degree of protection (acc. to EN 60034-5; IEC 60034-5)	IP 00
Cooling	Water cooling with T_{H2O} = 25 °C and Q = 8 l/min
Thermal motor protection (acc. to IEC 60034-6)	2 PTC thermistor (1 sensor as reserve)
Winding insulation (acc. to IEC 60034)	Temperature class F for a cooling medium temperature of +25 °C
Motor voltage	Max.: 3–ph. 430 V AC
Speed control range	> 1: 500 000
Connection type	Motor: Free cable ends with l = 1.5 m long, preferably l = 0.5 m Motor encoder: Plug–in connection (flange–mounted socket is supplied for the encoder system) PTC thermistor: via the motor encoder plug connector
Encoder system[1)] (option)	Toothed–wheel encoder[1)] SIZAG2
Balancing quality	Rotors with sleeve are pre–balanced; Rotors without sleeve are not balanced

1) As a result of the lower actual value resolution with SIZAG 2 (256/512 increments per revolution), the motor is only conditionally capable of being used for C-axis drives.

1.3 Typical mounting on the main spindle

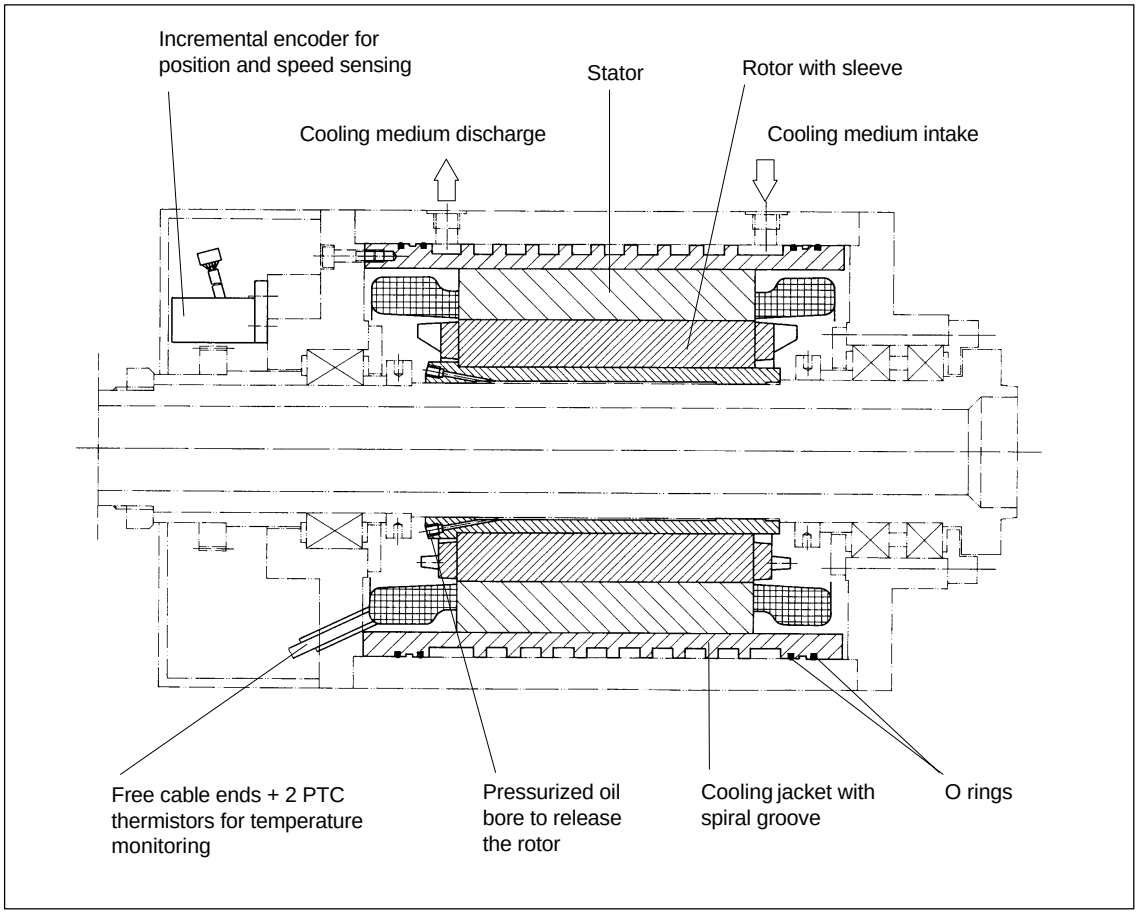


Fig. 1-2 Typical configuration where the rotor is directly mounted onto the main spindle

1.4 Technical and engineering data

Table 1-2 Technical and engineering data for standard motors

AC Main spindle motor	Rated speed	Max. speed	Rated torque		No–load current	Rated voltage	Rated motor power for the operating mode acc. to DIN VDE 0530 1)			Rated current for the operating mode acc. to IEC 60034 1)		
	n_N	n_{max}	M [Nm]		I_0 [A]	U_N [V]	P_N [kW]			I_N [A]		
	[RPM]	[RPM]	S1 ΔT= 70 K	S1 ΔT= 105 K			S1 ΔT= 70 K	S1 ΔT= 105 K	S6–60 %	S6–40 %	S1	S6–60 %	S6–40 %
Order No.													
Build–in motors with sleeve													
1PH2 093–6WF4□	1500	10000	48	60	11	308	7.5	9.4	8.2	9.0	24	26	28
1PH2 095–6WF4□			64	83	14	333	10.1	13	11	12	30	32	34
1PH2 113–6WF4□	1500	10000	95	118	22	253	15.1	18.5	17	19	56	61	67
1PH2 115–6WF4□			105	137	22	281	16.5	21.5	18.5	21	55	60	66
1PH2 117–6WF4□			115	151	25	274	18.1	23.7	20.5	23	60	67	74
1PH2 118–6WF4□			146	197	33	260	23.6	30.9	26.0	29.5	82	90	100
1PH2 182–6WC41	750	8000	150	183	17	270	11.8	14.4	14.8	17.7	37	44	52
1PH2 184–6WP41	600	8000	230	281	26	215	14.5	17.7	18.1	22	56	68	80
1PH2 186–6WB41	500	8000	350	428	31	248	18.3	22.4	21.8	25.8	65	77	87
1PH2 188–6WB41	500	6000	450	551	38	255	23.6	28.8	29	33	78	92	103
1PH2 254–6WB41	500	6000	550	673	42	185	28.8	35.3	36	40.6	117	141	161
1PH2 256–6WB41	500	4000	750	918	54	255	39.3	48.1	48.8	55.0	119	143	158
Build–in motors without sleeve 2)													
1PH2 092–4WG42 2)	2000	18000	22	34	11	208	4.7	7.1	5.2	5.8	22	23	25
1PH2 096–4WG42 2)			48	76	22	215	10.1	15.9	11	12.3	43	46	50
1PH2 123–4WF42 2)	1500	16000	73	108	21	173	11.5	17	13.5	16	57	64	74
1PH2 127–4WF42 2)			134	203	33	211	21	31.9	25	29	85	97	108
1PH2 128–4WF42 2)			159	235	37	204	25	36.9	29.5	35	101	116	132
1PH2 143–4WF42 2)	1500	12000	191	286	42	246	30	44.9	36	42	101	116	132
1PH2 147–4WF42 2)			242	350	44	263	38	55	46	53	116	136	153

1) Data for △T = 70 K and rated speed, if not specified differently
2) No longer listed in Catalog NC 60

Winding temperature rise ΔT = 70 K or ΔT = 105 K

Winding temperature rise ΔT = 105 K:

- Higher torque for the same envelope dimensions (refer to Table 1-2)
- Larger main spindle modules must be used (on request)
- Higher spindle bearing temperatures
- The specific cooling and mounting conditions must be carefully maintained

Assignment, motor – drive converter

The following current data refer to the SIMODRIVE 611 analog and digital drive converter system.

Table 1-3 Assignment, motor – drive converter

Motor type	Power module
Build–in motors with sleeve	
1PH2093	24/32/32 A
1PH2095	30/40/51 A
1PH2113	60/80/102 A
1PH2115	60/80/102 A
1PH2117	60/80/102 A
1PH2118	85/110/127 A
1PH2182	45/60/76 A
1PH2184	60/80/102 A
1PH2186	85/110/127 A
1PH2188	85/110/127 A
1PH2254	120/150/193 A
1PH2256	120/150/193 A
Build–in motors without sleeve	
1PH2092	24/32/32 A
1PH2096	45/60/76 A
1PH2123	60/80/102 A
1PH2127	85/110/127 A
1PH2128	120/150/193 A
1PH2143	120/150/193 A
1PH2147	120/150/193 A

1.5 Dimensions

Table 1-4 Dimensions of the build–in motors

Main spindle motor Type	Standard spindle diameter d [mm]	Inner rotor diameter d_i [mm]	Stator outer diameter D_A [mm]	Total outer diameter D [mm]	Total length L [mm]
Build–in motors with sleeve					
1PH2093–6WF4□ 1PH2095–6WF4□	67	85	180	205	250 300
1PH2113–6WF4□ 1PH2115–6WF4□ 1PH2117–6WF4□ 1PH2118–6WF4□	82	100	220	250	290 310 330 390
1PH2182–6WC41 1PH2184–6WP41 1PH2186–6WB41 1PH2188–6WB41	122	150	280	320	320 410 540 645
1PH2254–6WB41 1PH2256–6WB41	165	195	390	430	480 590
Build–in motors without sleeve [1]					
1PH2092–4WG42 1PH2096–4WG42	48	48	180	205	195 300
1PH2123–4WF42 1PH2127–4WF42 1PH2128–4WF42	64	64	235	265	260 380 450
1PH2143–4WF42 1PH2147–4WF42	75	75	280	310	385 440

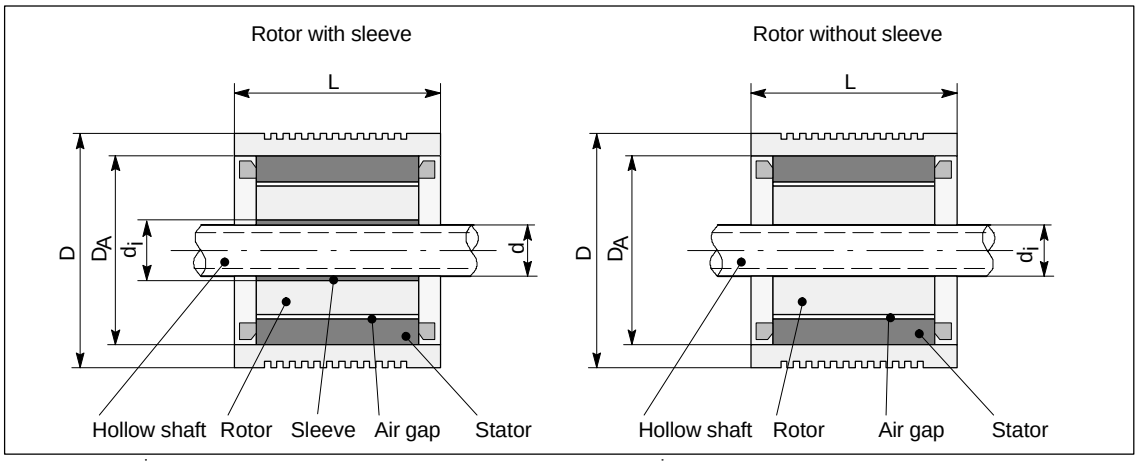


Fig. 1-3 Dimensions

1) No longer listed in Catalog NC 60

1.6 Cooling

The stators of build–in motors are liquid cooled. The user connects the duct, used for cooling, to the cooling circuit. The geometry of the cooling duct is designed so that the power loss of the stator and part of the rotor losses can be dissipated. The geometry is identical for all build–in motors.

Cooling medium

Water or low viscosity oils can be used as cooling media (carefully observe any de–rating required).

If water is used as cooling medium, then the appropriate quantity of additives must be used for anti–corrosion protection and to slow down the growth of algae. The type and quantity of additive should be taken from the manufacturer's specifications for these additives (refer to table 1-5) and the particular ambient conditions.

Table 1-5 Manufacturers of chemical additives

Company	Address	Telephone/URL
Tyforop Chemie GmbH	Hellbrookstr. 5a, D–22305 Hamburg	URL: www.tyfo.de
Joh. A. Beckiser Wassertechnik GmbH	Bergstr. 17 D-40699 Erkrath	Tel.: 02104 / 40075
CINCINATI CIMCOOL Cincinati Milacron b. v. / Cimcool Division	Postfach 98 NL–3031 AB Vlaardingen	Tel.: 003110 / 4600660
Fuchs Petrolub AG	Friesenheimer Strasse 17 D-68169 Mannheim	Tel.: 0621 / 3802–0 URL: www.fuchs–oil.com
Hebro Chemie GmbH	Rostocker Strasse D-41199 Mönchengladbach	Tel.: 02166 / 6009–0 URL: www.hebro–chemie.de
Hoechst	Refer to the Internet address	URL: www.hoechst.com
Houghton Lubricor GmbH	Werkstrasse 26 D-52076 Aachen	Tel.: 02408 / 14060
Schilling–Chemie GmbH u. Produktions KG	Steinbeissstr. 20 D-71691 Freiberg	Tel.: 07141 / 7030

Note

These recommendations involve third–party products which we know to be basically suitable. It goes without saying that similar products with the same quality from other manufacturers can be used. Our recommendation should only be considered as such and not as a specification. We cannot accept any liability for the quality and properties/features of third–party products.

If e.g. Tyfocor is used (Tyforop Chemie GmbH), then 75% water and 25% anti–corrosion additive should be used.

When using other cooling media (e.g. oil), the following data should be determined and the motor de−rating (reduced output) should be clarified with your local Siemens office:

- Specific density ρ [kgm^{-3}]
- Specific thermal capacity c_p [$Jkg^{-1}K^{-1}$]
- Kinematic viscosity ν [m^2/s]

Note

The motor power still does not have to be reduced for oil − water mixtures with less than 10 % oil. The cooling medium must be pre−cleaned or filtered in order to prevent the cooling circuit from becoming blocked.

The maximum permissible particle size after filtering 100 μm.

Flow quantity

Adequate thermal transfer is achieved with a flow quantity of 8 l/min.

Cooling medium pressure

Max. steady−state cooling medium pressure: 0.7 MPa (7.0 bar)
Pressure drop (this is automatically obtained): approx. 0.03 MPa (0.3 bar)

Cooling medium intake temperature

Recommendation: 25 °C

In order to avoid moisture condensation, the cooling medium intake temperature can be up to 40 °C, depending on the ambient temperature.

The motors are designed for operation up to a cooling medium temperature of 40 °C, but still maintaining all of the specified motor data. Often, in this case, additional thermal insulation must be provided between the motor components and the spindle bearings in order to prevent any critical bearing temperatures.

Cooling powers to be dissipated

For a cooling medium intake temperature of 25 °C, the following cooling powers are dissipated in continuous operation:

Table 1-6 Cooling powers to be dissipated

Build–in motors with sleeve		**Build–in motors without sleeve**	
Motor type	Cooling power [W]	Motor type	Cooling power [W]
1PH2093	1900	1PH2092	1200
1PH2095	2300	1PH2096	2200
1PH2113	2900	1PH2123	2200
1PH2115	3000	1PH2127	3500
1PH2117	3200	1PH2128	4000
1PH2118	4000	1PH2143	4000
1PH2182	2250	1PH2147	4800
1PH2184	2850		
1PH2186	3550		
1PH2188	4300		
1PH2254	3600		
1PH2256	4050		

Cooling system

In order to guarantee the cooling medium intake temperature of 25 °C a cooling system should be used. Several motors can be operated from a single cooling system.

The cooling systems are not included with the motors. You will find addresses of the cooling system manufacturers in Catalog NC 60.

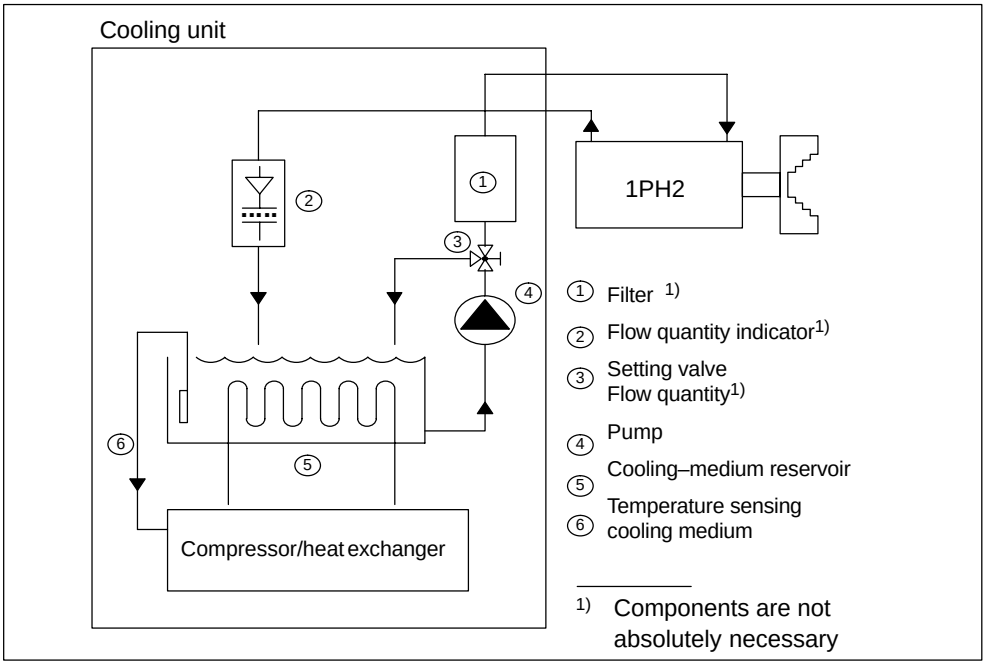


Fig. 1-4 Example of a cooling circuit

1.7 Machine safety

Caution

Electrical plants and systems must be constructed and implemented so that they do not pose any potential hazards. Information and instructions are specified in VDE 0113 (EN 60204–1).

Degree of protection

The motor components have degree of protection IP 00.

The spindle manufacturer defines the final degree of protection as a result of the spindle housing. Protection against contact, foreign bodies and water for electrical equipment is specified acc. to DIN IEC 34 Part 5.

Recommendation: IP 44 (minimum degree of protection)

Shock hazard protection

Caution

In order to prevent accidents caused by touching active components, protective measures must be provided to protect against direct as well as indirect contact. Information is provided in DIN VDE 0100, Part 410 and DIN VDE 0106, Part 100.

Note

For the grounding, it must be ensured that there is a good electrical connection that is protected against corrosion between the protective conductor and spindle box (e.g. a thin coating of Vaseline is applied to bare connecting surfaces).

Protection against indirect contact

The stator core is directly connected electrically to the cooling jacket. The cooling jacket must be electrically connected through a good connection in order to ensure the appropriate electrical connection to the spindle box. The effective connection surfaces are valid as cross–section. The spindle manufacturer is responsible for grounding/earthing the complete motor spindle in compliance with the relevant regulations.

Recommended grounding

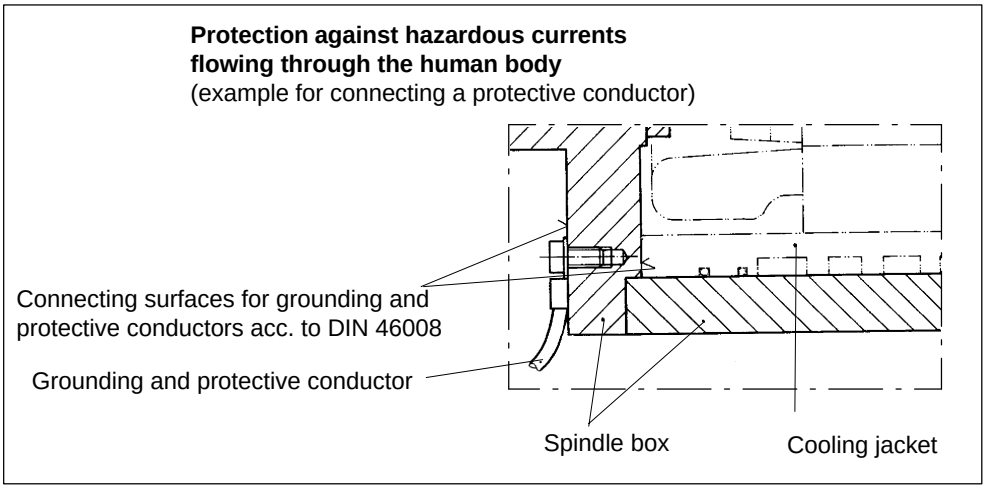


Fig. 1-5 Recommended grounding, motor spindle

High–voltage test

Before the stators of build–in motors are shipped, they are subject to a high voltage test in accordance with VDE 0530. However, the Standards Commission recommends, when installing electrical components (such as, e.g. build–in motors), that after the components have been finally mounted, the system is subject to a high voltage test in compliance with VDE 0530.

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! If the test voltage is connected to a temperature sensor then this sensor will be destroyed.

Thermal motor protection

A PTC thermistor is integrated in the stator winding to sense the motor temperature.

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

An external tripping device is not required. The PTC thermistor function is monitored. When a fault occurs, an appropriate message is output at the drive converter. When the motor temperature increases, the ”pre–alarm, motor overtemperature”, signal is output, which must be externally evaluated. If this signal is not observed, the drive converter trips and an appropriate fault signal is output when the motor limiting temperature is exceeded.

Note

When connecting–up, observe the polarity! The PTC thermistor characteristic depends on the polarity.

Polarity: 1PH2092 to 1PH2147
Brown conductor = +Temp
White conductor = –Temp
1PH2182 to 1PH2256
Yellow conductor = +Temp
Green conductor= –Temp

1.8 Mounting

1.8.1 Rotor

Design

The squirrel–cage rotor has an inner bore which is machined to the final dimensions.

Note

Build–in motors with sleeve

The rotor is located on an inner sleeve with stage press fit. The press fit can be released using pressurized oil without damaging the joint surfaces.

Build–in motors without sleeve

Force is transferred without any play and without using a sleeve which results in lower moments of inertia. The rotor bore allows hollow spindles to be used through which tool clamping systems, compressed air and cooling medium lines can be routed.

The spindle manufacturer thermally mounts the rotor onto the spindle. The spindle in the area around the press fit must be machined with the specified dimensions and tolerances to ensure that the torque is transferred through a force fit without any play.

Dimensions

Refer to Chapter 5.

A minimum spindle wall thickness is required in the area around the press fit, refer to Table 1-7.

Table 1-7 Spindle wall thickness

Motor types	Spindle wall thickness [mm]
Build–in motors with sleeve	
1PH2093 – 095 1PH2113 – 118 1PH2182 – 188 1PH2254 – 256	9 11 15 15
Build–in motors without sleeve	
1PH2092 – 096 1PH2123 – 128 1PH2143 – 147	10 13 15

Pressurized oil connection for 1PH2 motors with sleeve

The pressurized oil connections to disassemble the rotor are located in the rotor. If an outer spindle diameter is required which exceeds the standard value, then the bores for the oil pressure disassembly must be located in the spindle.

The spindle must have a larger inner diameter at the entry zone in order to allow centered mounting without damaging the inner rotor bore.

Mounting

Warning

Safe working procedures must be ensured and guaranteed when assembling and disassembling the rotor/spindle assembly and when re–using parts and components which have been disassembled. The information and instructions in DIN 15055 should be carefully observed.

Preparation

The rotor is thermally mounted onto the spindle. The following preparatory measures must be first carried out:

- The operation should take place in a dry, dust–free environment.
- Suitable tools and equipment must be used.
- The jointing surfaces must be free of any accumulated dirt, machining grooves and damage which could diminish the build–up of a pressurized oil film when disassembling the rotor/spindle assembly[1)].
- Any anti–corrosion agent on the jointing surfaces of the rotor sleeve must be completely removed.
- Clean the oil connection bores[1)]. The plugs must be removed from the threaded oil connections.
- Prepare the mounting equipment and set–up:

  A recommended mounting procedure is shown in Fig. 1-6. In this case, a set–up for vertical mounting is prepared so that the hot rotor is supported in the vertical position where it can accept the spindle.

1) only for build–in motors with sleeve

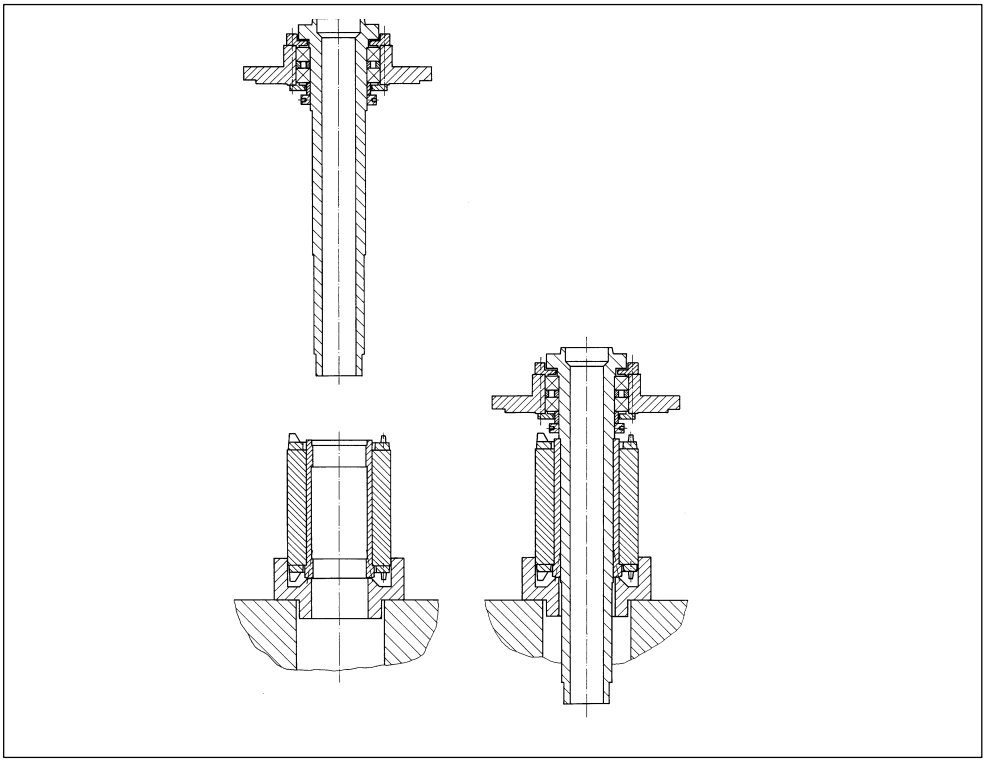


Fig. 1-6 Mounting the rotor onto the spindle

Introducing the rotor into the spindle

- Heat up the rotor in an oven to T = 180 °C up to max. 200 °C.

Note

Observe the hazards due to components and parts at high temperatures.

Maximum spindle temperature before mounting: 30 °C

- Quickly introduce the spindle to the correct position.
- Allow the rotor and spindle to cool down to room temperature.
- Re–close the threaded oil connections using the plugs supplied and secure them using Loctite 243[1)].
- After the rotor/spindle assembly has been mounted for the first time, we recommend that the rotor position with respect to the spindle is marked on the face side[1)]. This means that if the rotor is subsequently mounted, it is not necessary to fine balance the complete spindle.
- Check the radial eccentricity. The maximum radial eccentricity of the outer rotor diameter, referred to the spindle axis, is 0.05 mm.

1) only for build–in motors for lathe applications

- If, after room temperature has been reached, the parts are not in the required position with respect to one another, then they can be re–aligned using pressurized oil [1)]. In so doing, the information and instructions in the Section, Disassembly, must be carefully observed.

  Recommended viscosity of the disassembly fluid: 300 mm^2/s at 20 °C

  After the procedure has been completed, the oil must flow out between the joint surfaces. Full load can be applied to the rotor–spindle assembly after approx. 24 hours.

Disassembly, build–in motors with sleeve

When servicing the spindle (e.g. changing the bearings), it may be necessary to disassemble the spindle. The rotor can be released from the spindle shaft using pressurized oil.

The following procedure should be followed:

Warning

Observe all of the relevant safe working procedures when releasing the rotor from the spindle! Provide a protective barrier, e.g. Perspex panel.

- Release both of the threaded studs at the face of the rotor and check that the area around the oil connection bores is free of any accumulated dirt.
- Retain the spindle in a vertical position so that the oil connection bores are located horizontally above one another and provide an endstop. The rotor can suddenly release when the oil pressure is being established! Arrange a set–up which holds the rotor (refer to Fig. 1-7).
- Connect a suitable manually operated oil pump to one of the two oil connection bores. The manual oil pump must be provided with a manometer to measure the oil pressure.
- Inject oil into the assembly through the lower bore until it discharges at the upper oil connection thread. Close the oil connection threads with the plug provided.

  For disassembly, a disassembly fluid with a viscosity of 900 mm^2/s at 20 °C (e.g. LH DF 900 from SFK) is recommended.

Table 1-8 Maximum oil pressure

Motor type	Maximum oil pressure p_{max}
1PH2 093–095 1PH2 113–118	800 bar 800 bar
1PH2 182–188 1PH2 254–256	600 bar 770 bar

The disassembly process must be interrupted if the pressure increases above the values specified above.

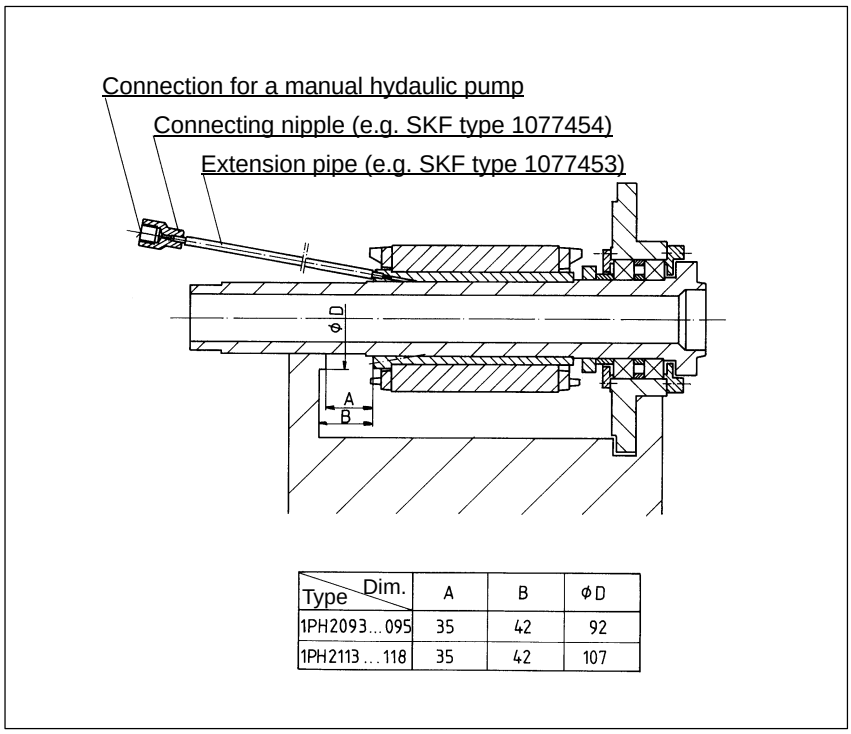
1) only for build–in motors with sleeve

- Slowly increase the pressure in the assembly up to approximately 2/3 p_{max} and allow it to take effect for approx. 15 min. This allows the oil to distribute and penetrate the joint. Ensure that the oil pressure does not decrease during this time.
- Then release the rotor from the spindle by increasing the pressure step–by–step, closely monitoring the oil pressure.

Warning

Carefully observe the maximum oil pressure!

- After a separating oil film has been established between the joint, the axial force, provided as a result of the graduated diameter, allows the rotor to slide off the spindle without having to apply any external force.
- Remove the rotor from the spindle.
- The release pressure causes radial and tangential stressing in the various components. When selecting a suitable spindle material, the stressing, which occurs in the spindle when releasing the rotor, should be observed. Equations for ring–shaped cross–sections are defined, e.g. in DIN 7190.



Type \ Dim.	A	B	ΦD
1PH2093...095	35	42	92
1PH2113...118	35	42	107

Fig. 1-7 Disassembling build–in motors with sleeve

Disassembly, build–in motors without sleeve

Generally, it is not possible to remove the rotor from the spindle without causing some damage. This should be taken into account in the mechanical design (e.g. when service is required, when changing bearings), so that the bearings on the drive and non–drive ends can be disassembled.

The rotor can be removed from the spindle, e.g. by cutting the rotor or by thermally releasing it.

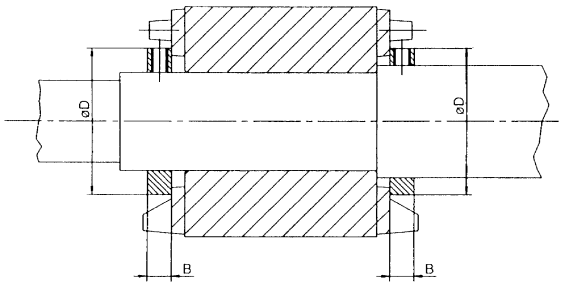
Balancing (acc. to VDI 2060, DIN ISO 1940)

- The rotors with sleeve are supplied in the following balance qualities: (reference speed, 3600 RPM)

Table 1-9 Balance quality

Motor types	Balance quality
Build–in motors with sleeve	
1PH2093 – 095 1PH2113 – 118 1PH2182 – 188 1PH2254 – 256	G 2.5 G 2.5 G 2.5 G 2.5

- Rotors without sleeve are not balanced.



	D	B	U[1)]
1PH209V–4	72	12	400 gmm
1PH212V–4	104	12	1100 gmm
1PH214V–4	119	12	1500 gmm

Balancing disk (not included in the scope of supply) – material: steel

Fig. 1-8 Recommended, balancing disk for build–in motors without sleeve

- After the rotor has been mounted onto the spindle, it may be necessary to finely balance the complete rotor–spindle system. The balancing planes required must be provided on the spindle assembly. It is not permissible to remove material from the short–circuit ring.

1) required imbalance compensation for each balancing disk

1.8.2 Stator

Design

The stators of build–in motors comprise a wound stator assembly which is pressed into a cooling housing. An open, spiral cooling duct is machined into the outer side of the cooling housing. The spindle manufacturer must install the stator in a spindle housing.

Dimensions

Refer to Chapter 5.

Spindle housing

The spindle housing seals–off the open stator cooling duct to the outside. In this case, the inner contour of the spindle housing in the stator area must fit the outer cooling jacket contour.

The spindle housing must fulfill the following functions:

- Seal the open cooling duct towards the outside.
- Center the stator with respect to the spindle.
- Accept the spindle with bearings.
- Provide cooling medium intake and outlet points.
- Accept the torque of the stator.
- Retain the spindle in the machine tool.
- Degree of protection of the motor spindle acc. to IEC 34, Part 5/VDE 0530, Part 5.
- A drain hole is provided at the lowest points on the drive and non–drive ends to allow condensation water to drain (acc. to DIN IEC 34, S10; Code 5b).
- The following minimum insulating clearances (minimum air distances) should be observed:

Table 1-10 Minimum insulating clearances

Supply voltage in [V]	= 500	> 500 to 660
Minimum air clearance in [mm]	4.5	6

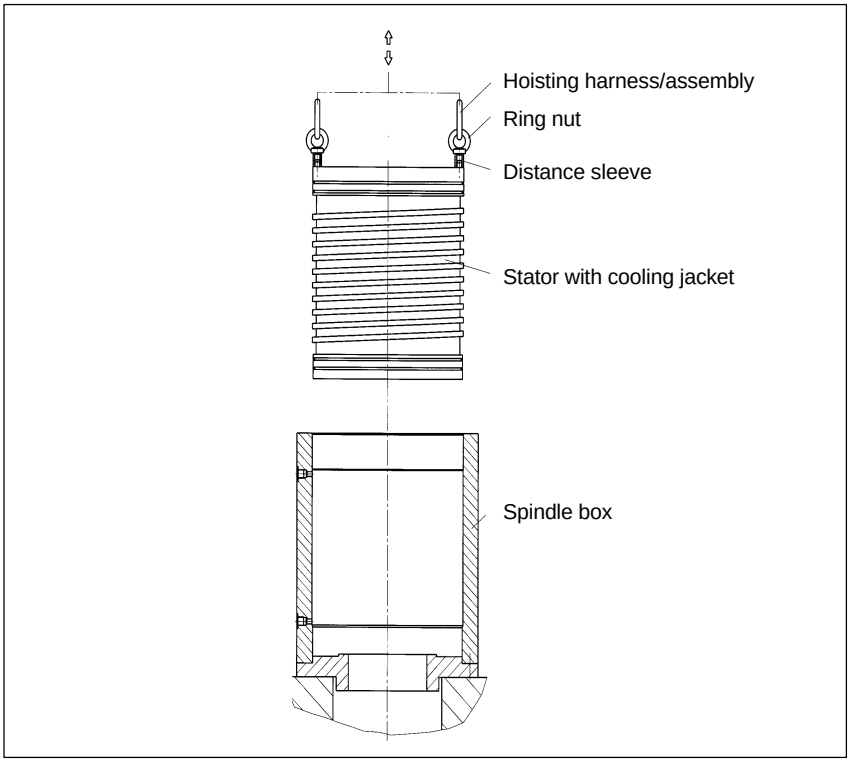


Fig. 1-9 Transporting and installing the built–in stator

Mounting

The spindle manufacturer mounts and bolts the stator into the spindle housing. The following procedure should be observed:

- The operation should take place in a dry, dust–free environment.
- Suitable tools and equipment must be used.
- The joint surfaces and O ring grooves must be free of any accumulated dirt, machining scores, swarf and damage. Any sharp edges in the spindle housing should be carefully removed.
- In order to guarantee a tight seal and for disassembly, a suitable anti–corrosion agent should be applied between the spindle housing and the cooling jacket, which does not come into contact with the cooling liquid.
- Install and lightly grease the 4 O rings.
- Allow the stator to slide, centered into the spindle housing (refer to Fig. 1-9). Suitable transport lugs should be used to hoist the built–in stators, e.g. ring bolts acc. to DIN 580.
- Bolt the face side of the stator to the spindle housing. The bolts must be evenly tightened, carefully measuring the torque.
- In order to check that the O ring seals are tight, the motor spindle cooling duct should be filled with a fluid and the pressure of this fluid continuously increased up to 7 bar. If there are any leaks, the sealing joints/surfaces and the O rings should be checked, and if required, replaced.

1.9 Electrical connection

Note

The build–in motors can be supplied from a DC link voltage up to 700 V DC (this is not valid for 1PH218□ and 1PH225□)

The connecting cables are in the form of free cable ends.

We recommend that the free cables are fed out at the spindle box in a suitable protective tubing with cable gland.

Effective strain relief must be provided.

Information and instructions for using cables is provided in VDE 0298, Part 3.

Cable cross–section (Cu) and outer diameter in the standard version, refer to Table 1-11.

Connecting cables

Table 1-11 Cable cross–section and outer diameter of the connecting cable

Motor type	Cable cross–section [mm^2]	Outer cable diameter [mm]
Build–in motors with sleeve		
1PH2093	2.5	3.6–4.4
1PH2095	4	4.3–5.5
1PH2113	10	6.4–7.9
1PH2115	10	6.4–7.9
1PH2117	10	6.4–7.9
1PH2118	16	7.5–9.0
1PH2182	6	max. 5.6
1PH2184	10	max. 7.2
1PH2186	10	max. 7.2
1PH2188	16	max. 9.2
1PH2254	25	max. 11
1PH2256	25	max. 11
Build–in motors without sleeve		
1PH2092	4	4.3–5.5
1PH2096	6	4.9–6.3
1PH2123	10	6.4–7.9
1PH2127	16	7.5–9.0
1PH2128	25	9.5–11.0
1PH2143	25	9.5–11.0
1PH2147	25	9.5–11.0

■

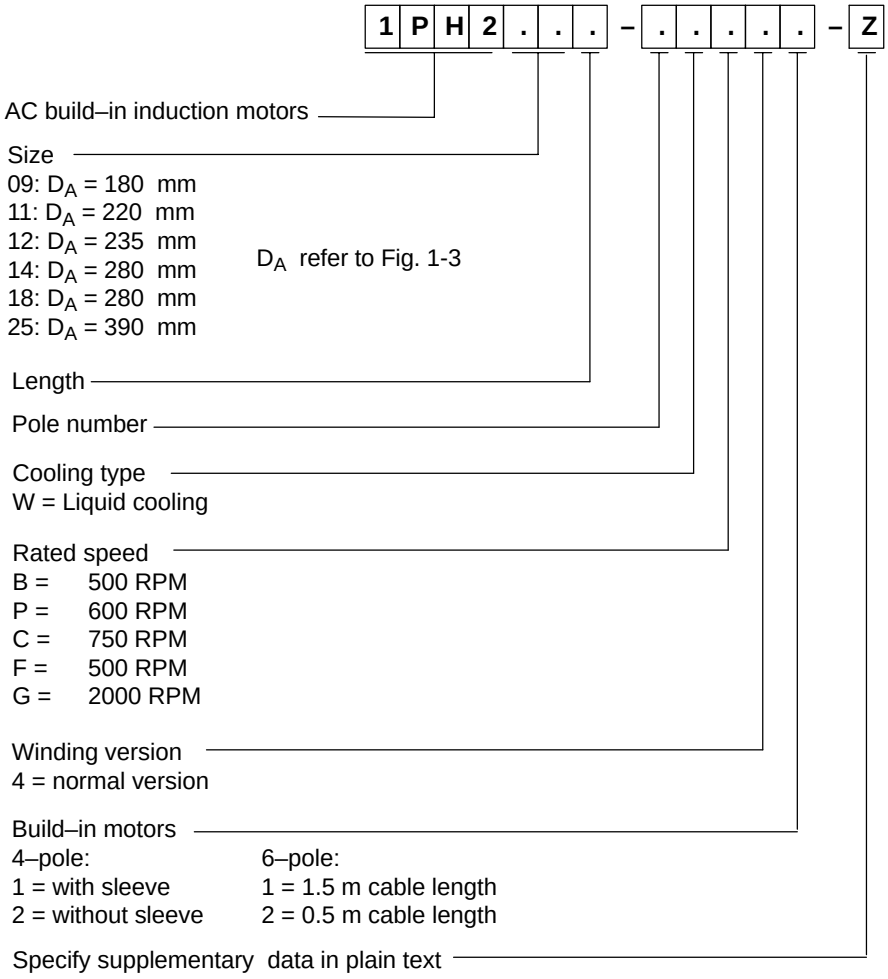
Order Designation

2

Order designation

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

The first block has seven positions and designates the motor type. Additional features are coded in the second block. The third block is provided for additional information.



Selection help

In addition to the electrical parameters (rated torque M_N, rated speed n_N, maximum speed n_{max}) the required mounting dimensions must be taken into account.

It must be checked to ensure that the total diameter D as well as the total length L of the motor matches the available mounting space.

It must be ensured that the inner bore d of the rotor is large enough to accept the spindle.

In order to make it as simple as possible to select the most suitable build–in motor, the following checklist should help you in determining the motor from Table 2-1. For terminology, refer to Fig. 2-1.

Table 2-1 Checklist

User: **Machine:**		**Date:** **Type:**	
Motor data	Code	Units	Value
Rated torque	M_N	Nm	
Rated speed	n_N	RPM	
Maximum speed	n_{max}	RPM	
Transition speed	n1	RPM	
Rated power	P_N	kW	
Mounting space			
Outer motor diameter	D	mm	
Motor length	L	mm	
Spindle geometry			
Outer spindle diameter in the motor area	d	mm	
Outer spindle diameter in the encoder area	$d_{Encoder}$	mm	
Inner spindle diameter	ds	mm	

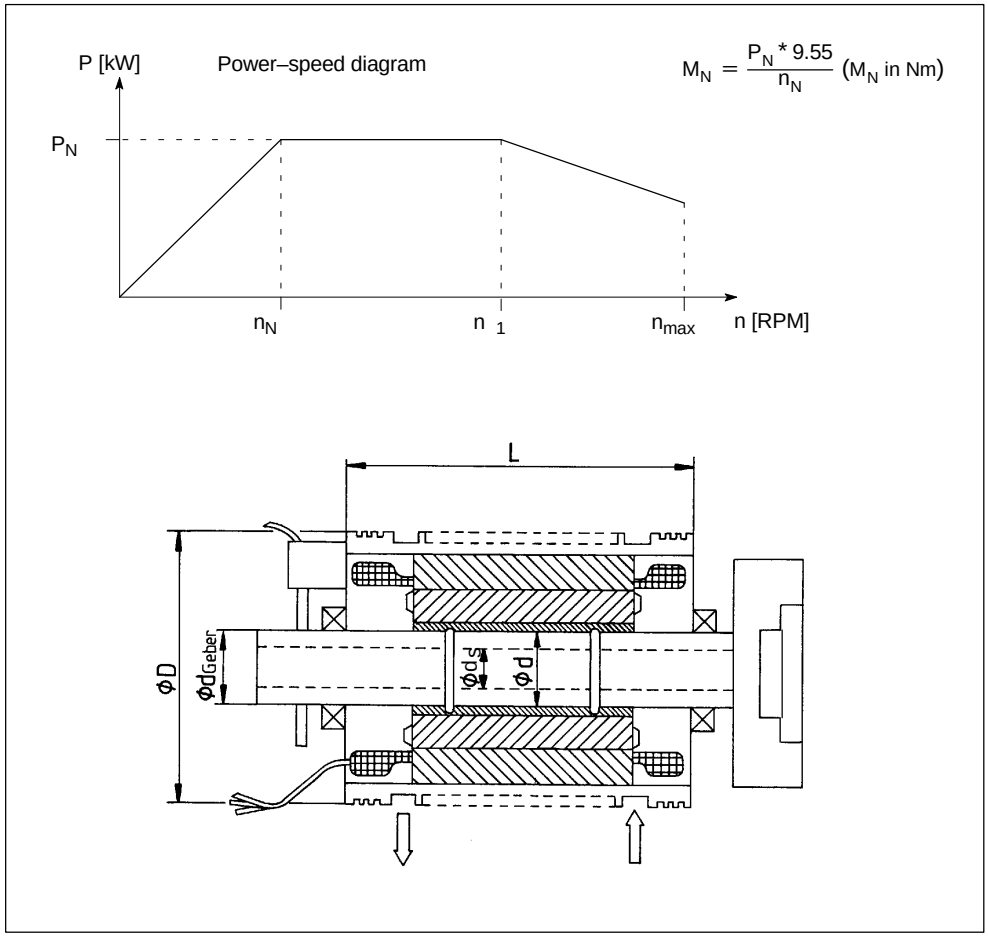


Fig. 2-1 Explanation of the terminology in the checklist

■

Space for your notes

Technical Data and Characteristics 3

3.1 Power–speed diagrams

Independent of the operating mode, the build–in motors must be continually cooled in operation.

Note

Depending on the design of the motor spindle, varying levels of frictional losses occur (e.g. bearing losses, losses at rotating glands).

The manufacturer of the build–in motors does not know the magnitude of these losses. This means that motor outputs and torques, specified in this documentation, refer to values which the build–in motor rotor transmits to the spindle. In order to be able to determine the net shaft power, all of the friction losses must be subtracted from the specified values.

The dotted lines in the diagrams indicate the power limit of the particular SIMODRIVE 611 for the specified build–in motor. The power module is specified.

3.1.1 Build–in motors with sleeve

Table 3-1 AC build–in motor 1PH2093–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
7.5	1500	48	24	4	10000	0.028	34

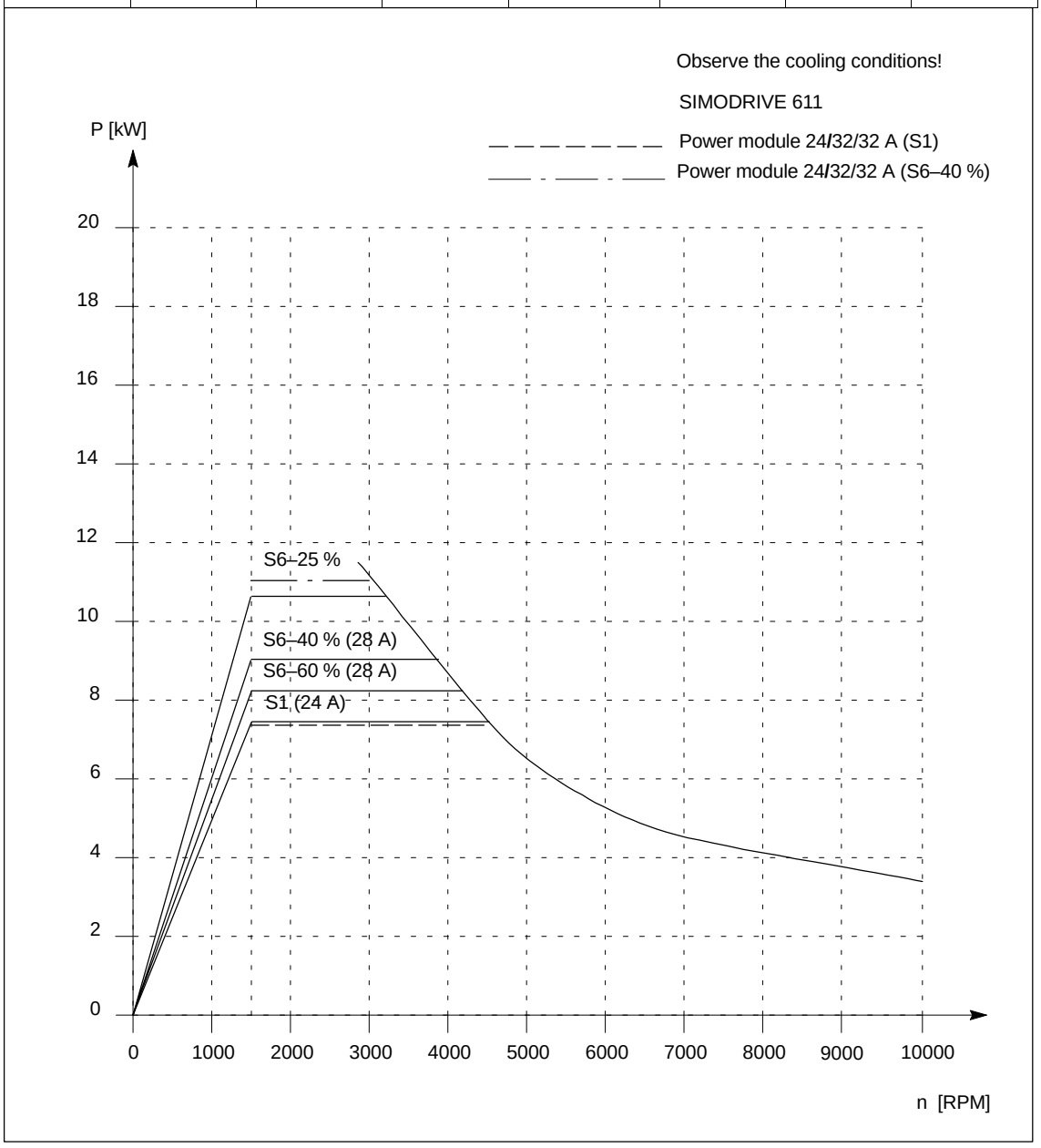


Fig. 3-1 Power–speed diagram 1PH2093–6WF4

Table 3-2 AC build–in motor 1PH2095–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
10	1500	64	30	4	10000	0.036	44

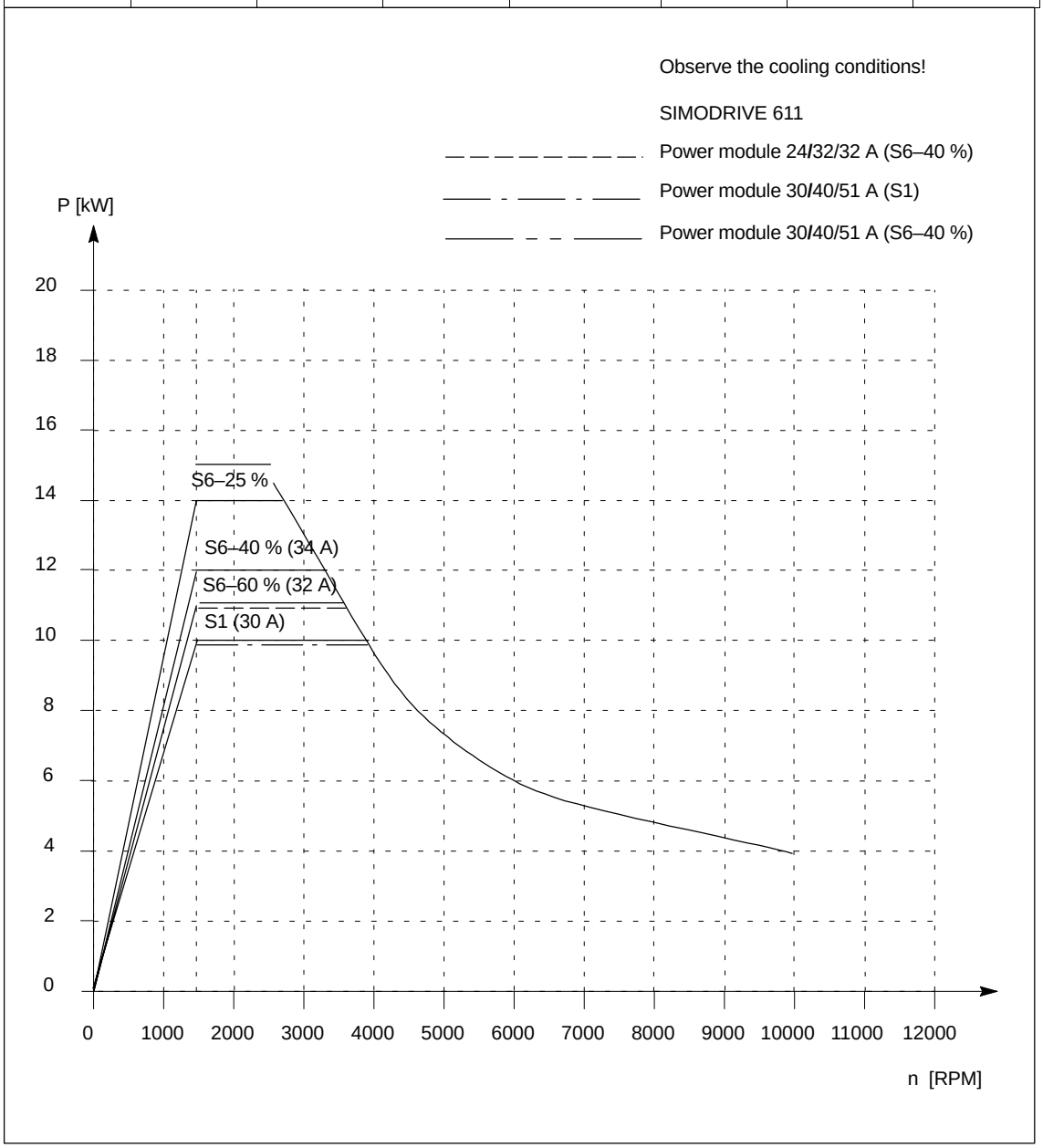


Fig. 3-2 Power–speed diagram 1PH2095–6WF4

Table 3-3 AC build–in motor 1PH2113–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
15	1500	95	56	6	10000	0.066	59

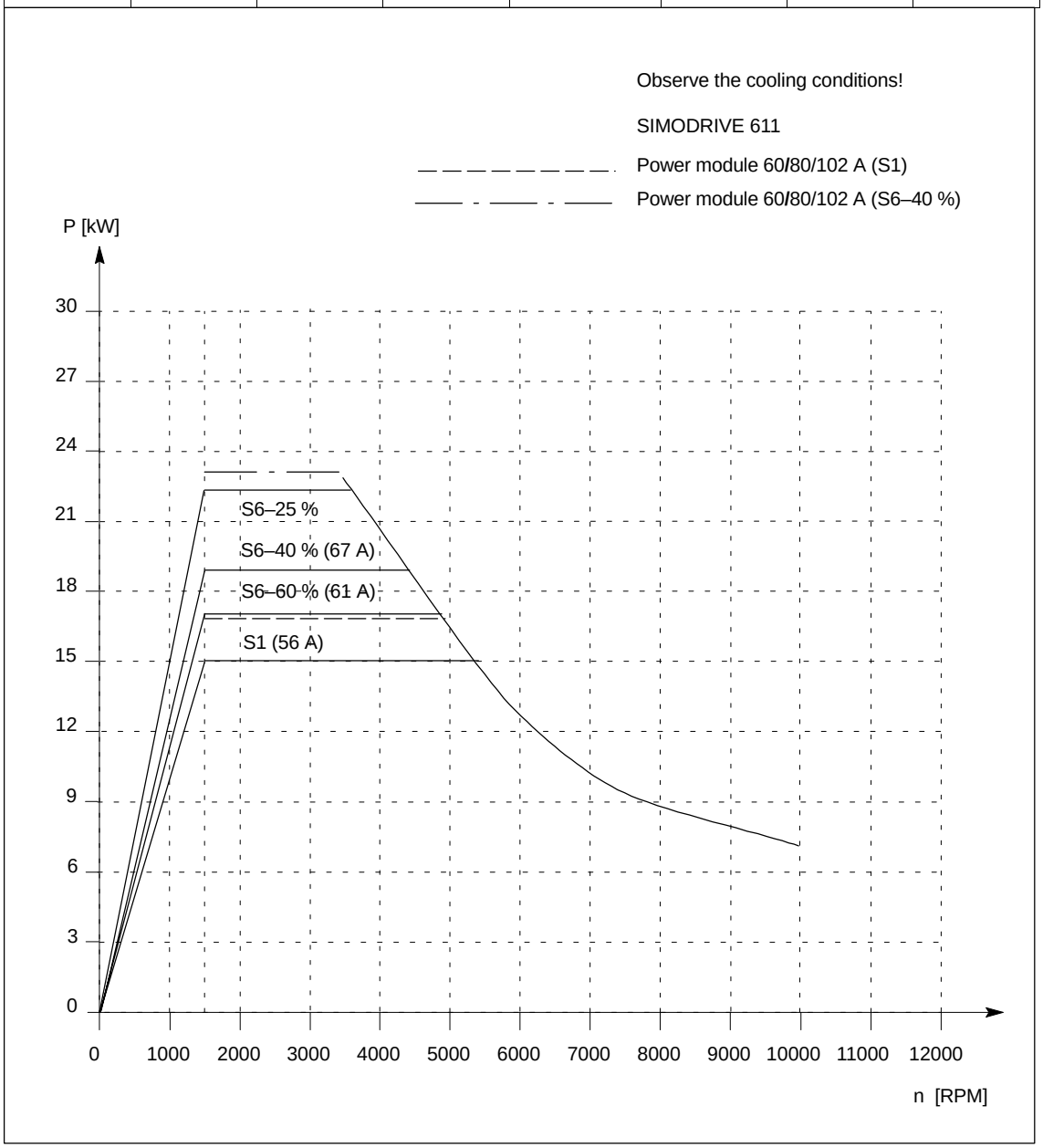


Fig. 3-3 Power–speed diagram 1PH2113–6WF4

Table 3-4 AC build–in motor 1PH2115–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
16.5	1500	105	55	6	10000	0.073	65

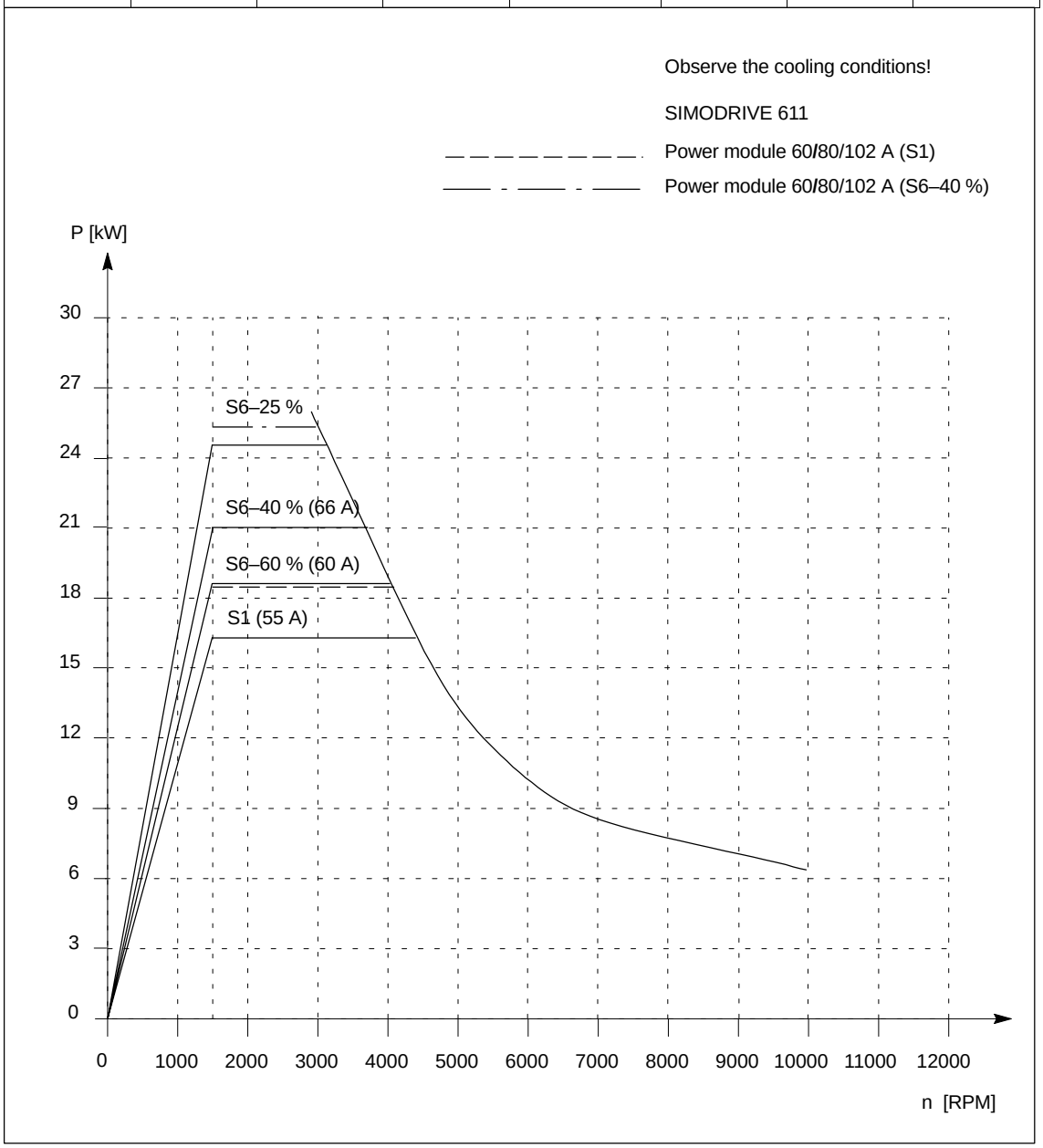


Fig. 3-4 Power–speed diagram 1PH2115–6WF4

Table 3-5 AC build–in motor 1PH2117–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
18	1500	115	60	6	10000	0.079	72

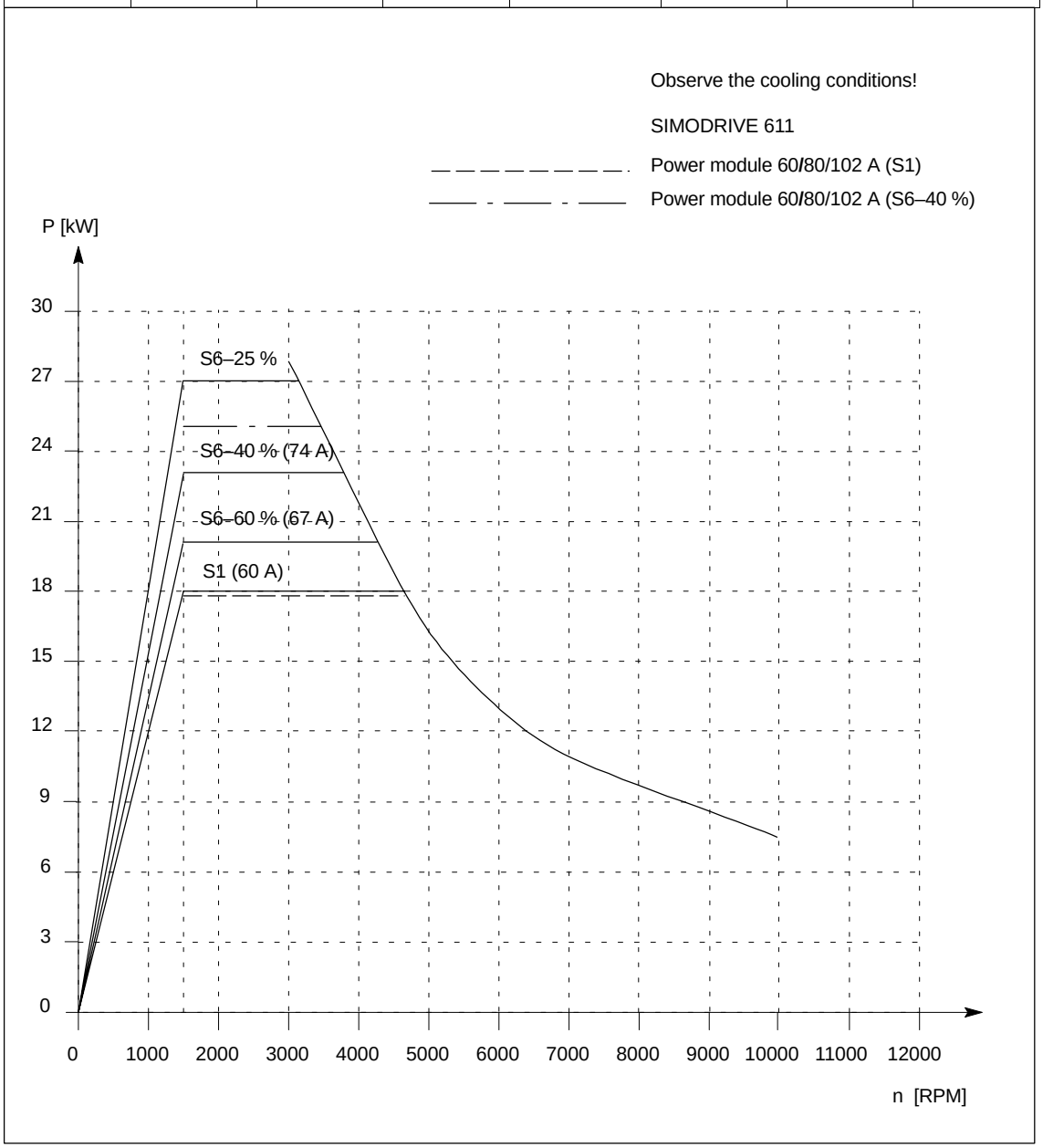


Fig. 3-5 Power–speed diagram 1PH2117–6WF4

Table 3-6 AC build–in motor 1PH2118–6WF4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
23	1500	146	82	6	10000	0.100	89

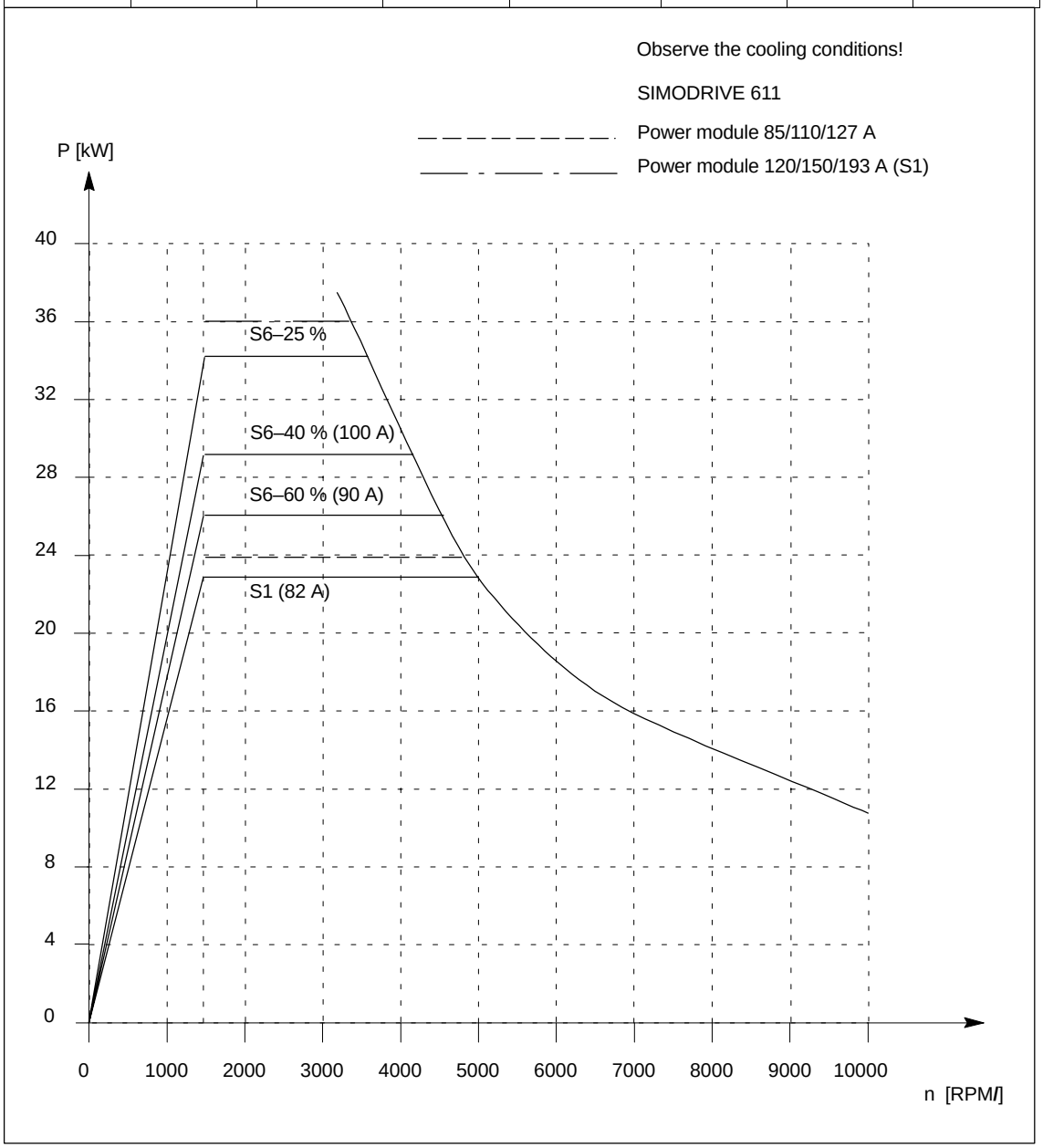


Fig. 3-6 Power–speed diagram 1PH2118–6WF41

Table 3-7 AC build–in motor 1PH2182–6WC4

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
11.8	750	150	37	20	8000	0.218	98

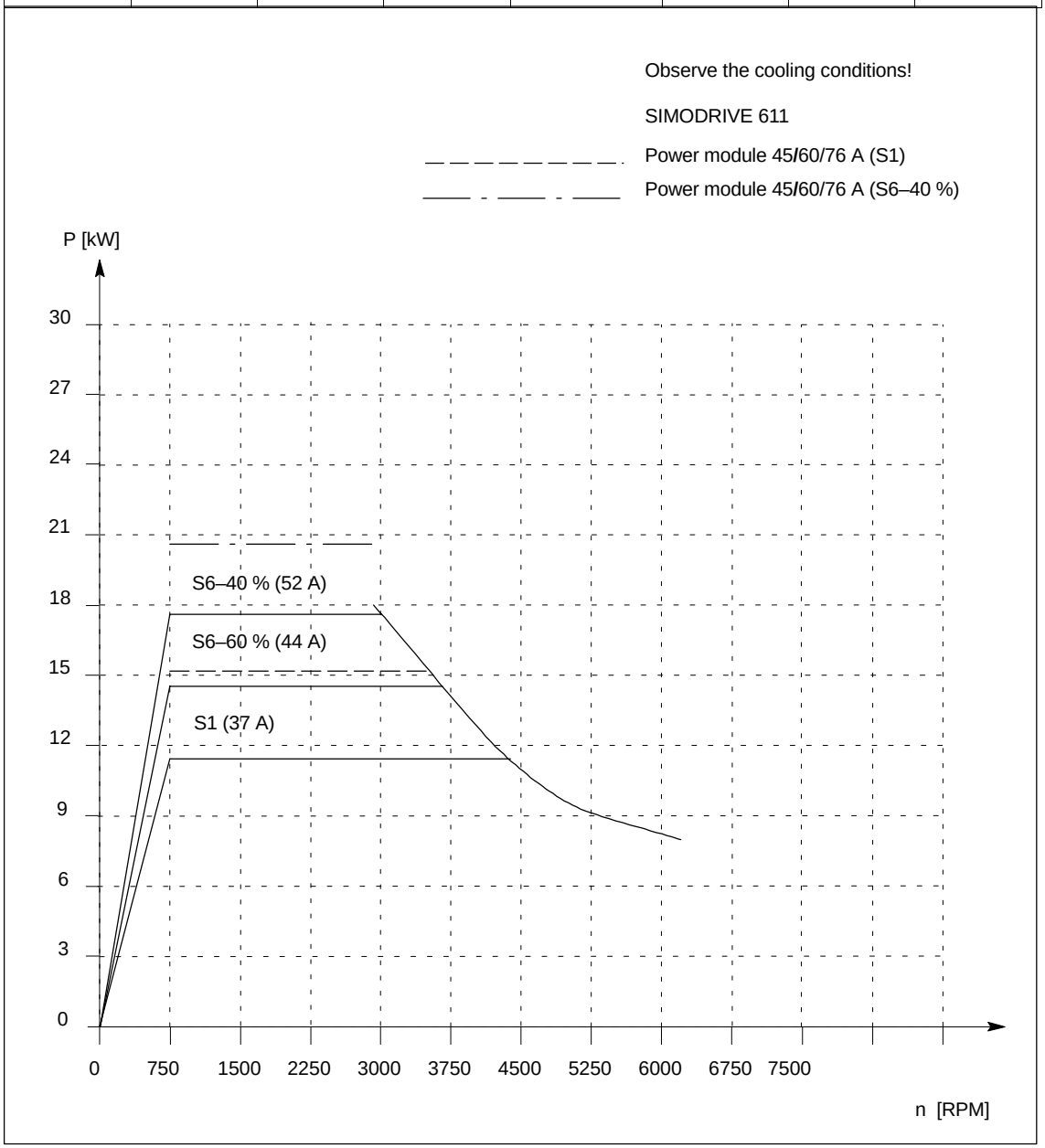


Fig. 3-7 Power–speed diagram 1PH2182–6WC4

Table 3-8 AC build–in motor 1PH2184–6WP41

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
14.5	600	230	56	20	8000	0.306	136

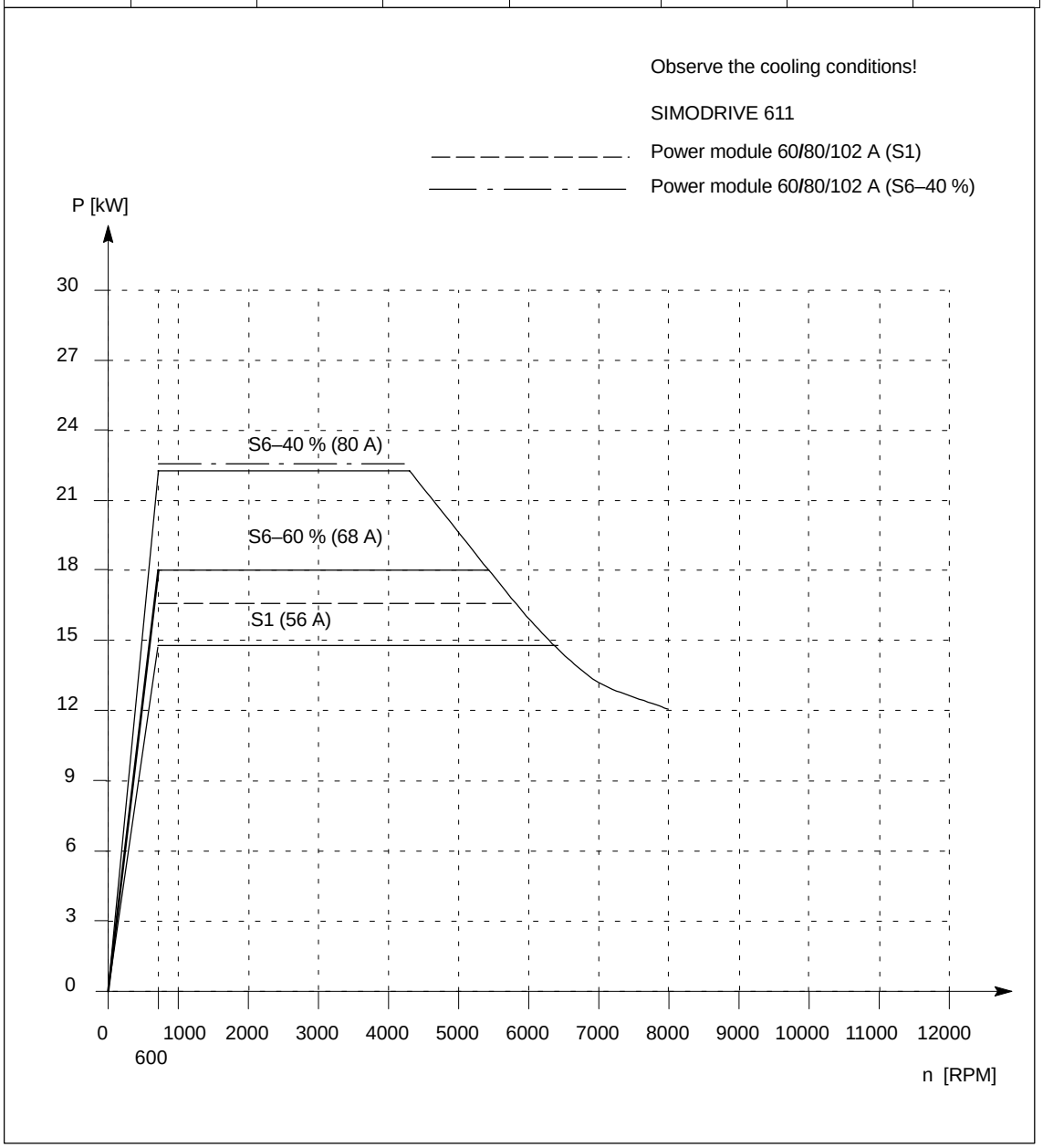


Fig. 3-8 Power–speed diagram 1PH2184–6WP41

Table 3-9 AC build–in motor 1PH2186–6WB41

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
18.3	500	350	65	20	8000	0.428	191

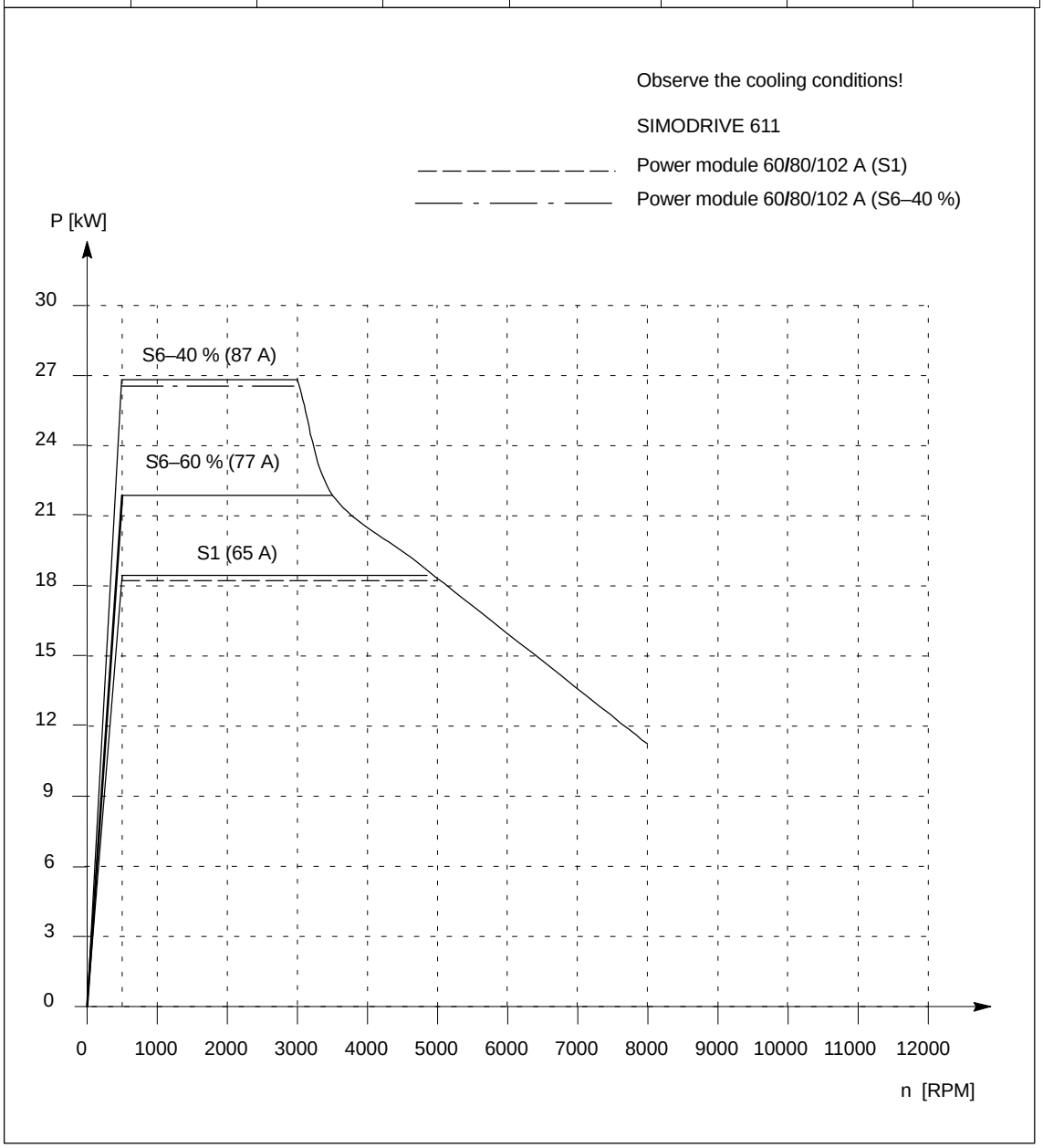


Fig. 3-9 Power–speed diagram 1PH2186–6WB41

Table 3-10 AC build–in motor 1PH2188–6WB41

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
23.6	500	450	78	20	6000	1.018	237

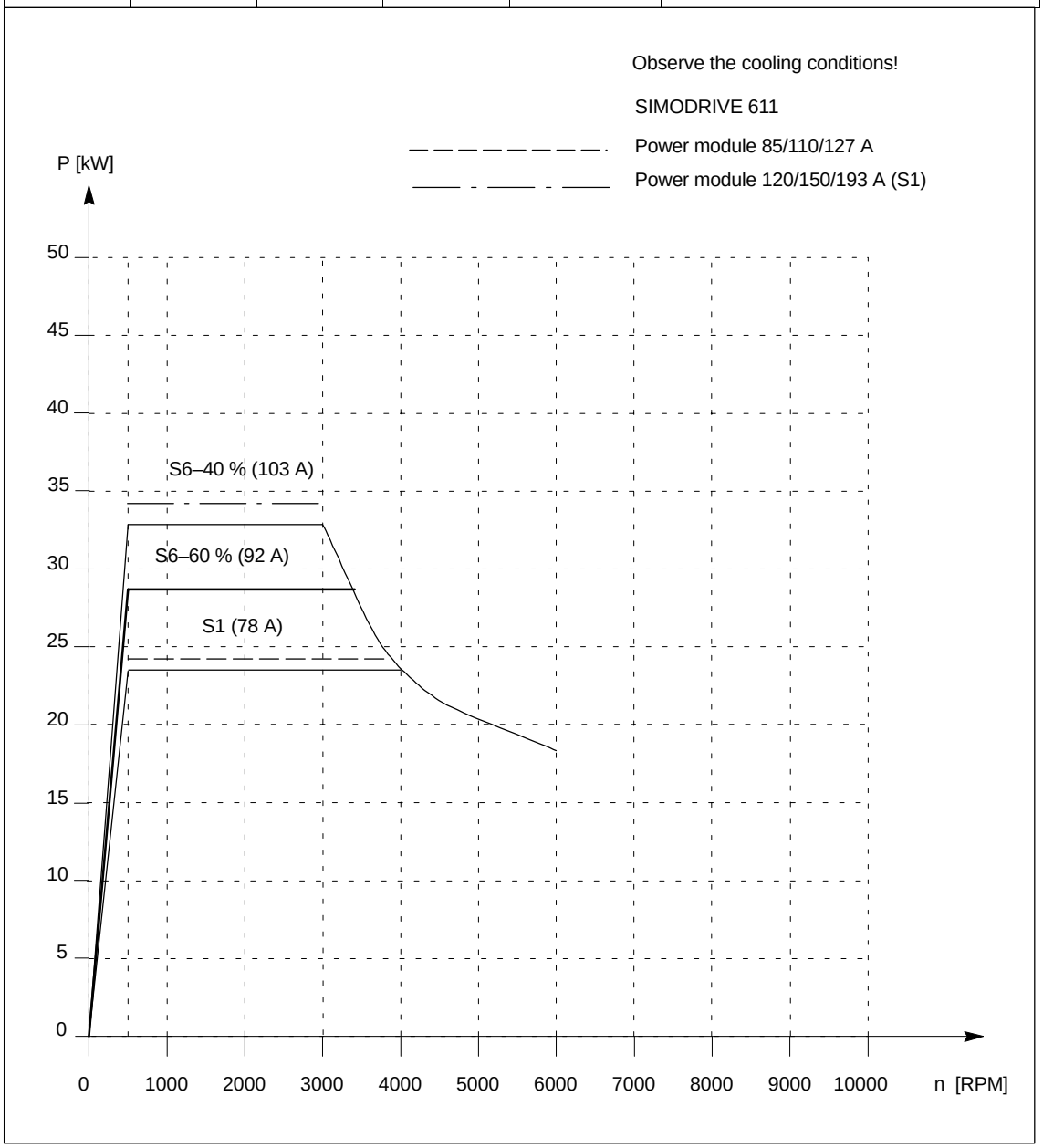


Fig. 3-10 Power–speed diagram 1PH2188–6WB41

Table 3-11 AC build–in motor 1PH2254–6WB41

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
28.8	500	550	117	20	6000	1.215	260

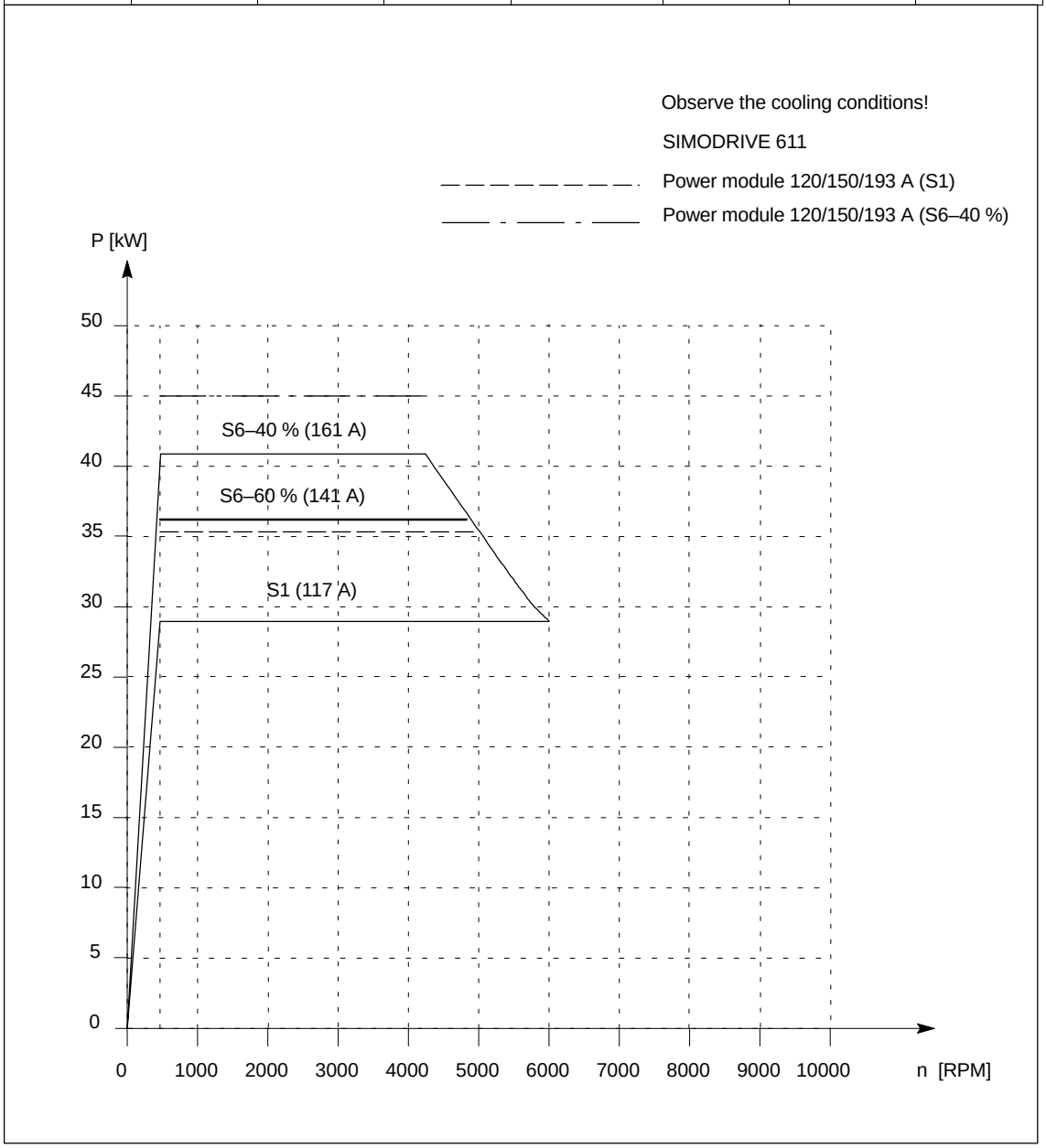


Fig. 3-11 Power–speed diagram 1PH2254–6WB41

Table 3-12 AC build–in motor 1PH2256–6WB41

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
39.3	500	750	119	20	4000	1.649	344

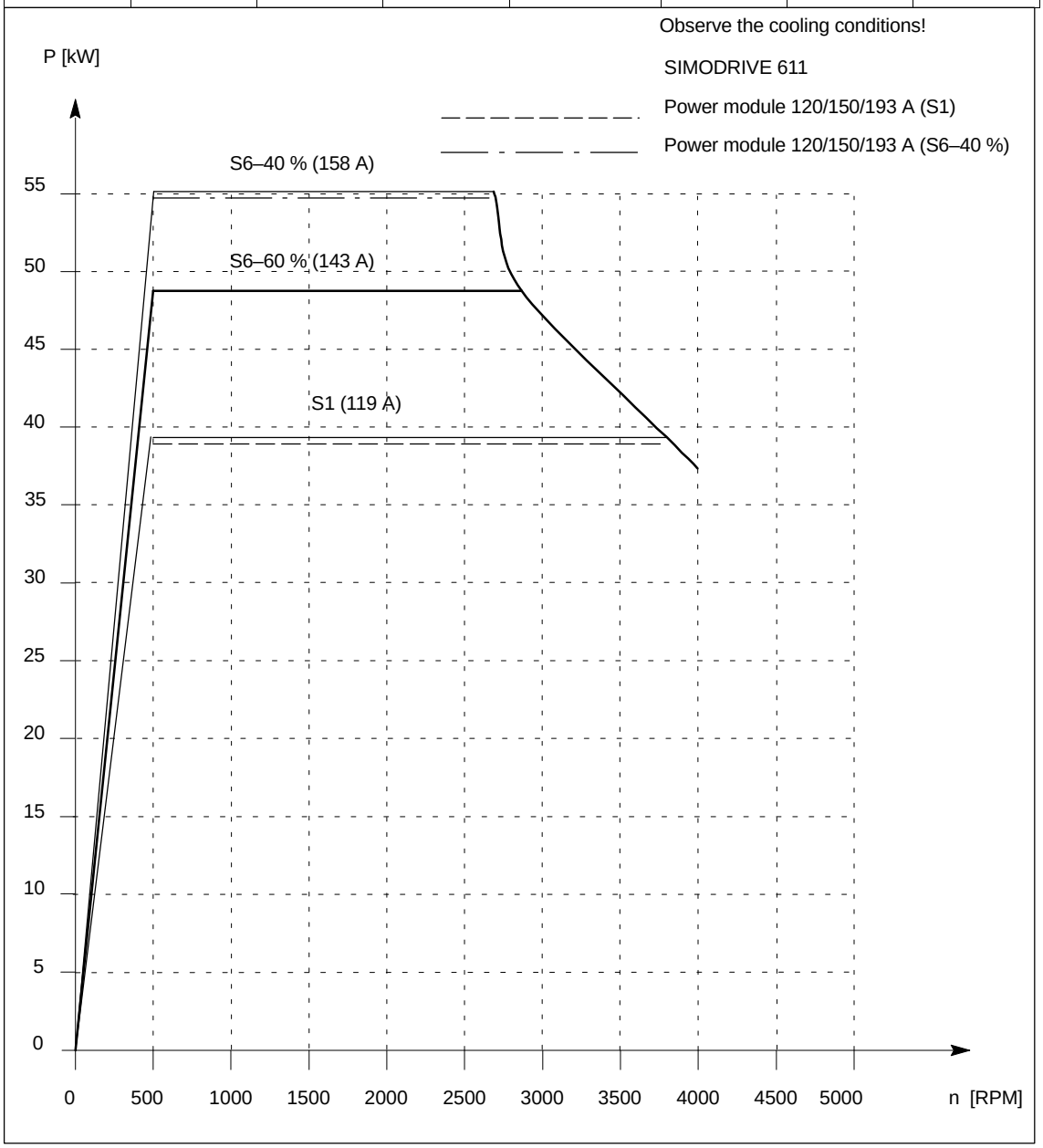


Fig. 3-12 Power–speed diagram 1PH2256–6WB41

3.1.2 Build–in motors without sleeve

Table 3-13 AC build–in motor 1PH2092–4WG42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
4.7	2000	22	22	4	18000	0.01	26

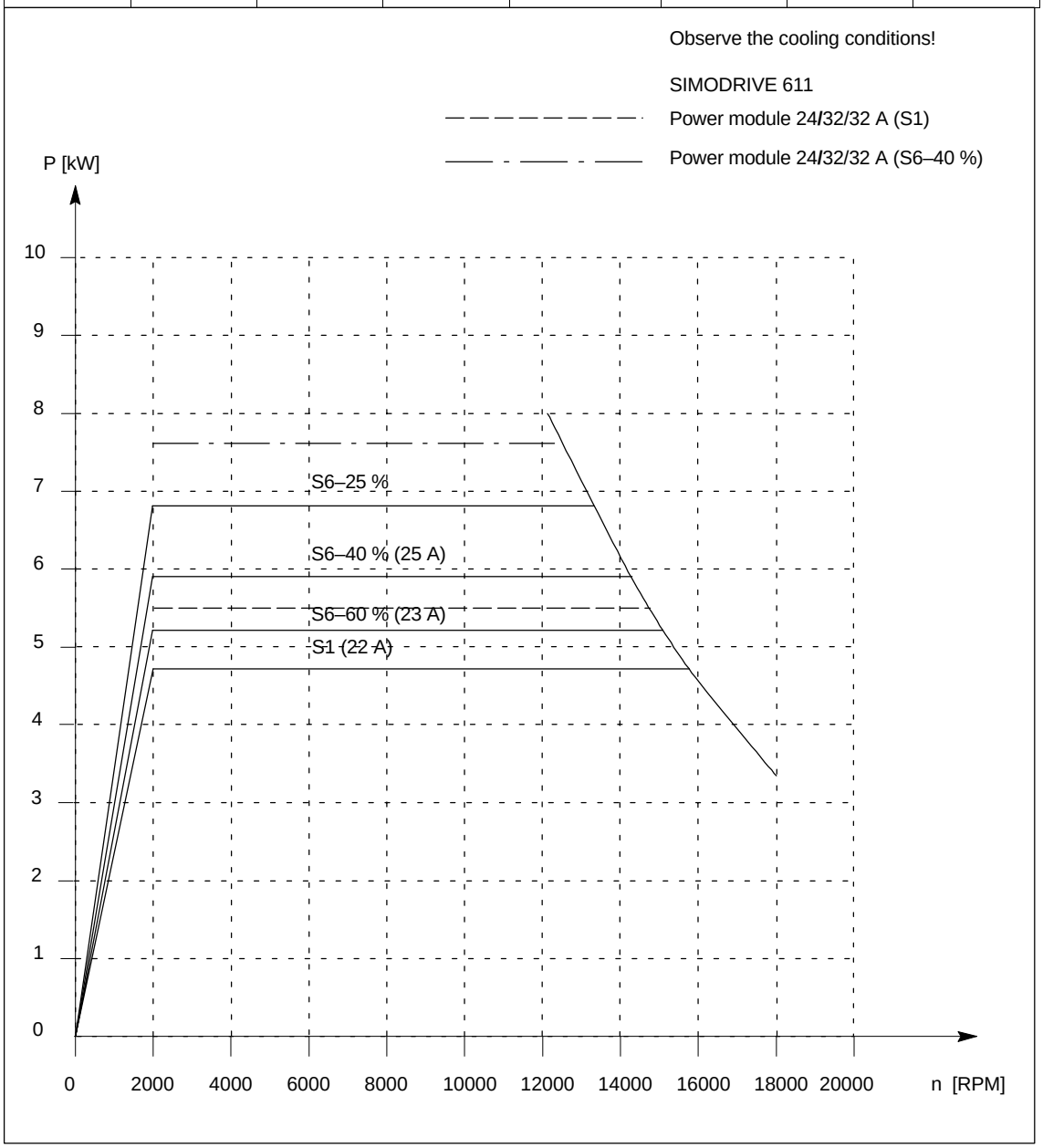


Fig. 3-13 Power–speed diagram 1PH2092–4WG42

Table 3-14 AC build–in motor 1PH2096–4WG42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
10	2000	48	43	4	18000	0.021	47

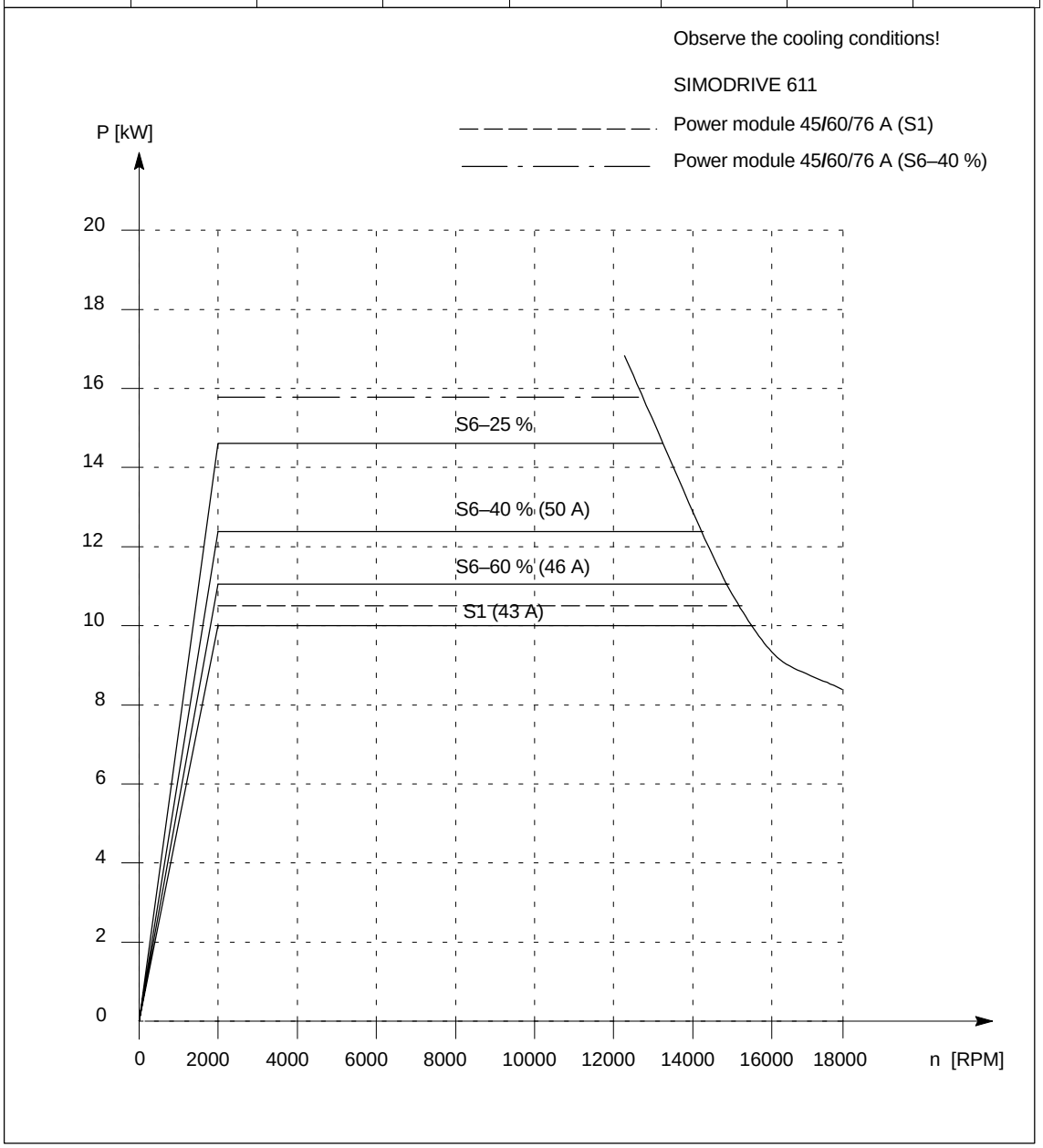


Fig. 3-14 Power–speed diagram 1PH2096–4WG42

Table 3-15 AC build–in motor 1PH2123–4WF42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
11.5	1500	73	57	8	16000	0.044	62

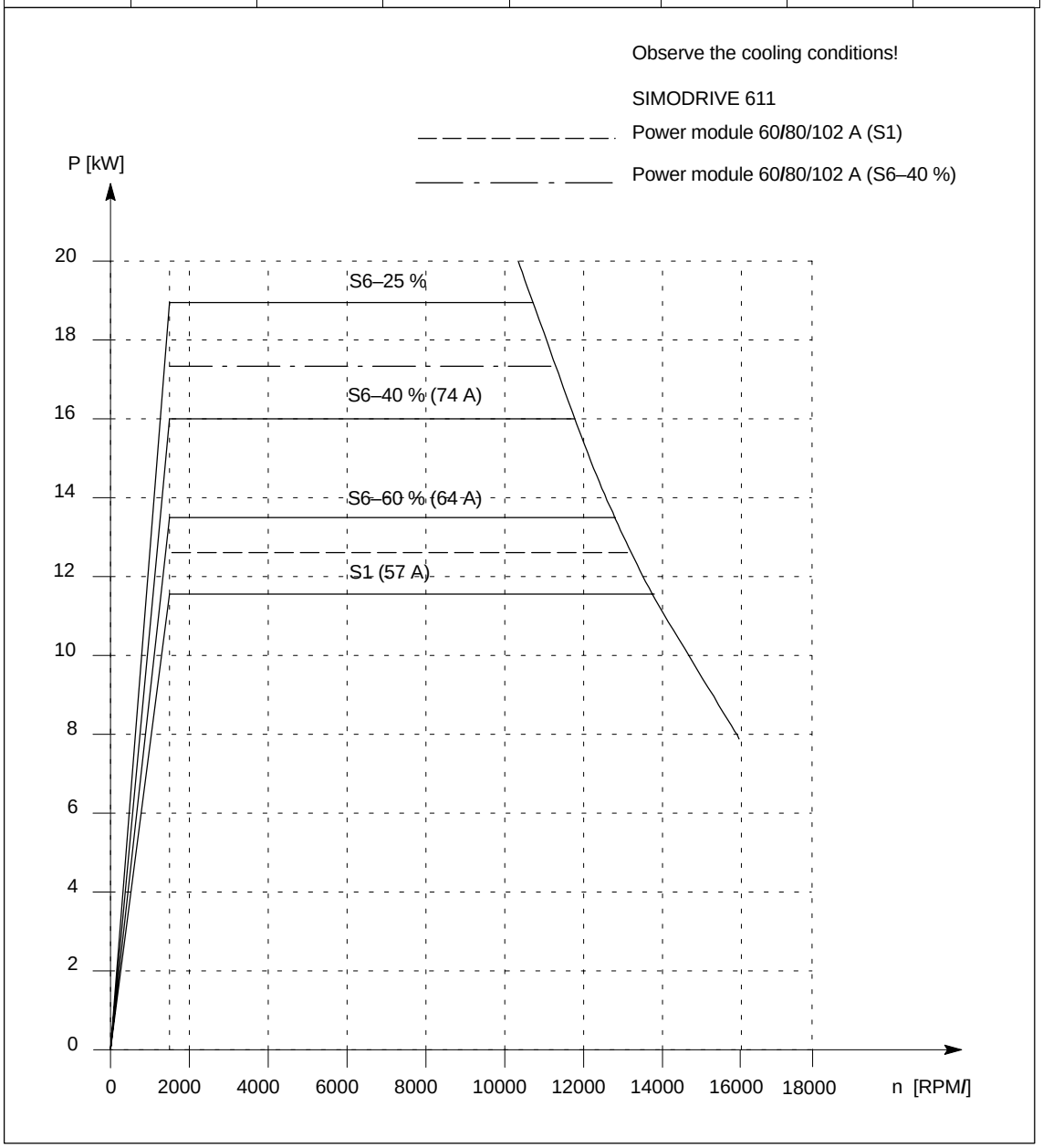


Fig. 3-15 Power–speed diagram 1PH2123–4WF42

Table 3-16 AC build–in motor 1PH2127–4WF42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
21	1500	134	85	8	16000	0.081	104

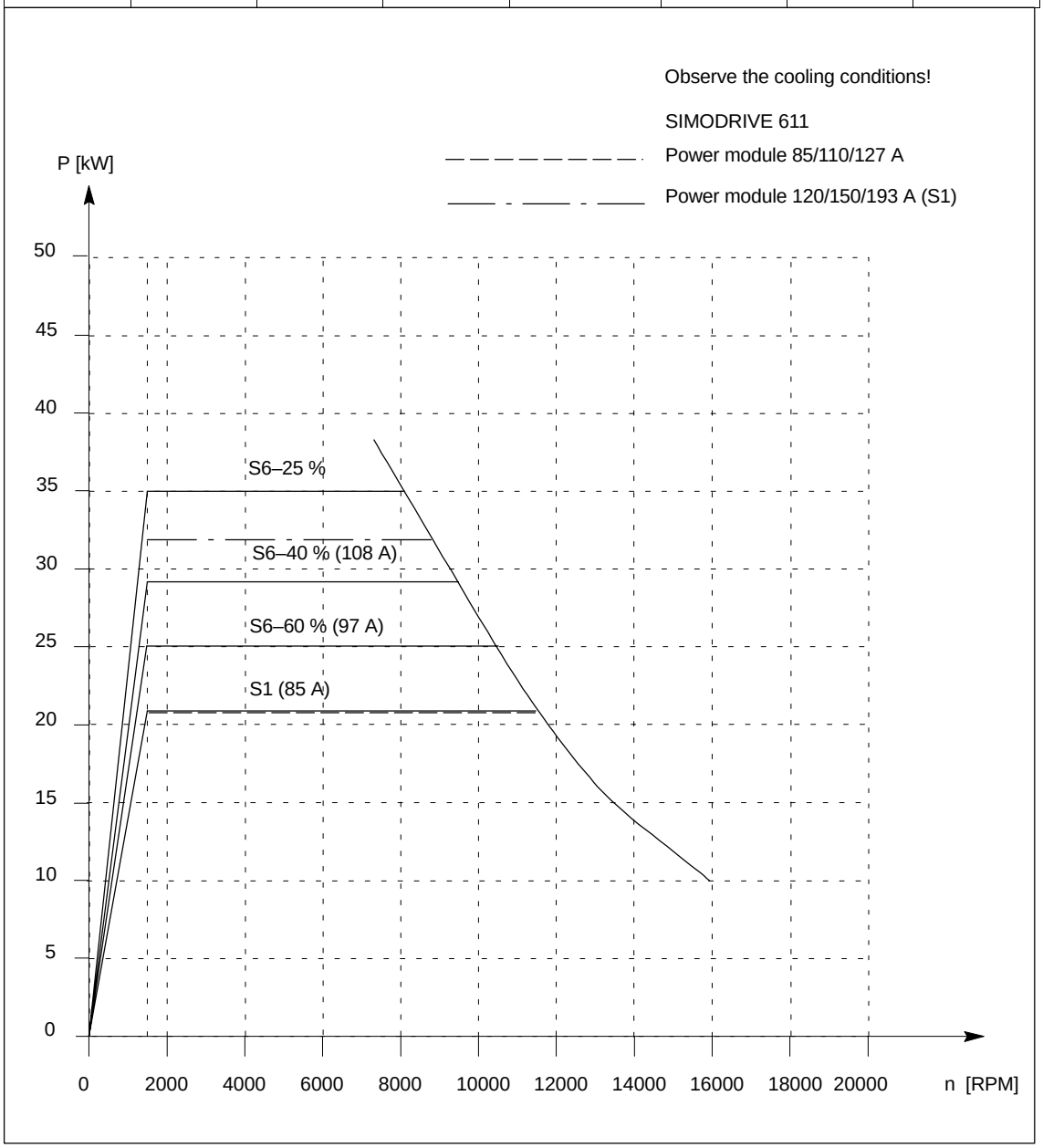


Fig. 3-16 Power–speed diagram 1PH2127–4WF42

Table 3-17 AC build–in motor 1PH2128–4WF42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
25	1500	159	101	8	16000	0.103	127

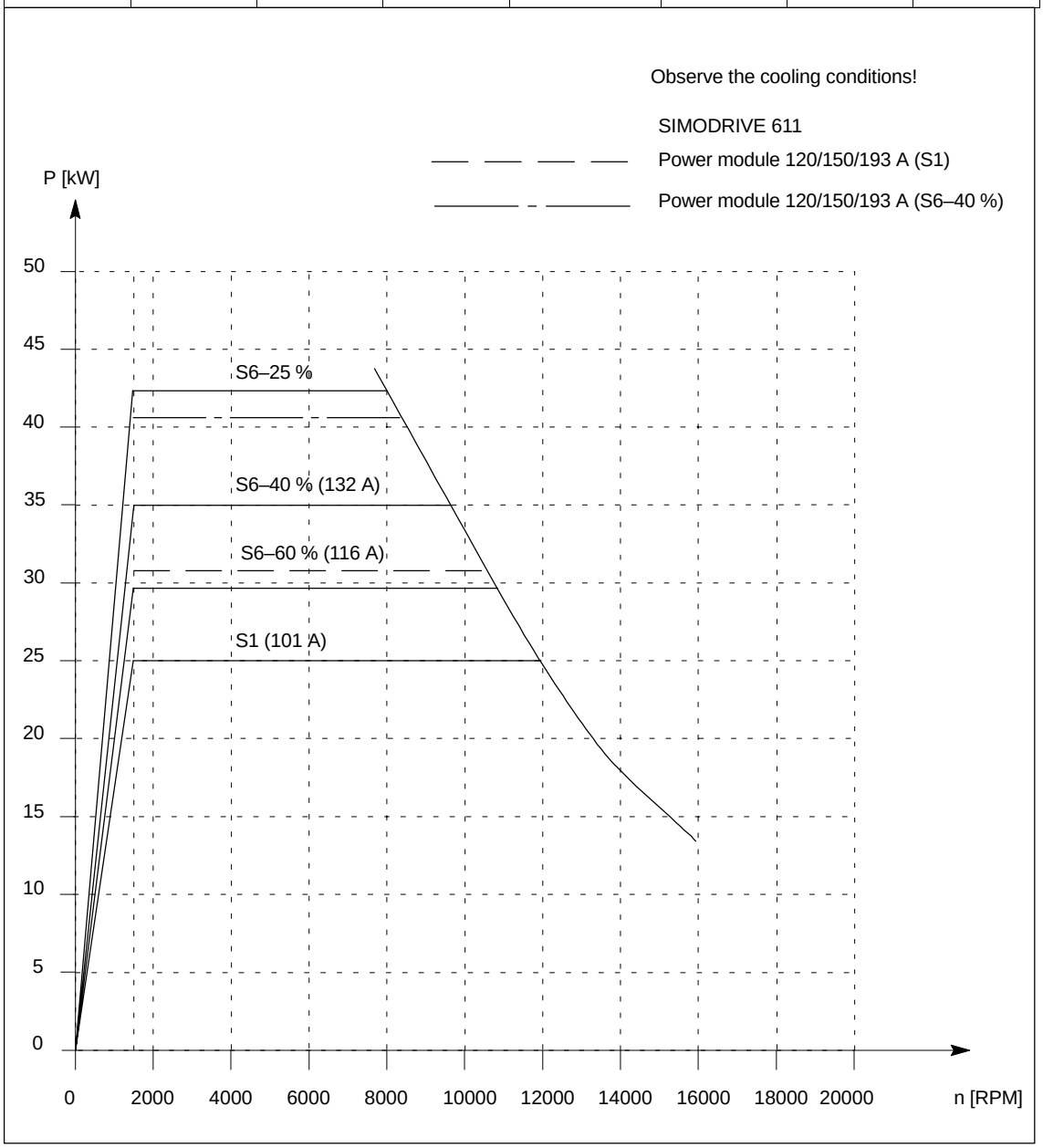


Fig. 3-17 Power–speed diagram 1PH2128–4WF42

Table 3-18 AC build–in motor 1PH2143–4WF42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
30	1500	191	101	10	12000	0.154	137

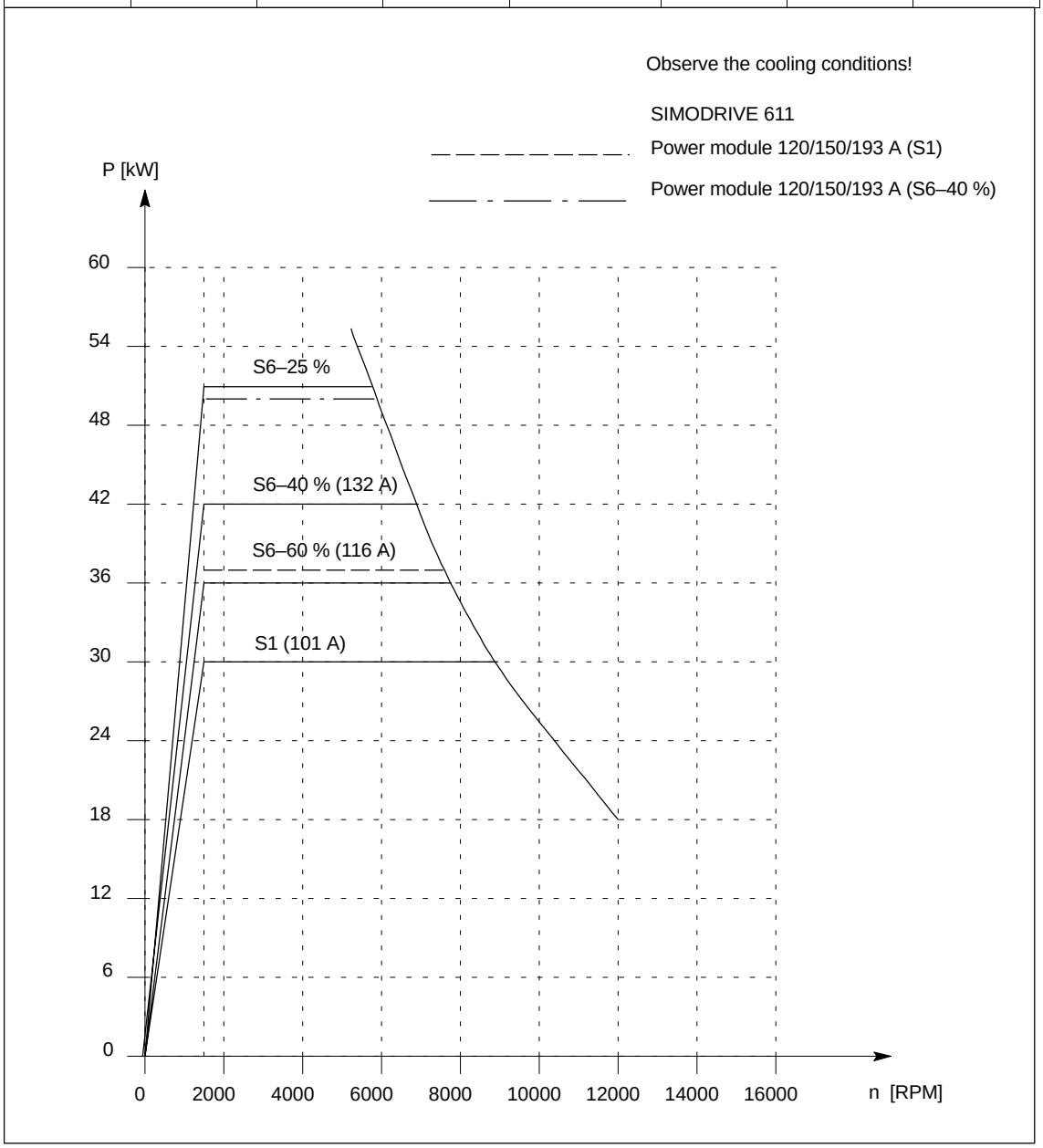


Fig. 3-18 Power–speed diagram 1PH2143–4WF42

Table 3-19 AC build–in motor 1PH2147–4WF42

Rated power P_N [kW]	Rated speed n_N [RPM]	Rated torque M_N [Nm]	Rated current I_N [A]	Time constant (therm.) T_{th} [min]	Max. speed n_{max} [RPM]	Moment of inertia J [kgm^2]	Weight m [kg]
38	1500	242	116	10	12000	0.187	164

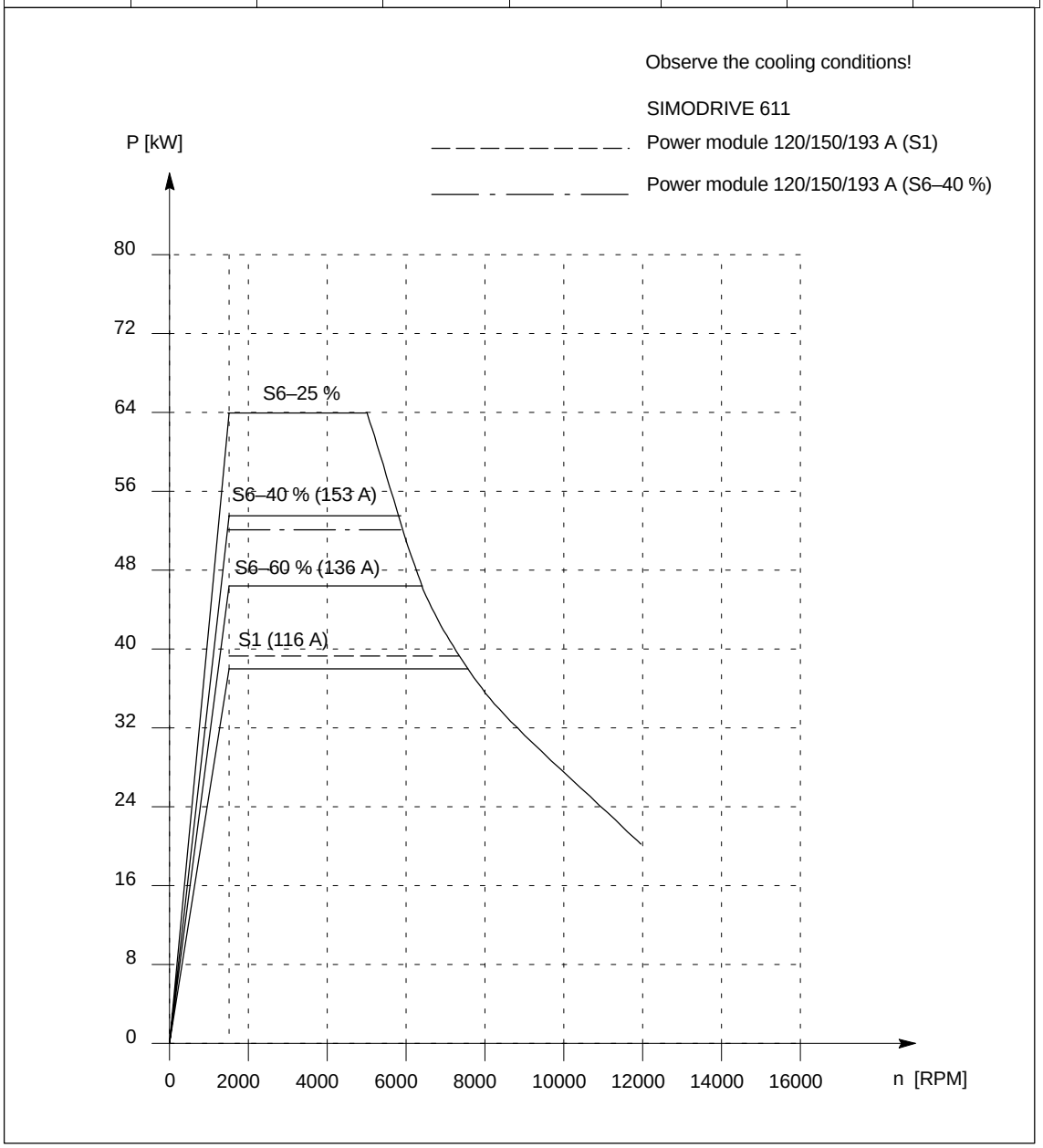


Fig. 3-19 Power–speed diagram 1PH2147–4WF42

Motor Components (Options)

4

4.1 Thermal motor protection

Type:	KTY 84
Resistance when cold (20 °C):	approx. 580 Ohm
Resistance when hot (100 °C):	approx. 1000 Ohm
Connection:	using an encoder cable
Response temperature:	Pre–alarm at 120 °C Shutdown at 155 °C $\pm$ 5 °C

The resistance change is proportional to the winding temperature change. For 1PH motors, the temperature characteristic is taken into account in the closed–loop control.

The pre–alarm signal from the evaluation circuit in the SIMODRIVE drive converter can be externally evaluated.

High short–time overload conditions require additional protective measures. This is due to the thermal coupling time of the sensor. If the overload condition ($4 \cdot M_0$) lasts longer than 4 s, additional protection should be provided.

The temperature sensor cables are included in the encoder cable.

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 is carried–out! If the test voltage is connected to only one terminal of the temperature sensor, it will be destroyed.

Carefully observe the polarity when connecting–up!

Caution

The integrated temperature sensor protects the motors against overload conditions up to 4 • $I_{0\ 60K}$ (= shaft height 63) and speed <> 0.

There is no adequate protection against thermally critical load situations, e.g. a high overload at motor standstill. In this case, other protective measures must be provided, e.g. a thermal overcurrent relay.

If they exist, reduced data for standstill is specified.

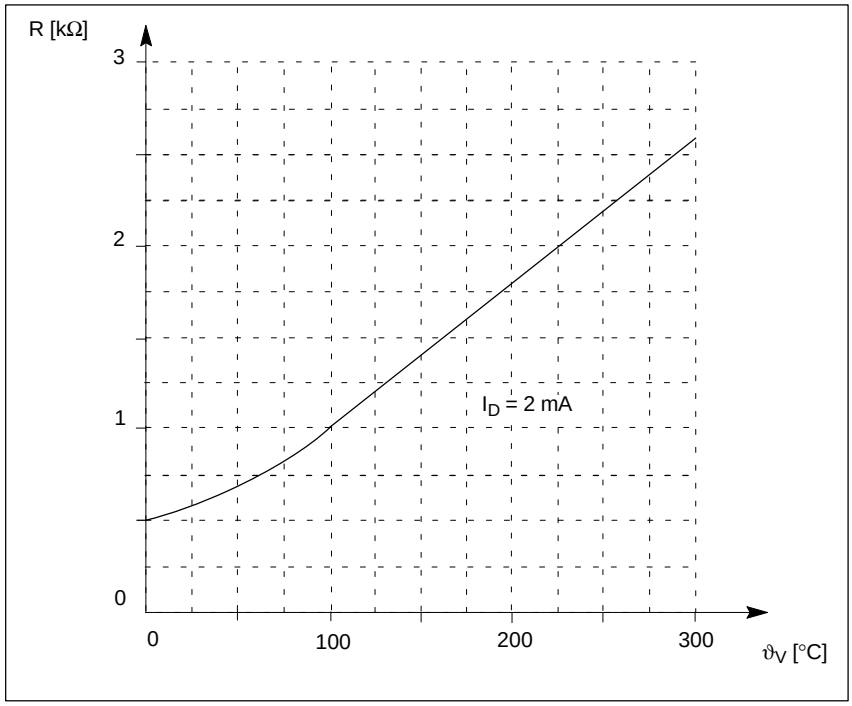


Fig. 4-1 Resistance characteristic as a function of the KTY 84 thermistor temperature

4.2 SIZAG 2 toothed–wheel encoder

Applications

To sense the speed and position of 1PH2 build–in motors or as spindle encoder for conventional spindle drives.

Note

The toothed–wheel encoder is not included with the 1PH2 motors.

Output signals

- Sinusoidal signals
- Incremental track for position sensing and closed–loop speed control
- Zero track as reference signal
- Clearance track for amplitude adaptation at power–on

Design

- Toothed wheel
  with 256 or 512 teeth; module m = 0.3 or 0.5.
  Various inner and outer diameters (refer to the technical data and dimension drawings).
- Scanning head
  with connecting cable and flange–mounted socket including retaining kit (this is provided with the device); module m = 0.3 or 0.5.

Note

Only toothed wheels and scanning heads with the same module m may be combined.

Connection

Table 4-1 Connecting cables, toothed–wheel encoder

	Spindle encoder (direct measuring system)	Motor encoder (indirect measuring system)
SIMODRIVE 611 digital	6FX2002–2CA15–□□□□	6FX2002–2CA31–□□□□
SIMODRIVE 611 analog	6FX2002–2CA71–□□□□	6FX2002–2CA51–□□□□
SIMODRIVE 611 analog and high–resolution position	6FX2002–2CA51–□□□□	6FX2002–2CA51–□□□□

Caution

It should be ensured that suitable HF grounding is provided.

In order to secure the noise immunity, the scanning head and the flange–mounted socket must be mounted on grounded metal.

Scope of supply

- Toothed wheel
- Scanning head with connecting cable
- Split flange–mounted socket with mounting screws
- Feeler gauge
  - for module m=0.3: 0.15 mm
  - for module m=0.5: 0.30 mm

Technical data

Table 4-2 Technical data

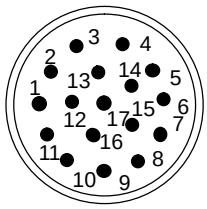
Mech. limiting speed for Z=512 for Z=256	 nmax.=12000 RPM nmax.=24000 RPM
Operating voltage	5V± 5%
Current drain	250 mA (typ.)
Incremental signals	1 V_{pp}
No. of teeth Absolute accuracy for the ideal mounting	256 or 512 ±36” mech. for Z=512 teeth ±72” mech. for Z=256 teeth
Errors due to incorrect centering	Dependent on the toothed wheel used (refer to Table 2–1)
Degree of protection	IP65 acc. to DIN 40050

Table 4-2 Technical data, continued

Operating temperature and Storage temperature	 –20 °C to +85 °C
Immunity to vibration Vibration (0–2000 Hz) Shock (11 ms)	 200 m/s^2 acc. to DIN IEC 68–2–6 1000 m/s^2 acc. to DIN IEC 68–2–27
Weight (scanning head)	approx. 0.3 kg

Connection, flange–mounted socket 17-pin (pin contacts)

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



When viewing the connector side (plug contacts)

Mating connector: 6FX2003–0CE17 (socket)

Connecting cable at the encoder: with split flange–mounted socket
Permissible bending radius:
> 100 mm for continuous bending
> 52 mm for one single bend

4.2.1 Toothed–wheel versions and order designations

Table 4-3 Overview, toothed–wheel versions

Order designation	Z	a [mm]	m	d_{iz} [mm]	d_k [mm]	b [mm]	Weight [g]	J [$kgm^2 \cdot 10^{-3}$]	Error per 1 µm eccentricity ["]
6FX2001–8RA03–1B	256	0.15	0.3	45	77.4	15	360	2.9	5.3
6FX2001–8RA03–1C	256	0.15	0.3	60	77.4	15	220	2.1	5.3
6FX2001–8RA03–1D	512	0.15	0.3	80	154.2	15	1600	48.3	2.7
6FX2001–8RA03–1E	512	0.15	0.3	110	154.2	15	1070	38.5	2.7
6FX2001–8RA05–1F	256	0.3	0.5	65	129.0	15	1140	23.8	3.2
6FX2001–8RA05–1G	512	0.3	0.5	150	257.0	15	4000	364.2	1.6

Z	No. of teeth
a	Distance betw. the tooth wheel crown circle and the scanning head
m	Module
d_{iz}	Inner diameter; fit H6
d_k	Tooth wheel crown diameter
b	Tooth width
J	Moment of inertia

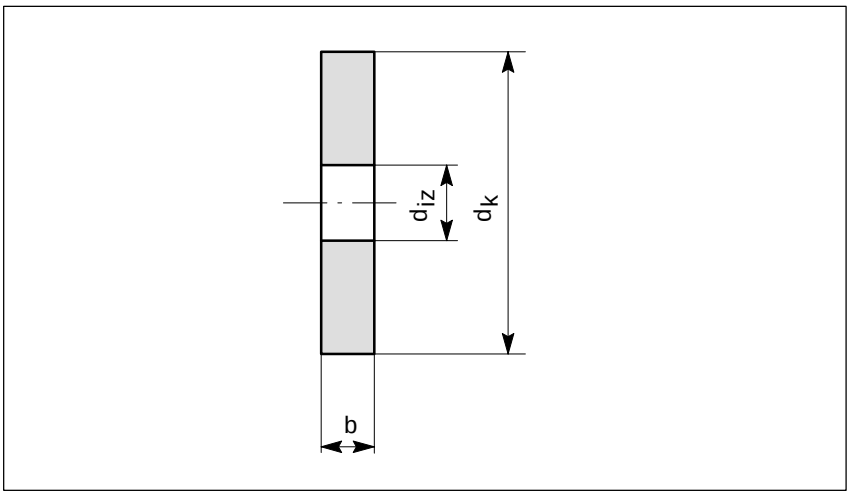


Fig. 4-2 Dimension drawing

4.2.2 Scanning head versions and order designations

Table 4-4 Overview, scanning head versions

Order designation	Module m	Connecting cable
6FX2001–8AA03 6FX2001–8AA05	0.3 0.5	0.5 m 0.5 m
6FX2001–8AJ03 6FX2001–8AJ05	0.3 0.5	2.0 m 2.0 m
6FX2001–8AK03 6FX2001–8AK05	0.3 0.5	0.2 m 0.2 m

4.2.3 Assignment, encoders for 1PH2 motors

Motor encoder assignment

Table 4-5 Encoder assignment

Motor type	Scanning head	Toothed wheel
1PH2 092	6FX2001–8A□03	6FX2001–8RA03–1B
1PH2 096	6FX2001–8A□03	6FX2001–8RA03–1B
1PH2 123	6FX2001–8A□03	6FX2001–8RA03–1C
1PH2 127	6FX2001–8A□03	6FX2001–8RA03–1C
1PH2 128	6FX2001–8A□03	6FX2001–8RA03–1C
1PH2 143	6FX2001–8A□05	6FX2001–8RA05–1F
1PH2 147	6FX2001–8A□05	6FX2001–8RA05–1F
1PH2 093	6FX2001–8A□05	6FX2001–8RA05–1F
1PH2 095	6FX2001–8A□05	6FX2001–8RA05–1F
1PH2 113	6FX2001–8A□03	6FX2001–8RA03–1D
1PH2 115	6FX2001–8A□03	6FX2001–8RA03–1D
1PH2 117	6FX2001–8A□03	6FX2001–8RA03–1D
1PH2 118	6FX2001–8A□03	6FX2001–8RA03–1D
1PH2 182	6FX2001–8A□03	6FX2001–8RA03–1E
1PH2 184	6FX2001–8A□03	6FX2001–8RA03–1E
1PH2 186	6FX2001–8A□03	6FX2001–8RA03–1E
1PH2 188	6FX2001–8A□03	6FX2001–8RA03–1E
1PH2 254	6FX2001–8A□05	6FX2001–8RA05–1G
1PH2 256	6FX2001–8A□05	6FX2001–8RA05–1G

K =0.2 m connecting cable length
A =0.5 m connecting cable length
J =2 m connecting cable length

Note

When commissioning the system, it should be checked that the right combination of scanning head and toothed wheel is used!

Only toothed wheels and scanning heads with an 8 at the 8th position of the order designation may be combined with one another.

The toothed wheel and scanning head must have the same module (→ the same digit at the 12th position of the order designation).

4.2.4 Recommended mounting

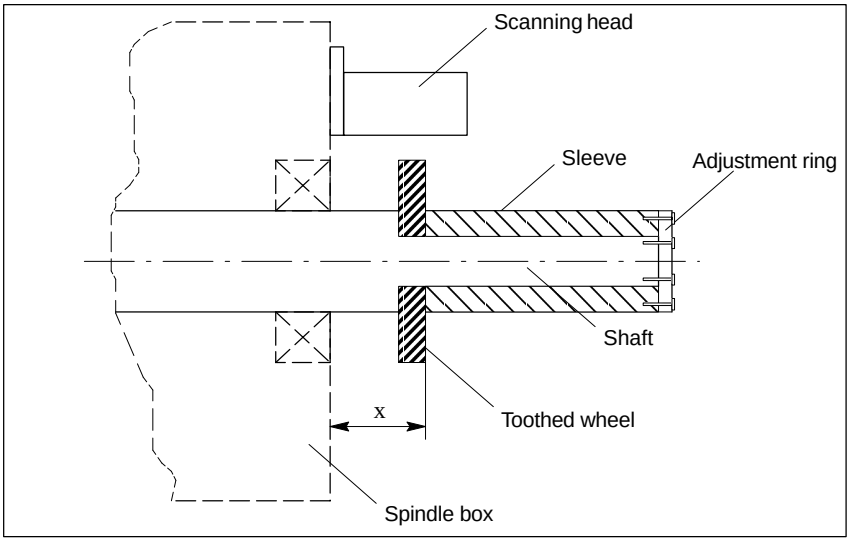


Fig. 4-3 Recommended mounting for the toothed wheel encoder

Note

It must be ensured that the incremental track and zero track are correctly arranged (refer to the mounting drawing, Fig. 4-6).

Before assembly, the mounting surfaces as well as, if necessary, the toothed wheel and scanning head must be cleaned.

The connecting cable may only be inserted when the equipment is in a no–voltage condition!

The toothed wheel must be handled extremely carefully. The toothed–wheel encoder will be destroyed even if the teeth are slightly damaged.

Ensure that the shield is correctly routed.

When assembling, observe the specified direction of rotation.

Ensure that the flange–mounted socket is correctly mounted (refer to the mounting instructions).

The specified tolerances must also be maintained in operation (temperature, speed, vibration etc.).

It must be ensured that no particles of dirt (metal chips etc.) can enter the working space of the toothed–wheel encoder. This could destroy the toothed wheel and/or the scanning head.

Carefully observe the polarity when connecting the temperature sensor.

Mounting the toothed wheel

The toothed wheel and the spindle must form a transition fit, e.g. H6 – j6.

The toothed wheel can be pressed against a shaft shoulder using a setting sleeve, so that there is a friction–locked connection. It is also possible to mount a toothed wheel to a shaft shoulder using axial screws (also refer to the mounting instructions).

Mounting equipment: none

Tolerances:

The data refer to the corresponding mounting drawing.

Radial eccentricity of the shaft under the toothed wheel: <10 µm

Radial eccentricity deviation (with the toothed wheel mounted): < 20 µm

Axial eccentricity of the shaft shoulder and retaining sleeve: <10 µm

Mounting the scanning head

The scanning head must be mounted in accordance with the mounting instructions.

If required, provide strain relief for the connecting cable. Ensure that the flange–mounted socket is grounding through the largest possible surface area.

The cables for the temperature sensors must be connected to the appropriate motor connections. When the toothed–wheel encoder is used as autonomous spindle encoder, the temperature sensor corrections are not required.

Important

It is not permissible to adjust the system using the encoder signals!

The 6EX2007–1AA00 encoder diagnostics unit may **not** be used for adjustment.

The feeler gauge provided must be used to make this adjustment.

Mounting equipment (not included in the scope of supply):

- 4 M6 $\times$ 20 mm screws with spring washer and washer
- Torque wrench with hexagonal size 5 socket

Tolerances:

The data refer to the corresponding mounting drawing.

Radial eccentricity at the crown circle and at the clearance track disk of the mounted toothed wheel: <20 µm

Axial position of the toothed wheel (refer to Fig. 2–2) and the mounting drawing (dimension x) x=38 mm $\pm$ 0.1mm

The position changes relative to the dimension x, obtained as a result of the various operating statuses, may be: +1 mm/–0.2 mm

Tangential offset between the scanning head and the shaft center point: < $\pm$0.1 mm

Clearance between the toothed–wheel crown circle and the scanning head:
Module m = 0.3 a = 0.15 mm
Module m = 0.5 a = 0.3 mm

Tilt angle, axial and tangential 90° $\pm$ 5’

4.2.5 Dimension diagrams and mounting drawings

Note

Siemens AG reserves the right to change the dimensions of the motors as part of mechanical design improvements without prior notice. Dimension drawings can become out–of–date. Updated dimension drawings can be requested at no charge.

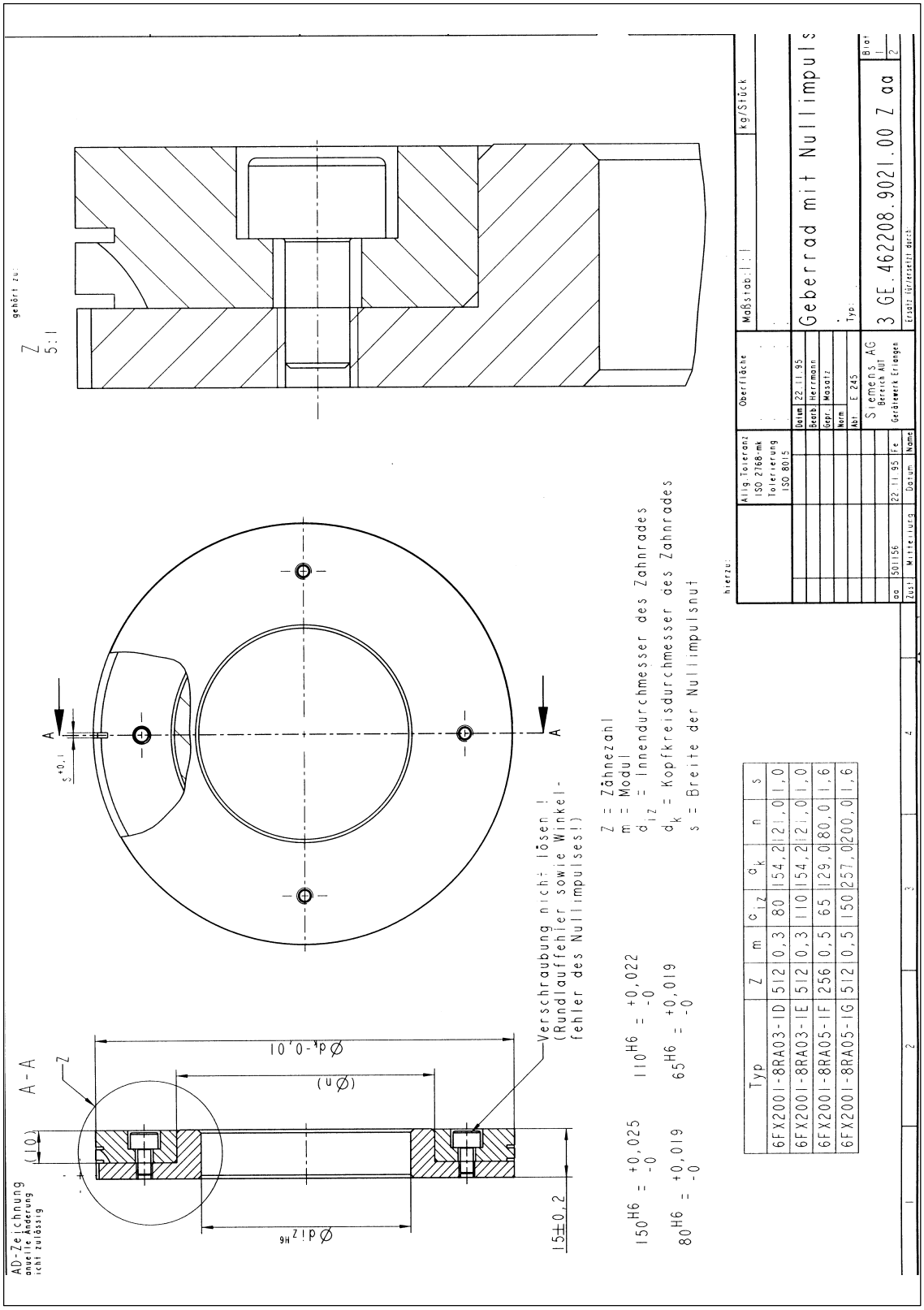


Fig. 4-4 Encoder wheel with zero pulse

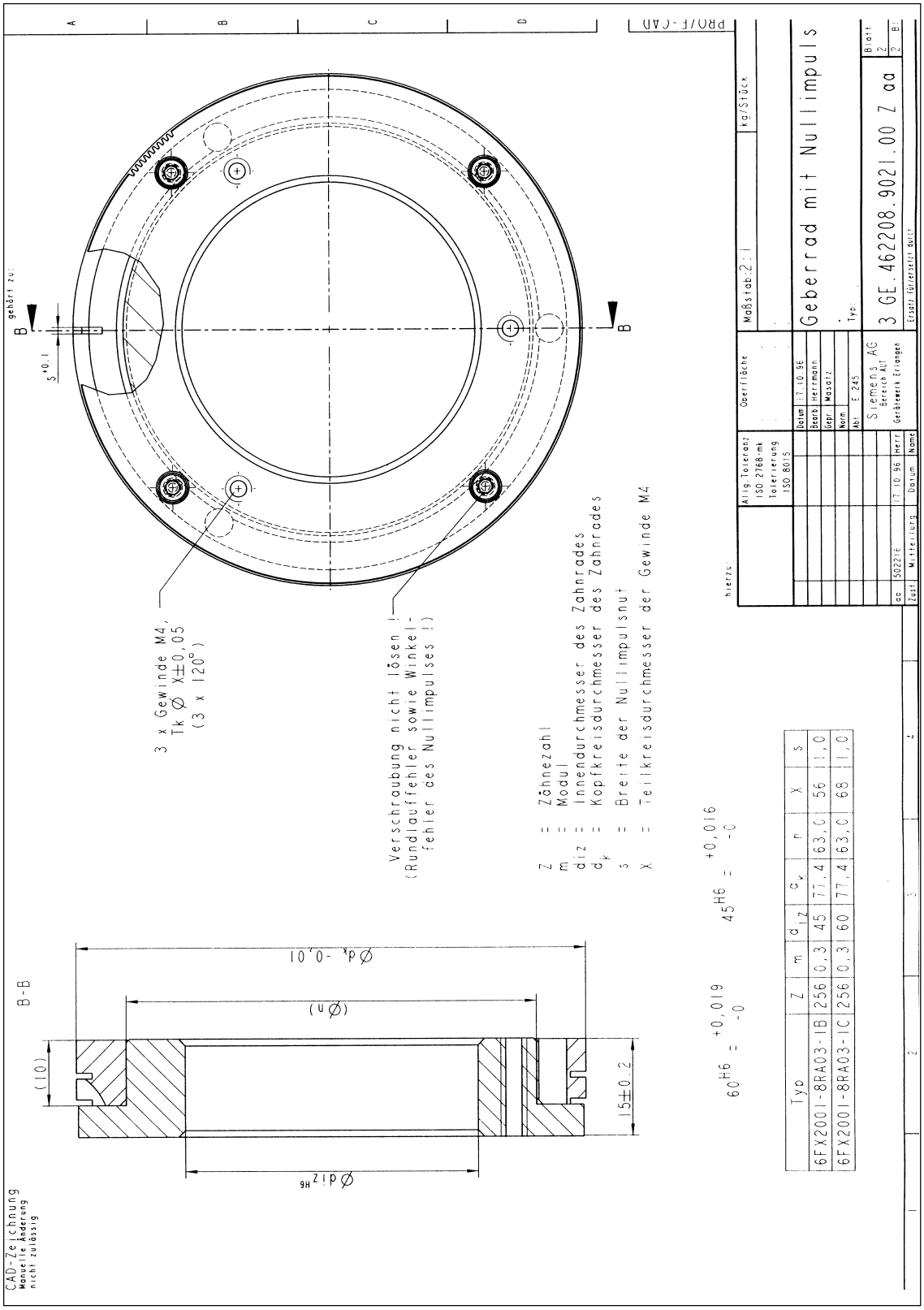


Fig. 4-5 Encoder wheel with zero pulse

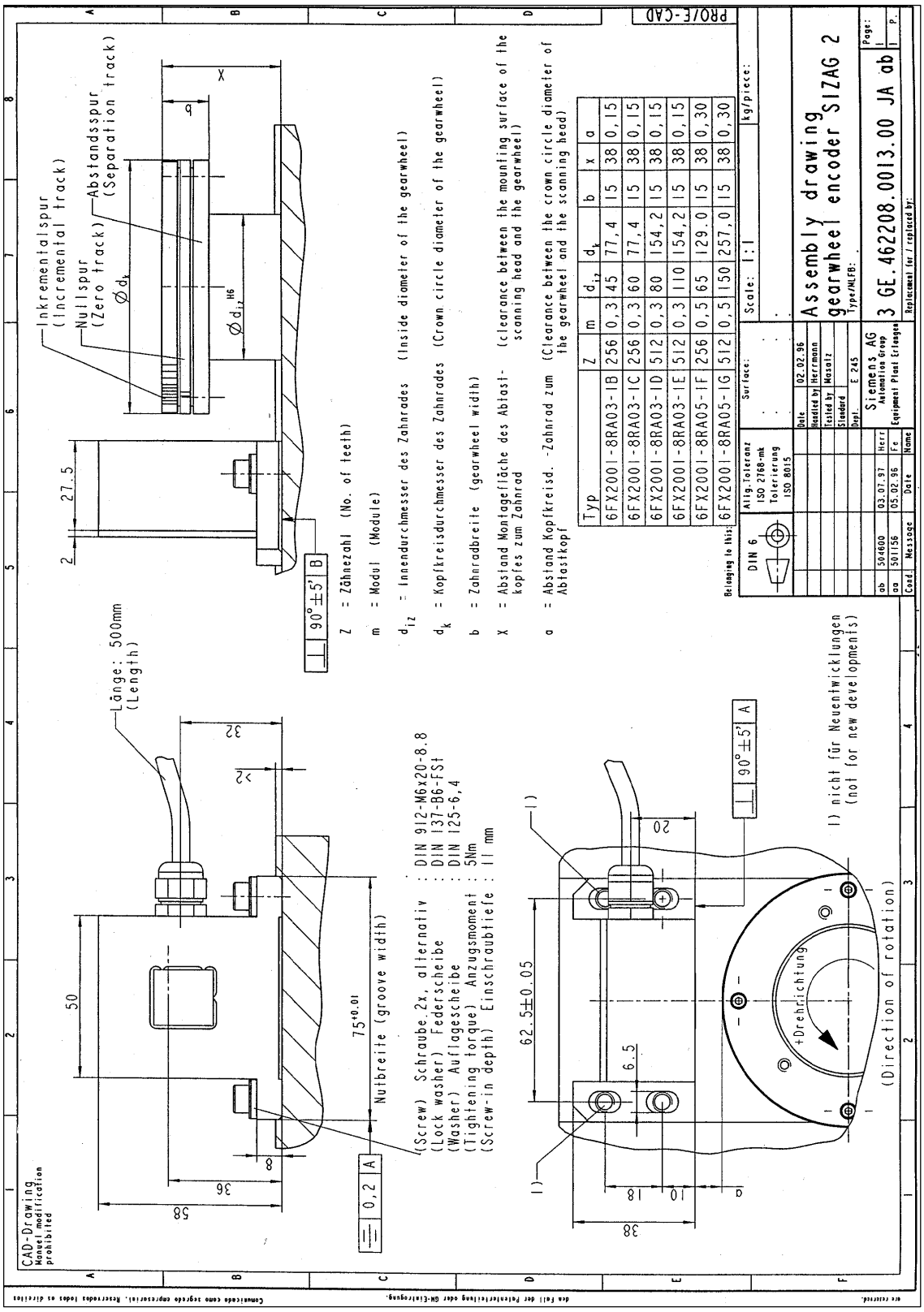


Fig. 4-6 Mounting drawing, SIZAG 2 toothed–wheel encoder

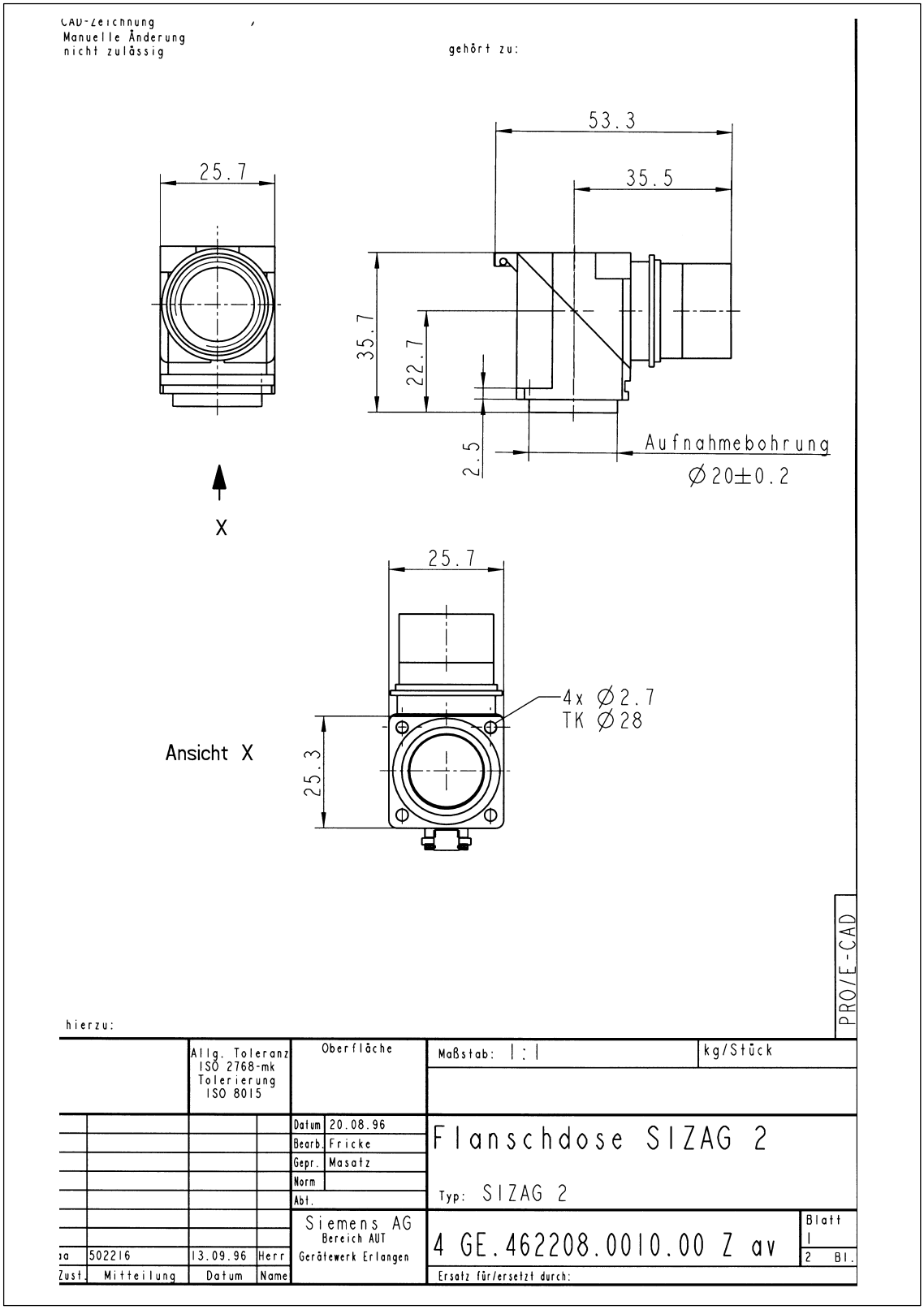


Fig. 4-7 Mounting drawing, SIZAG 2 flange–mounted sockets

■

Space for your notes

Dimension drawings

5

Note

Siemens AG reserves the right to change the dimensions of the motors as part of mechanical design improvements without prior notice. Dimension drawings can go out–of–date. Updated dimension drawings can be requested at no charge.

Version with sleeve

Version without sleeve

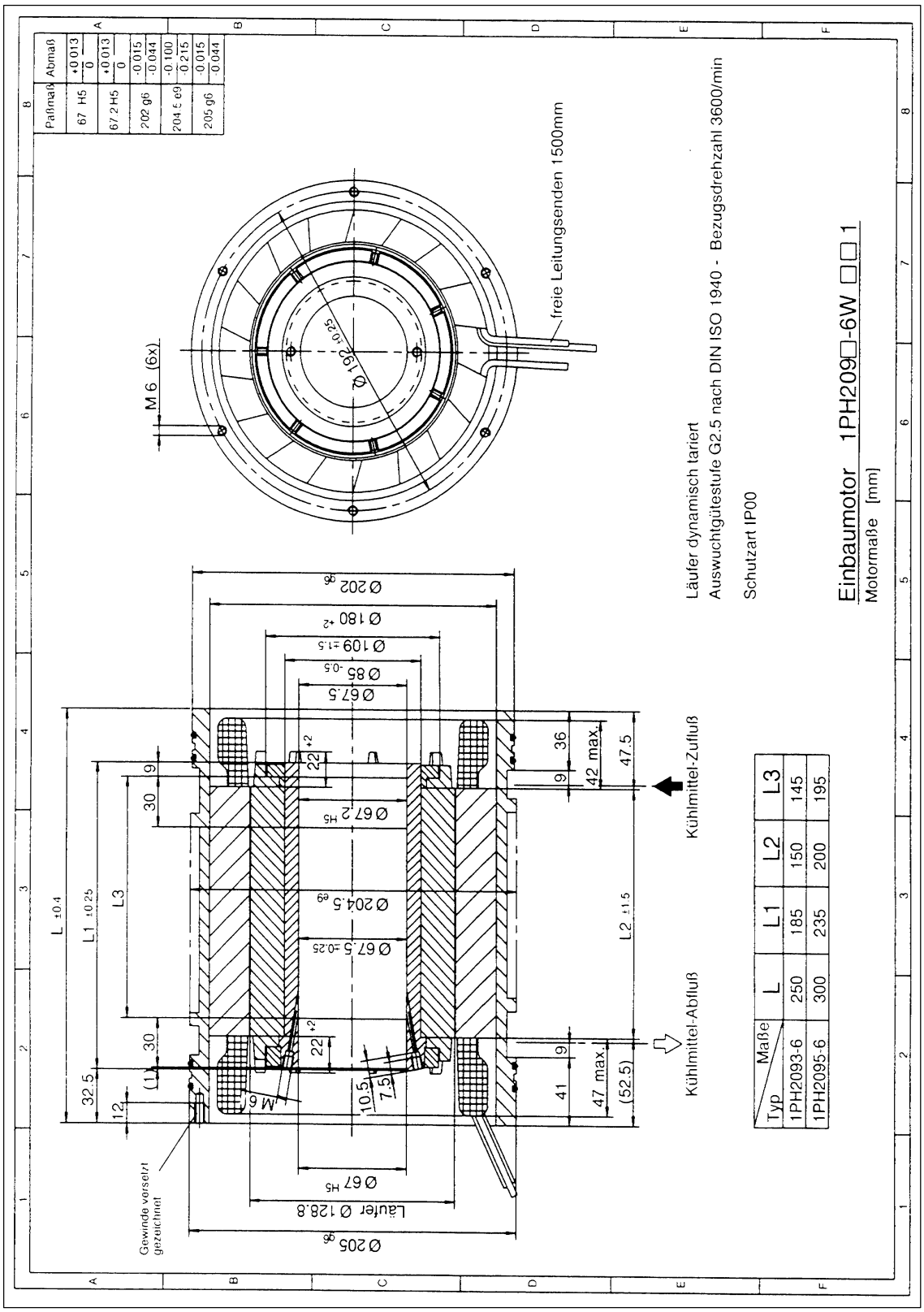


Fig. 5-1 1PH209□–6W motor dimensions

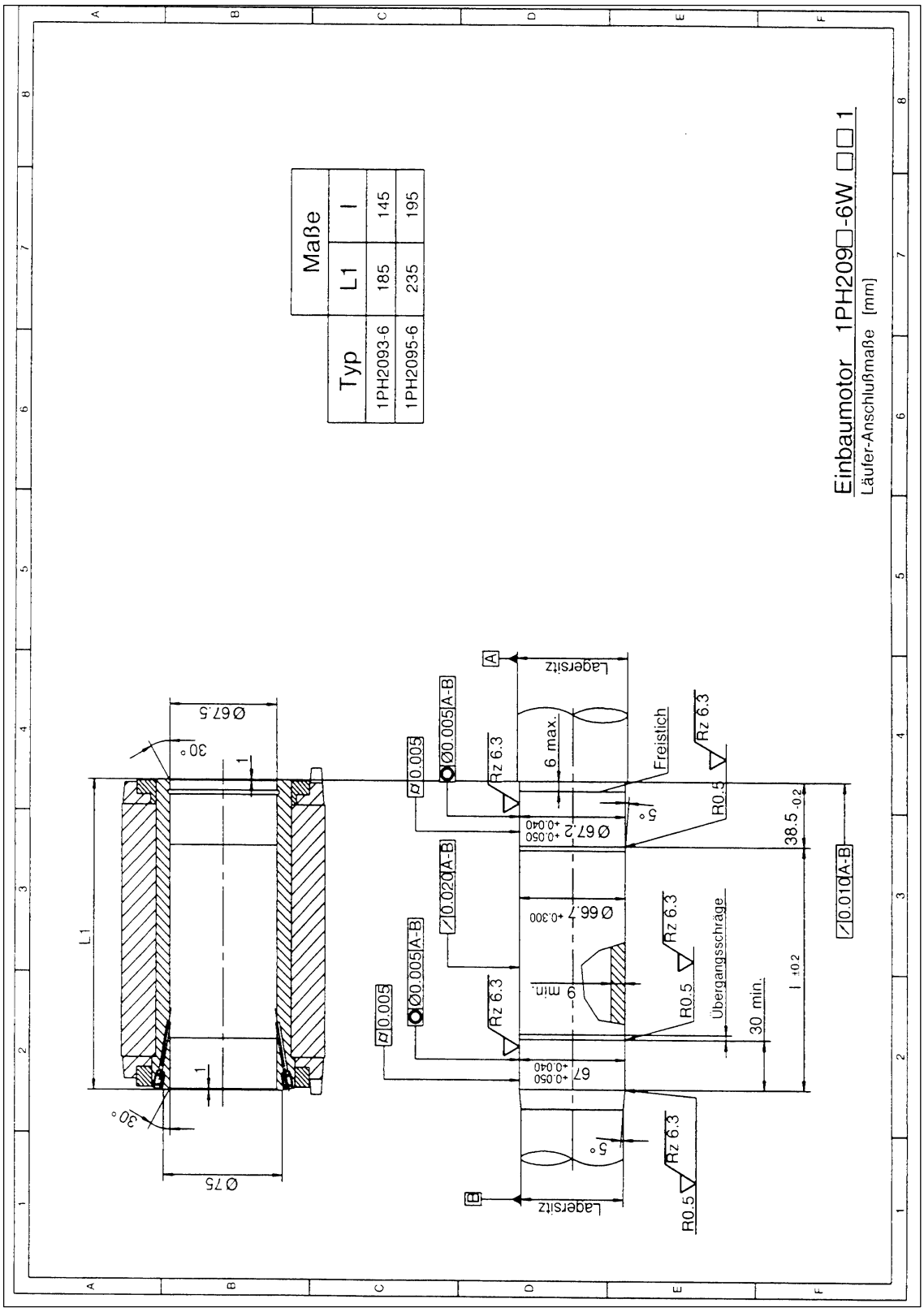


Fig. 5-2 1PH209□–6W rotor companion dimensions

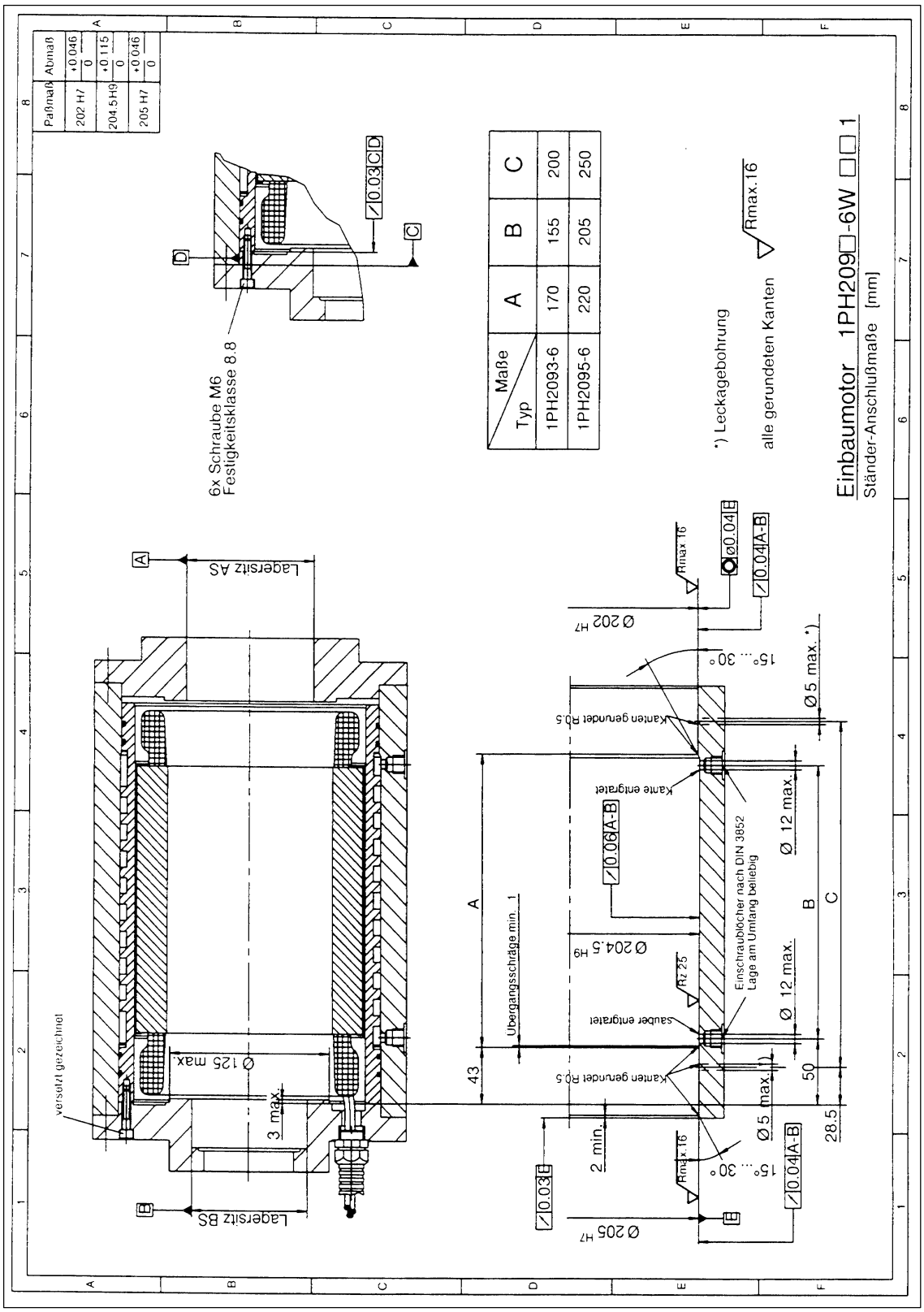


Fig. 5-3 1PH209□–6W stator companion dimensions

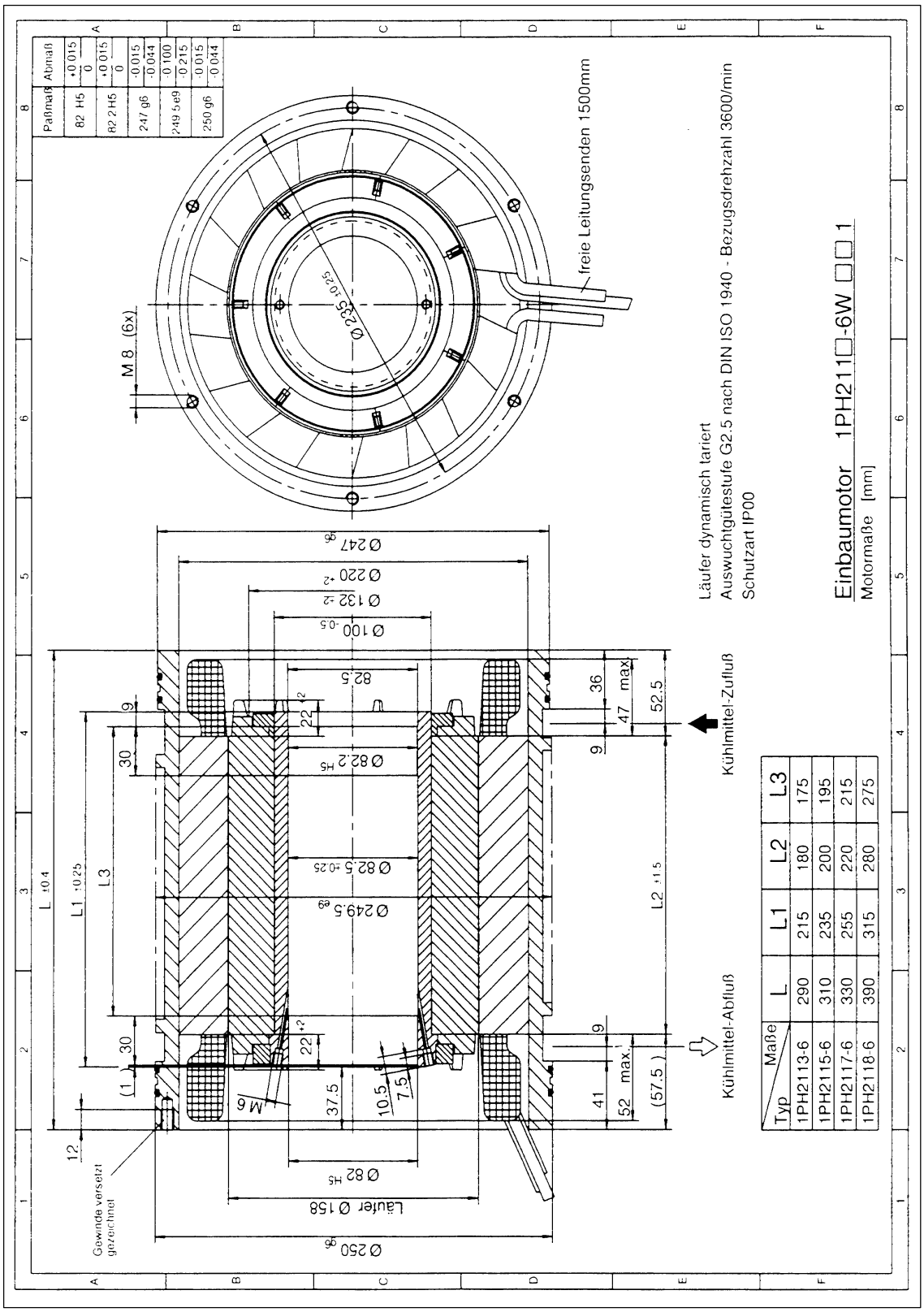


Fig. 5-4 1PH211□–6W motor dimensions

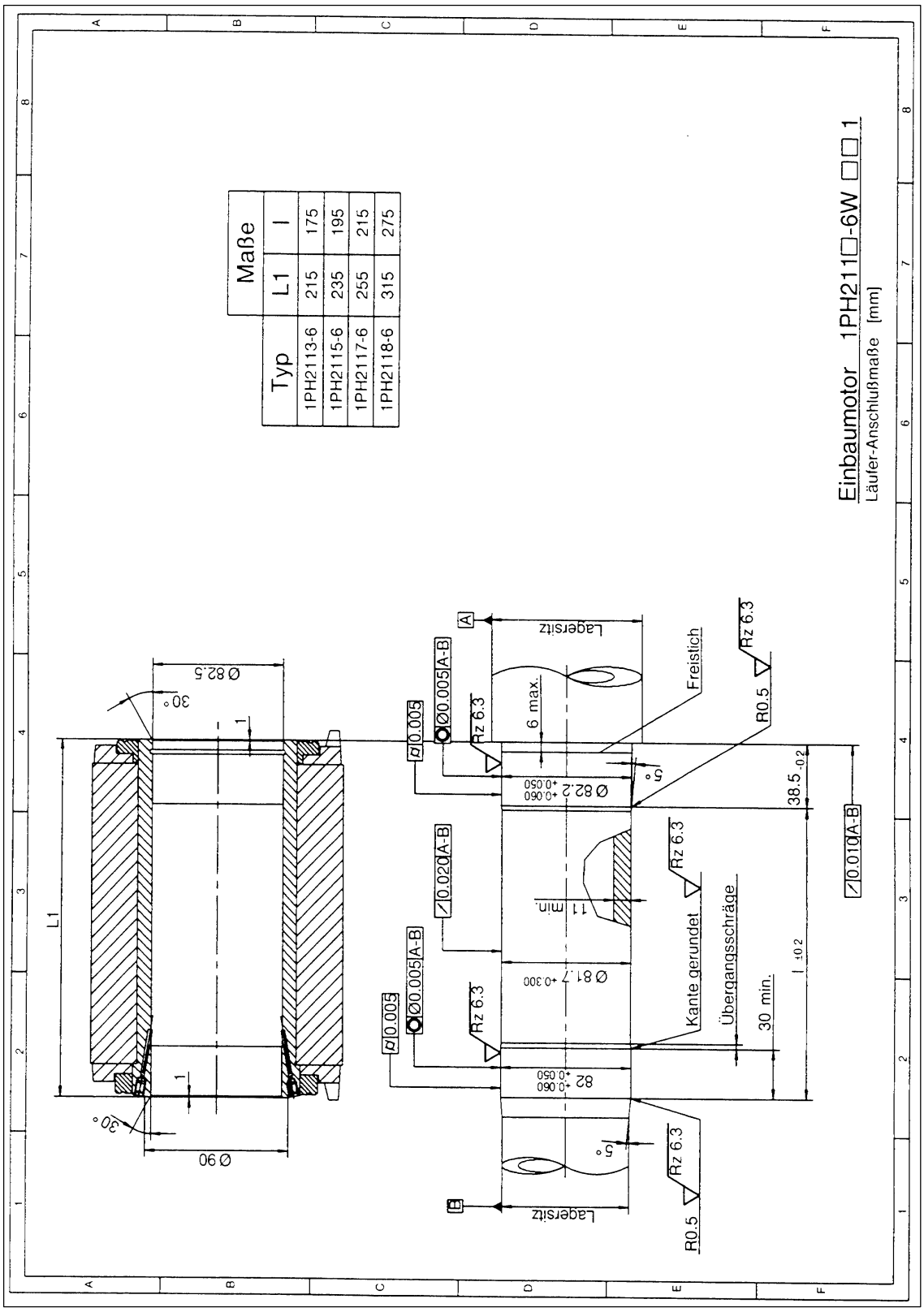


Fig. 5-5 1PH211□–6W rotor companion dimensions

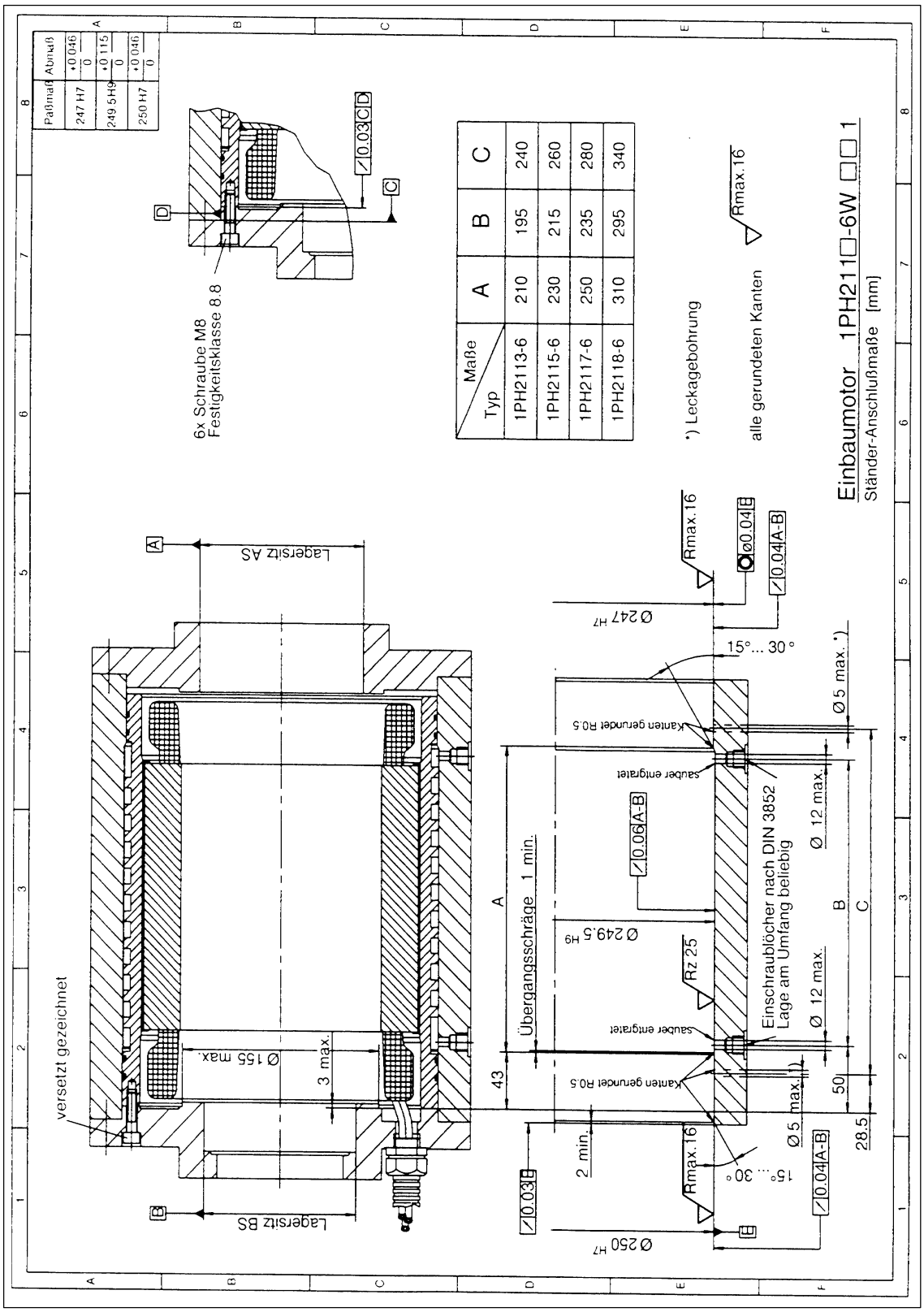


Fig. 5-6 1PH211□–6W stator companion dimensions

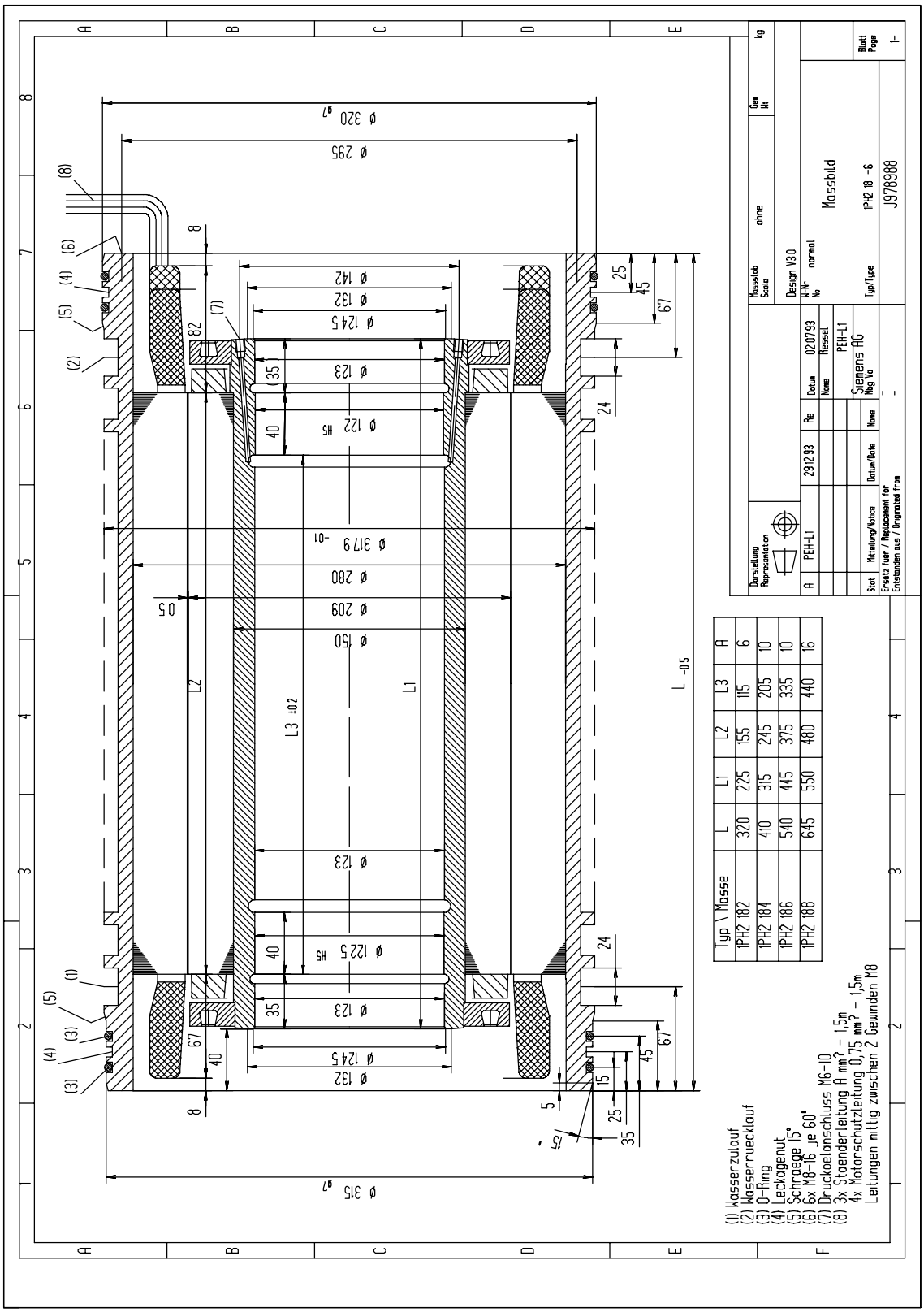
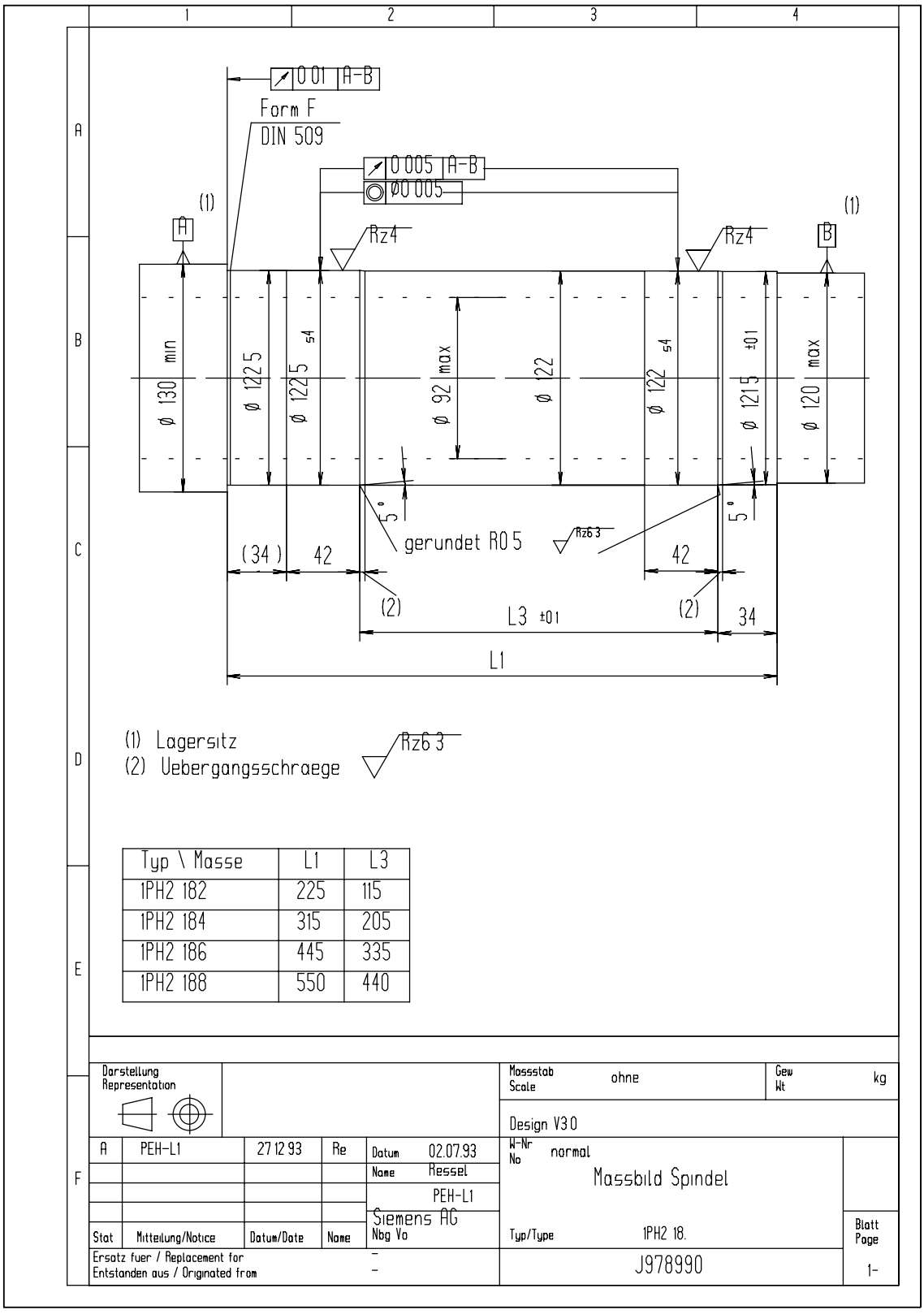


Fig. 5-7 1PH218□–6W motor dimensions (dimension drawing)



Typ \ Masse	L1	L3
1PH2 182	225	115
1PH2 184	315	205
1PH2 186	445	335
1PH2 188	550	440

Darstellung Representation

Massstab Scale ohne

Gew Wt kg

Design V3.0

A PEH-L1 27.12.93 Re

Datum 02.07.93

Name Ressel

PEH-L1

Siemens AG

Nbg Vo

W-Nr No normal

Massbild Spindel

Typ/Type 1PH2 18.

Blatt Page 1-

Stat Mitteilung/Notice Datum/Date Name

Ersatz fuer / Replacement for –

Entstanden aus / Originated from –

J978990

Fig. 5-8 1PH218□–6W rotor companion dimensions (spindle)

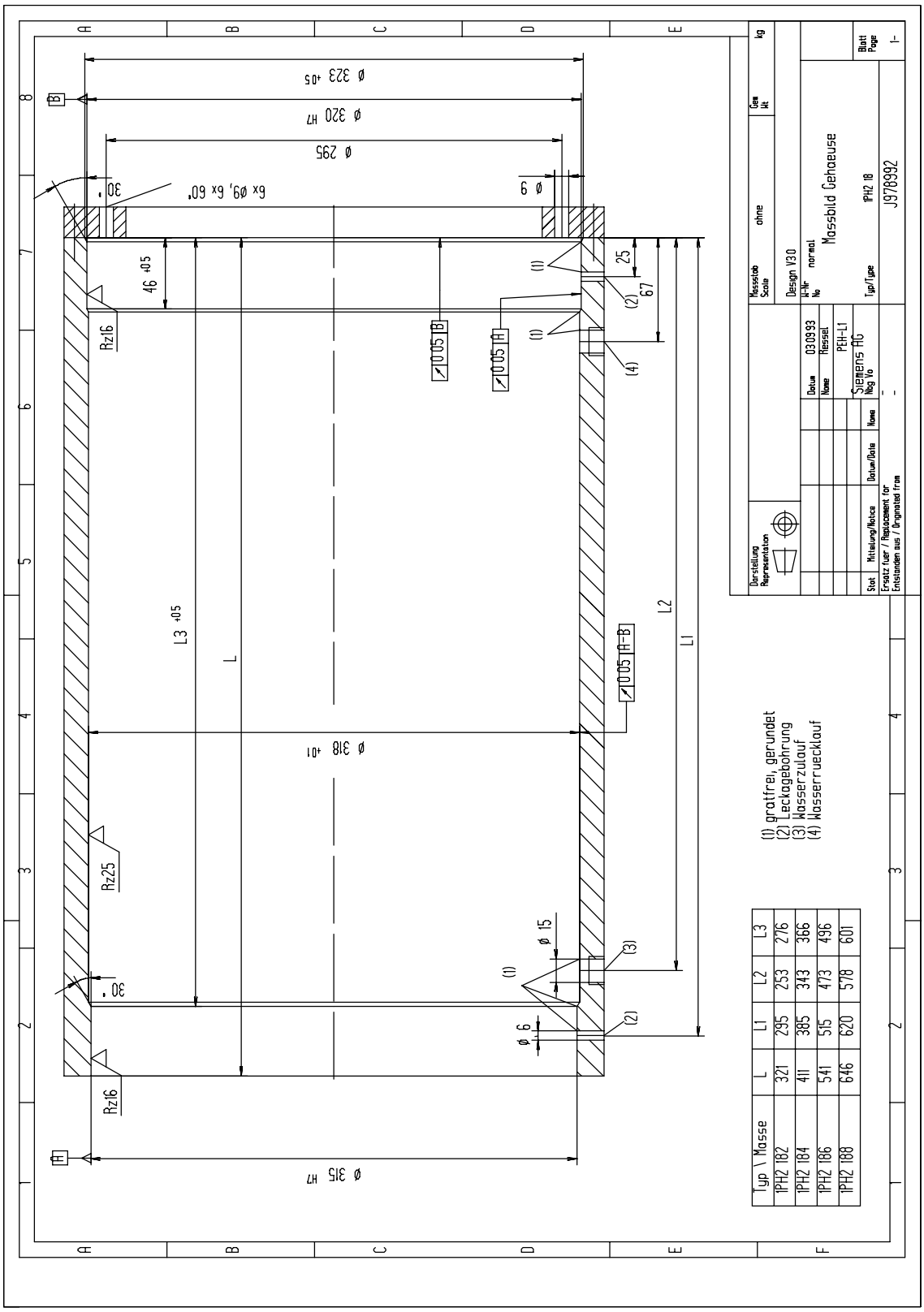


Fig. 5-9 1PH218□–6W stator companion dimensions (housing)

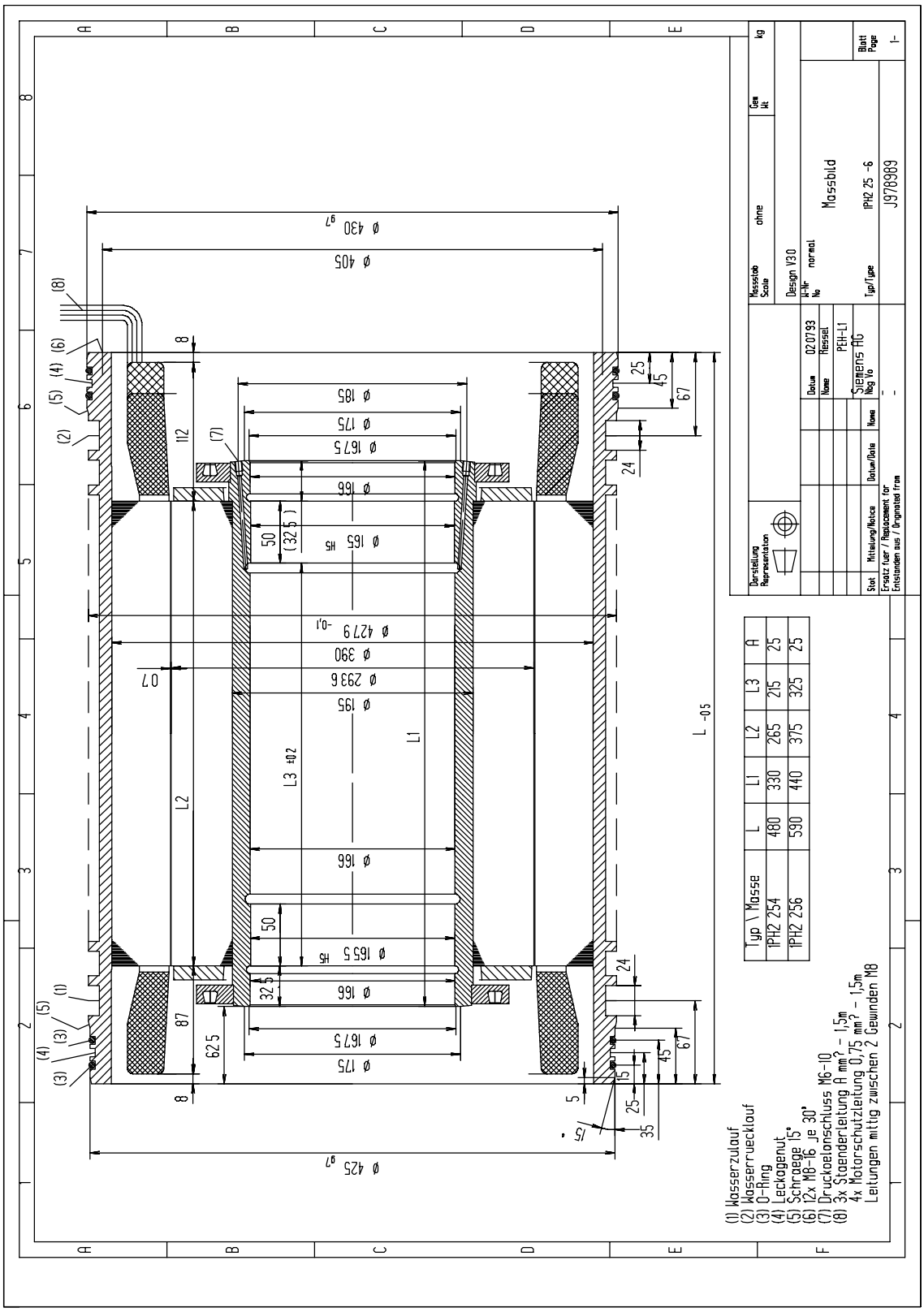
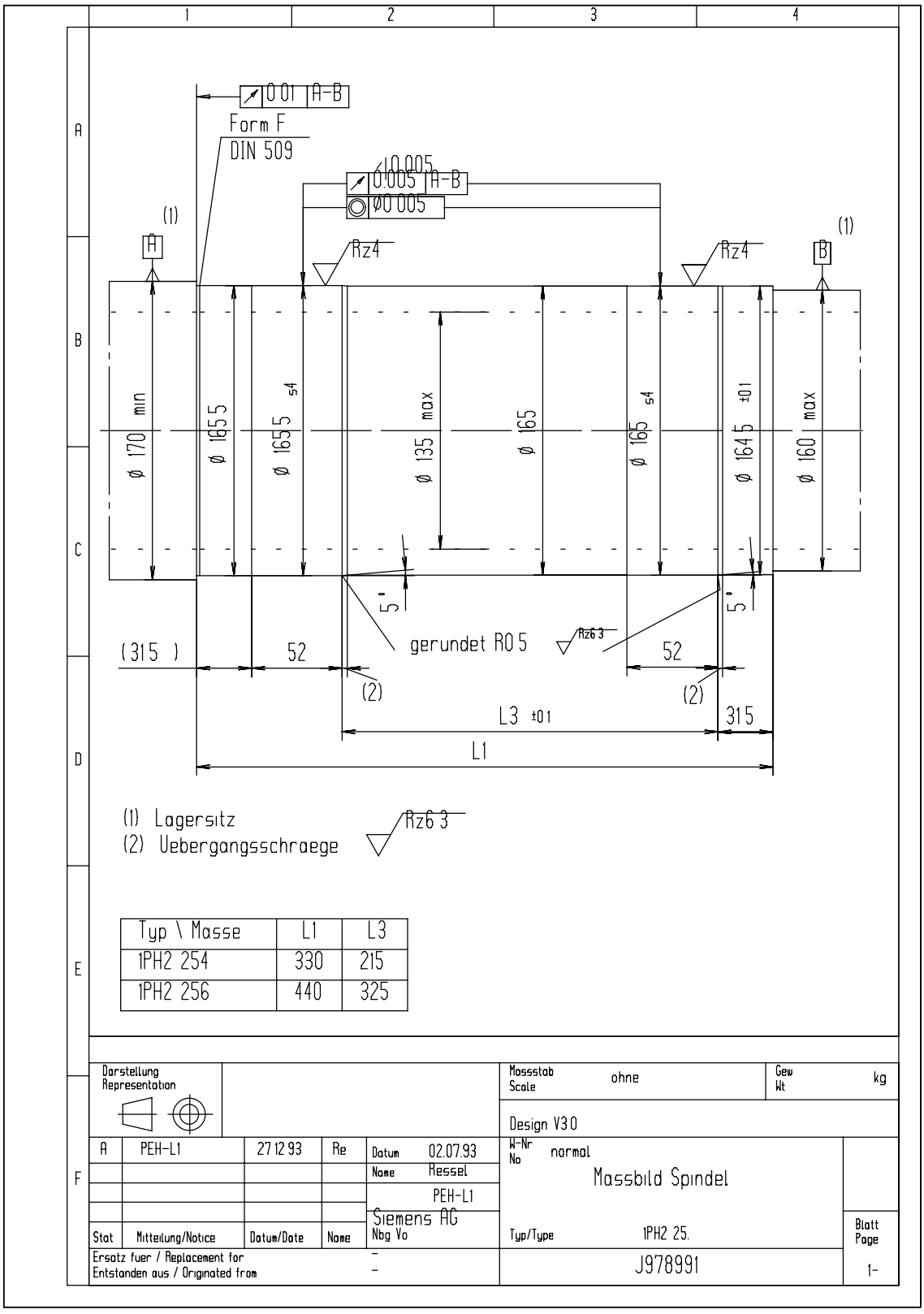


Fig. 5-10 1PH225□–6W motor dimensions (dimension drawing)



Typ \ Masse	L1	L3
1PH2 254	330	215
1PH2 256	440	325

Darstellung Representation				Massstab Scale	ohne	Gew Wt kg
				Design V30		
A	PEH-L1	27.12.93	Re	Datum 02.07.93	W-Nr No normal	
				Name Ressel	Massbild Spindel	
				PEH-L1		
				Siemens AG		
Stat	Mitteilung/Notice	Datum/Date	Name	Nbg Vo	Typ/Type 1PH2 25.	Blatt Page
Ersatz fuer / Replacement for				-	J978991	1-
Entstanden aus / Originated from				-		

Fig. 5-11 1PH225□–6W rotor companion dimensions (spindle)

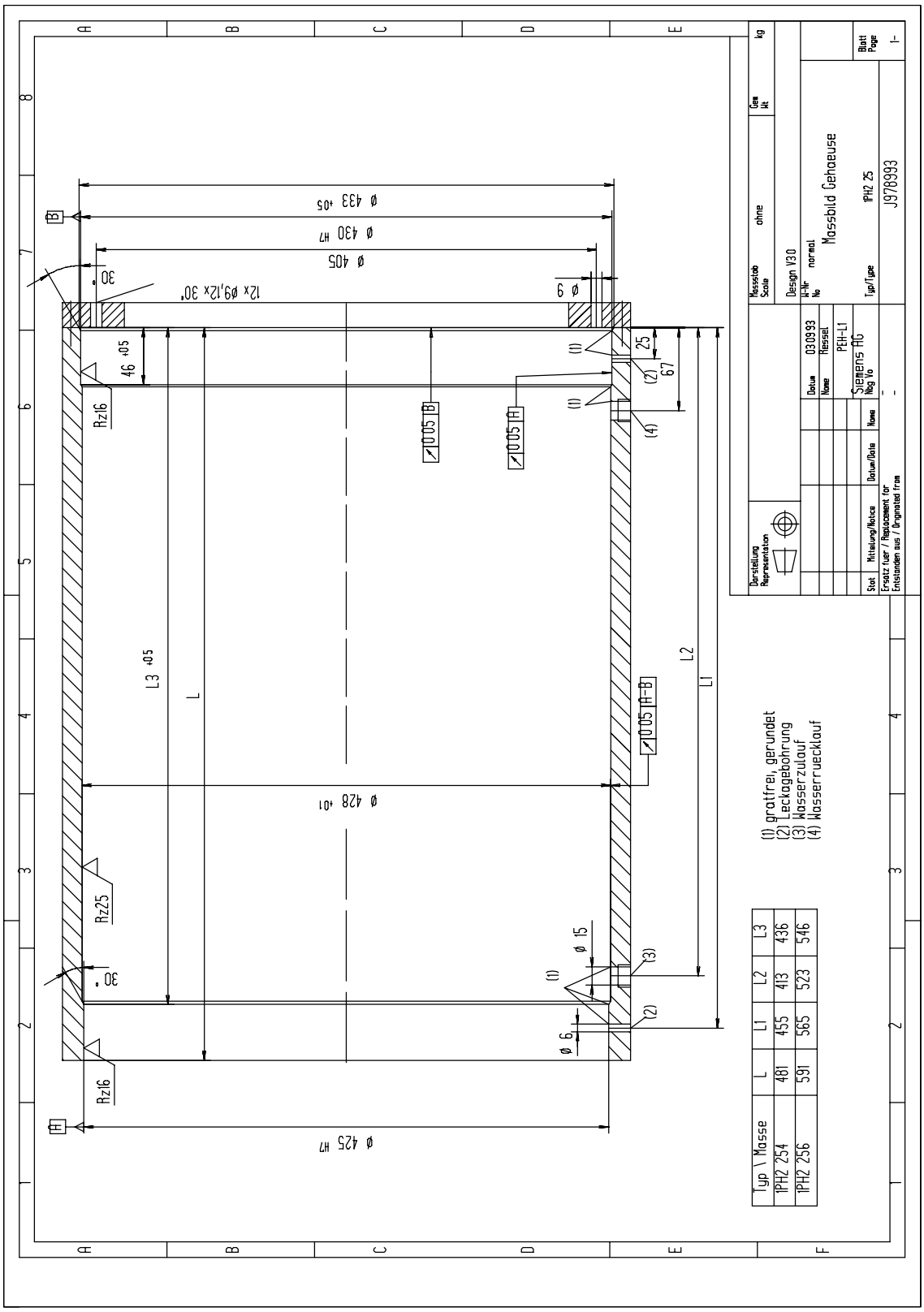


Fig. 5-12 1PH225□–6W stator companion dimensions (housing)

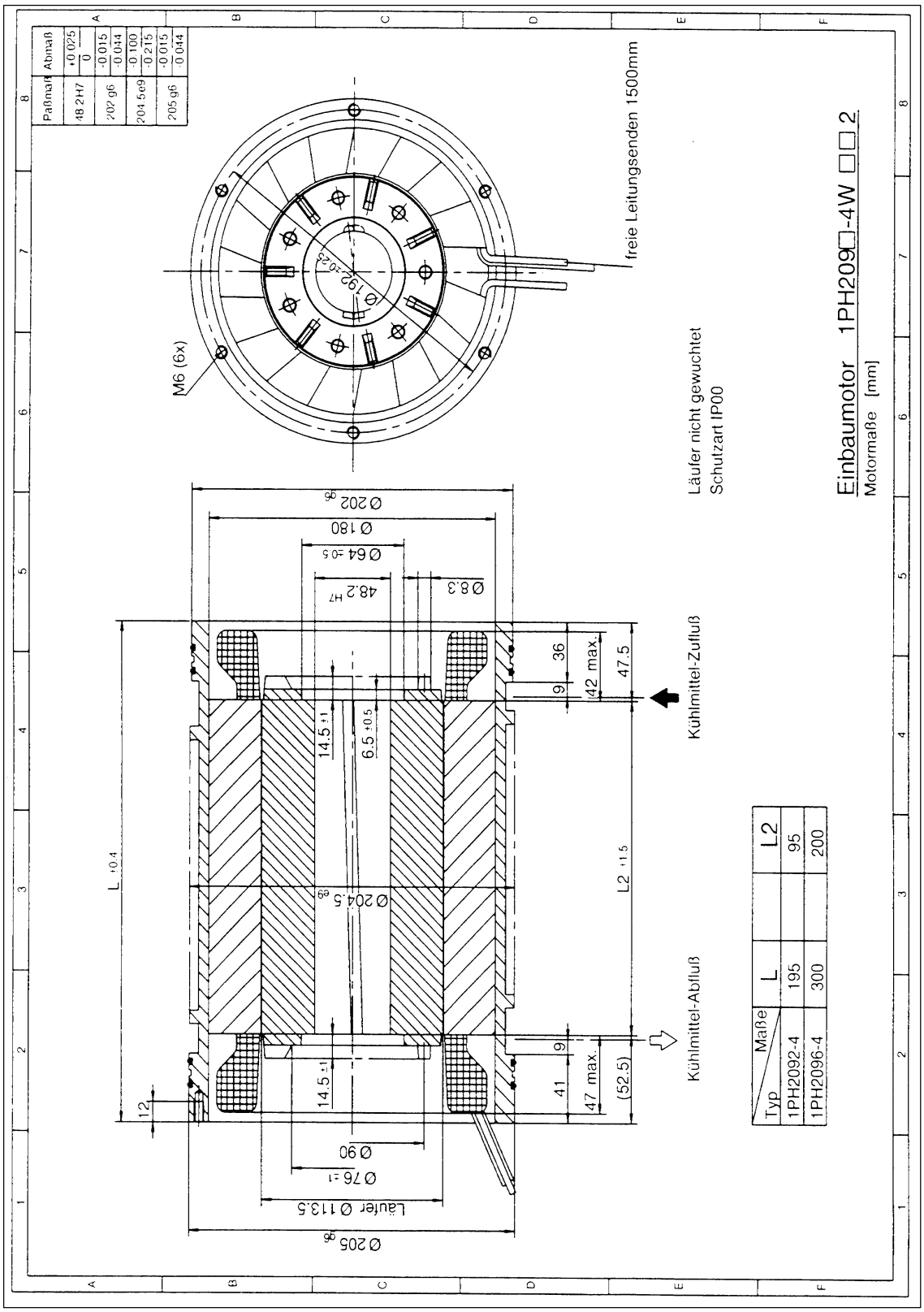


Fig. 5-13 1PH209□–4W motor dimensions

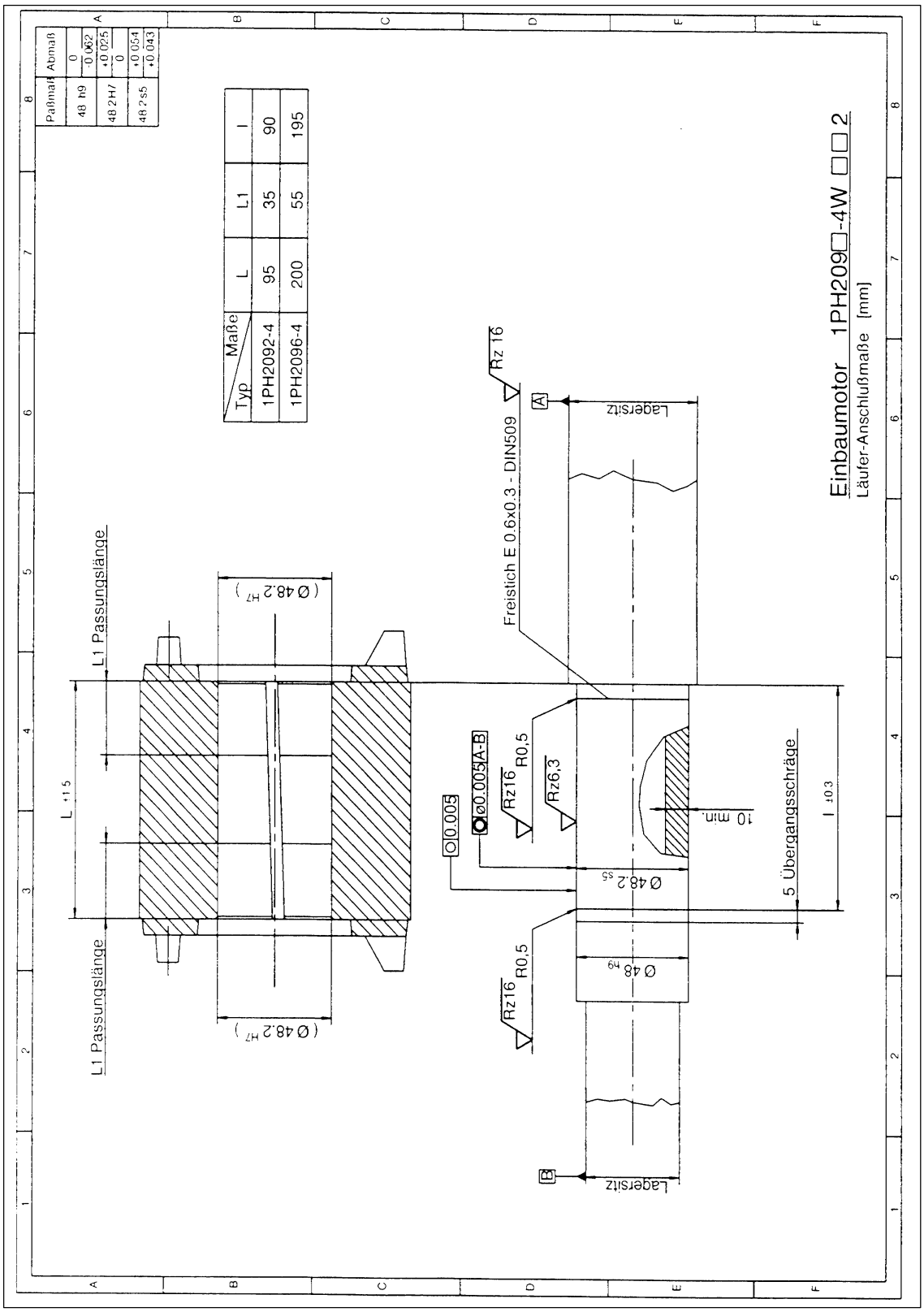


Fig. 5-14 1PH209□–4W rotor companion dimensions

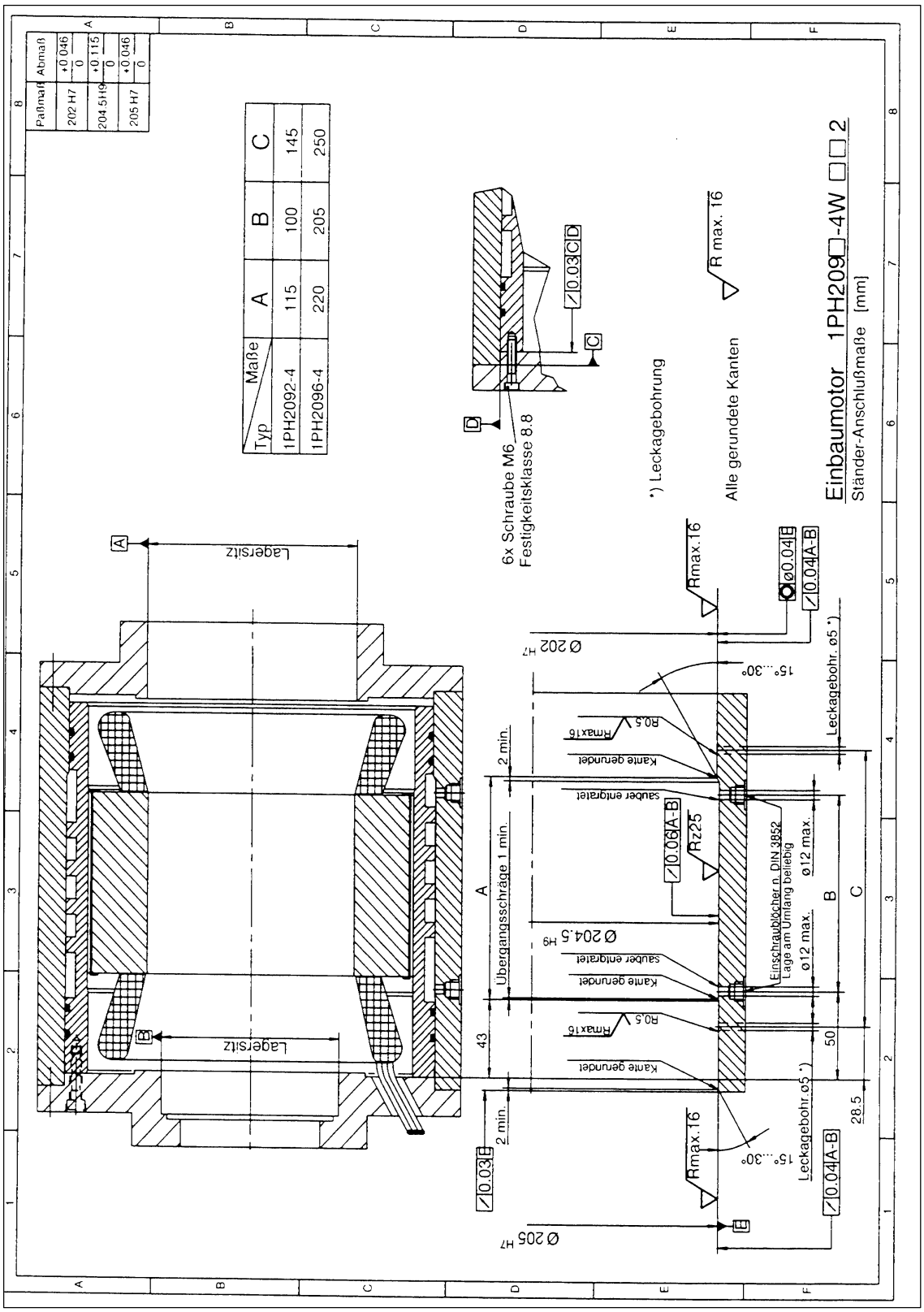


Fig. 5-15 1PH209□–4W stator companion dimensions

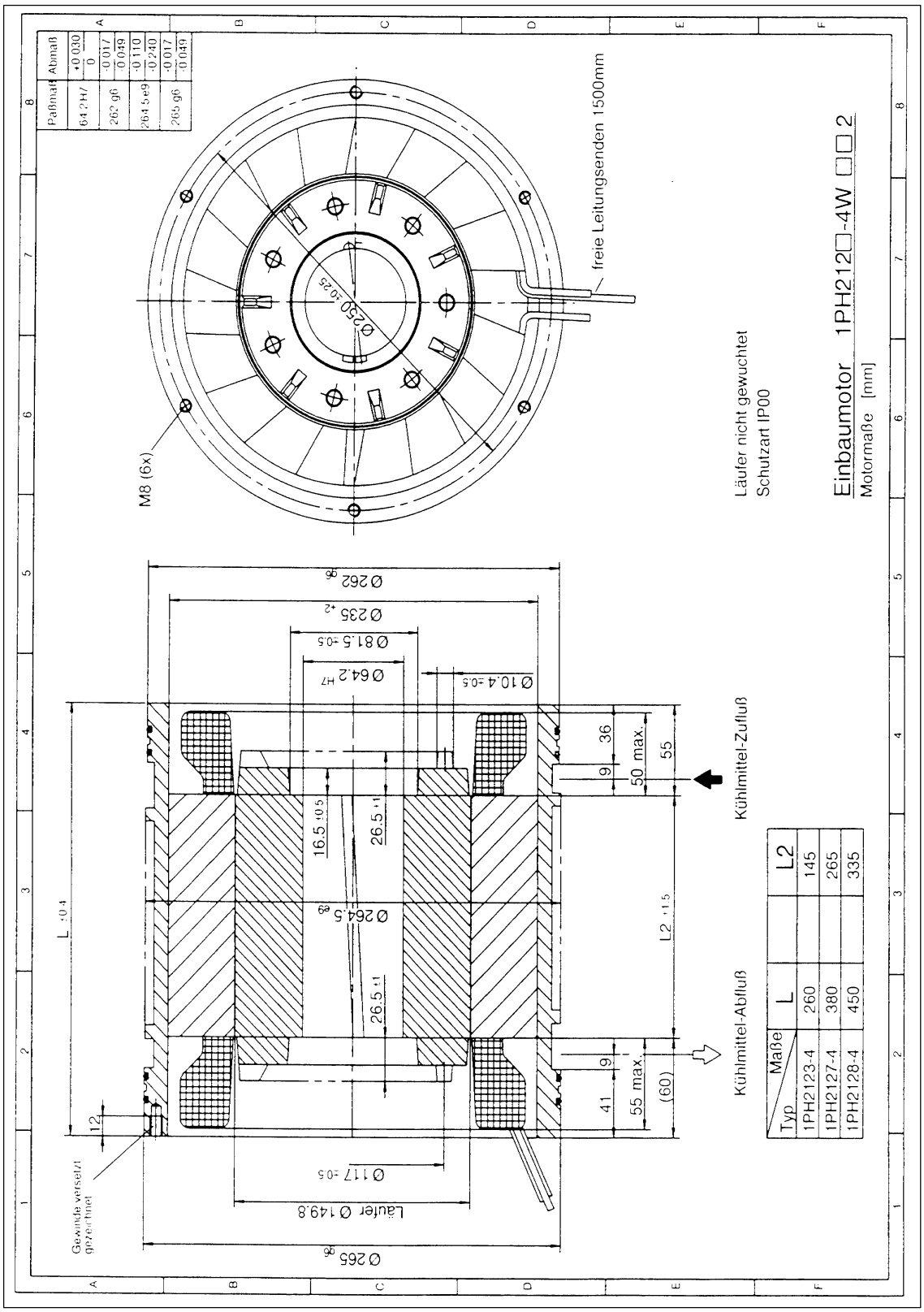


Fig. 5-16 1PH212□–4W motor dimensions

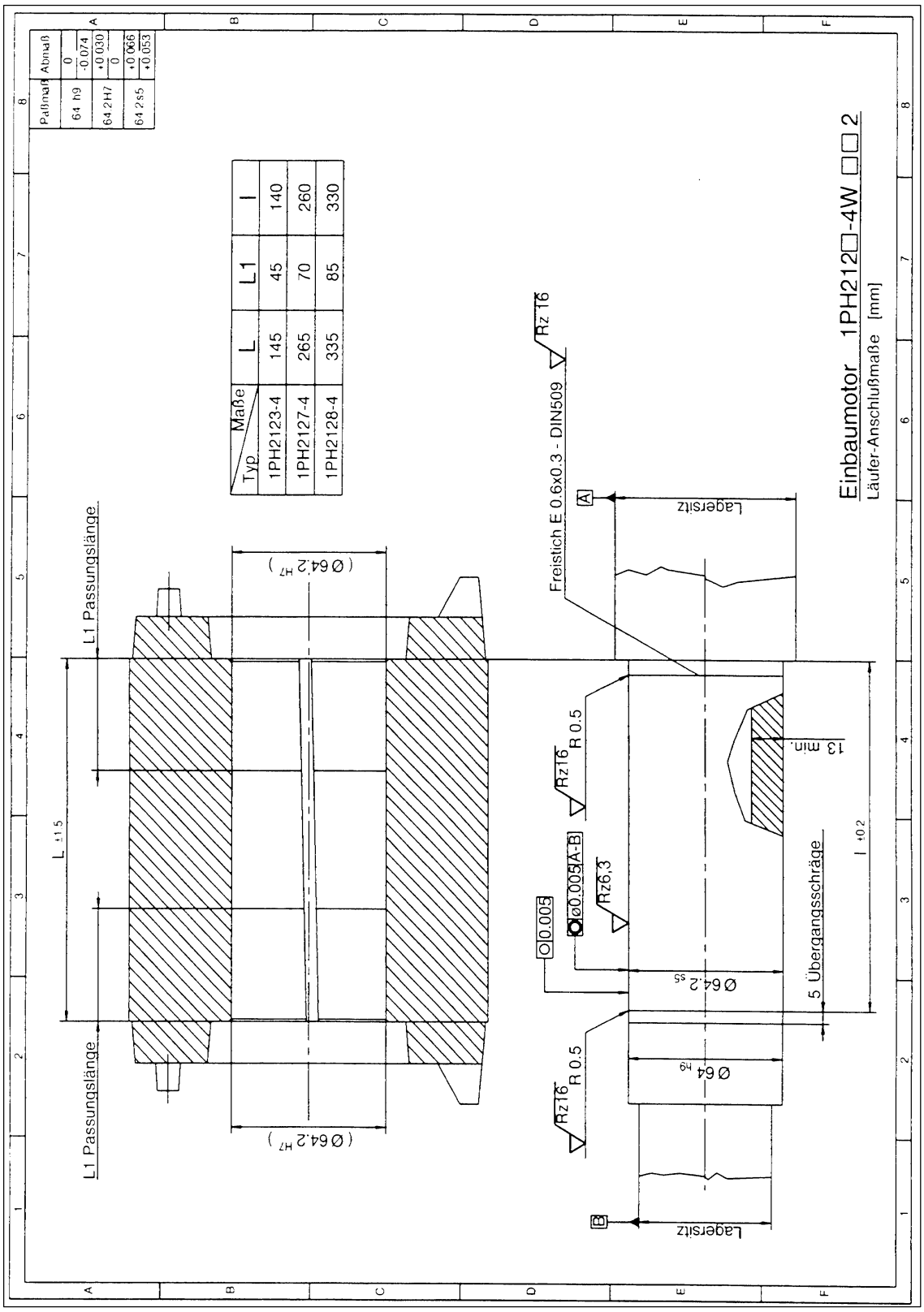


Fig. 5-17 1PH212□–4W rotor companion dimensions

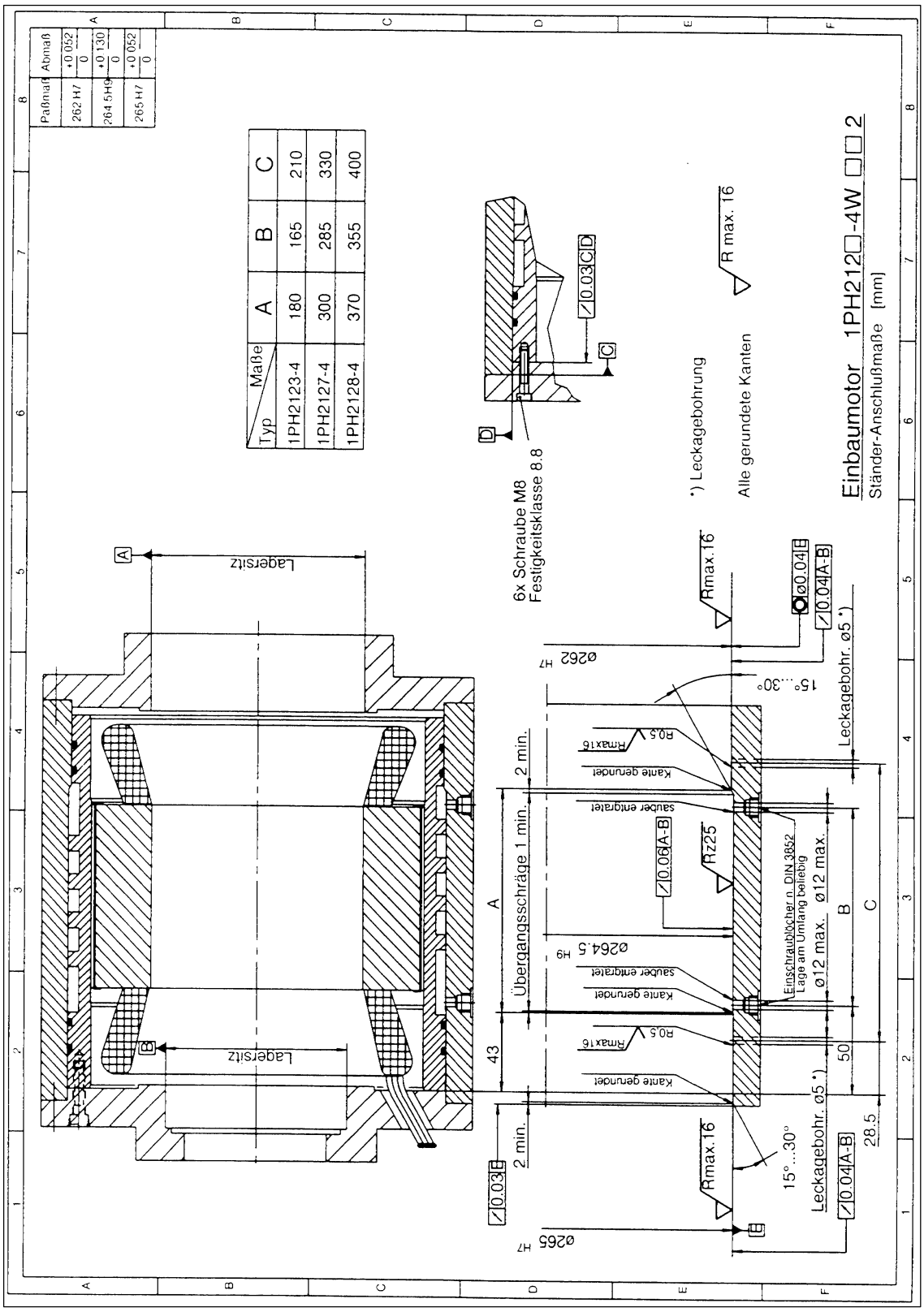


Fig. 5-18 1PH212□–4W stator companion dimensions

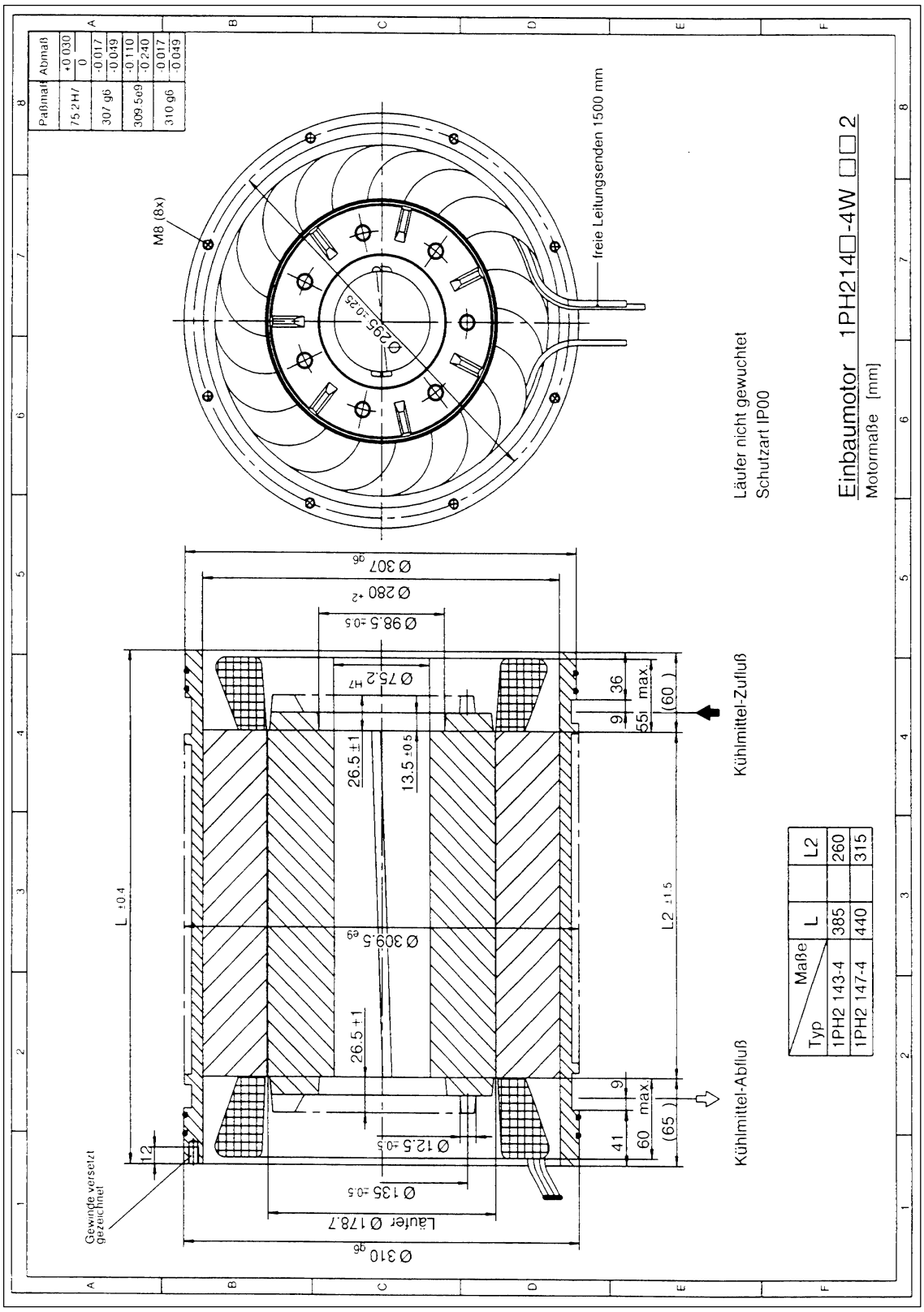


Fig. 5-19 1PH214□–4W motor dimensions

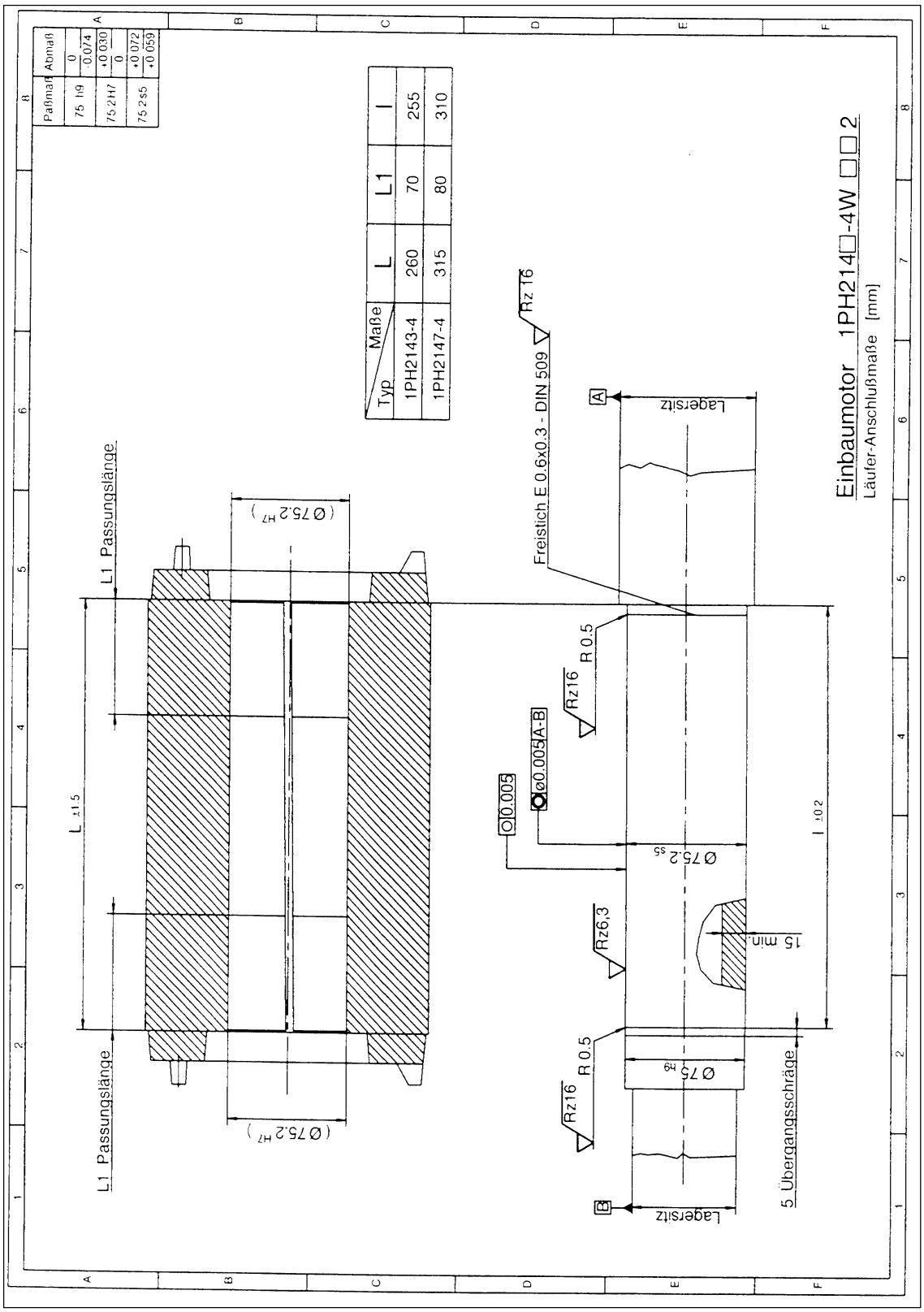


Fig. 5-20 1PH214□–4W rotor companion dimensions

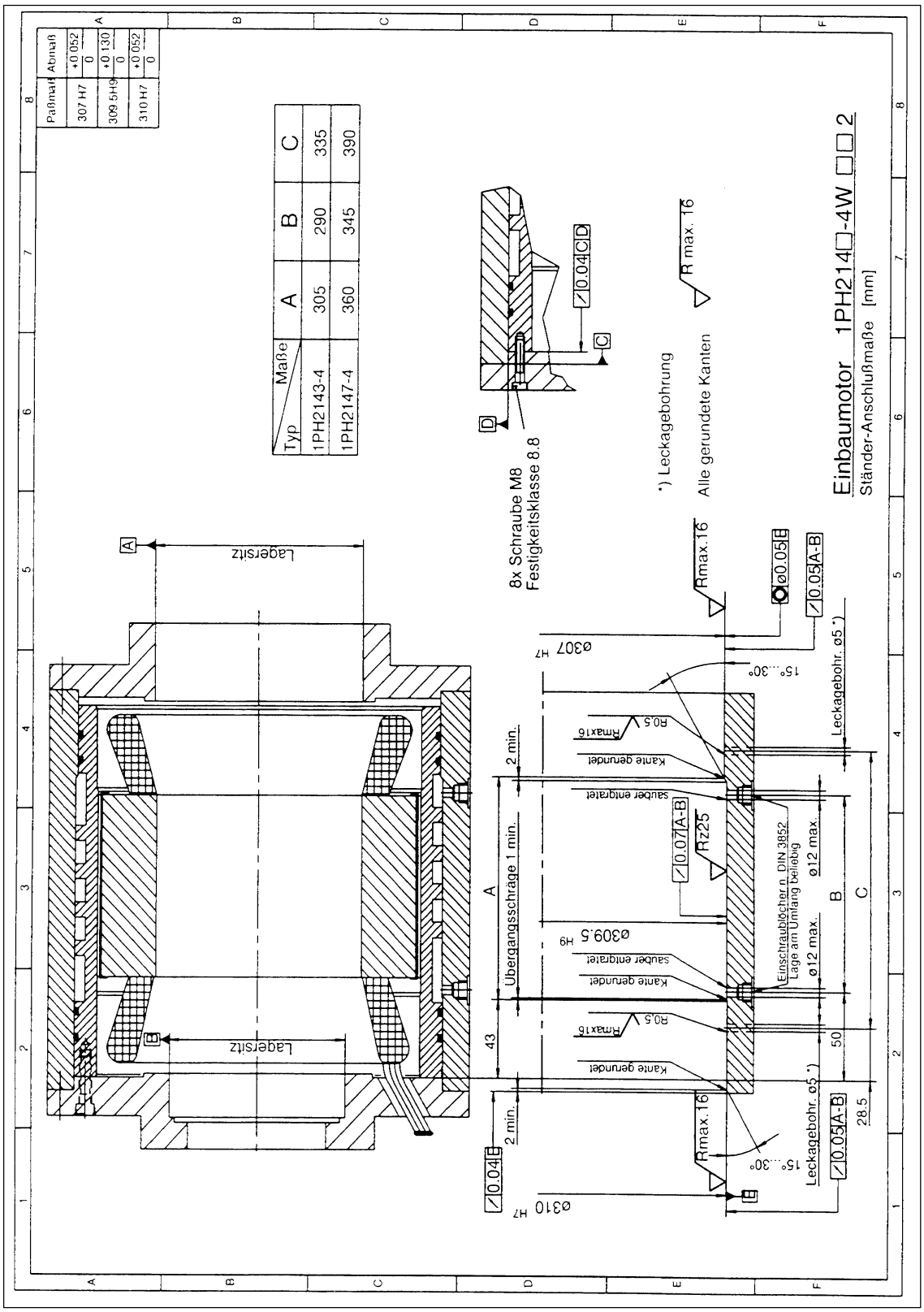


Fig. 5-21 1PH214□–4W stator companion dimensions

■

References

General Documentation

/BU/ **Catalog NC 60**

Automation Systems for Machine Tools
Ordering document
Order No.: E86060–K4460–A101–A8
Order No.: E86060–K4460–A101–A8–7600 (English)

/Z/ **Catalog NC Z**

SINUMERIK, SIMODRIVE & SIMOVERT MASTERDRIVES
Connection Technology and System Components
Order No.: E86060–K4490–A001–A7
Order No.: E86060–K4490–A001–A7–7600 (English)

Electronic Documentation

/CD1/ **DOC ON CD**

The SINUMERIK System
(includes all SINUMERIK 840D/810D and SIMODRIVE 611D documents)
Order No.: 6FC5 298–6CA00–0BG4

Manufacturer/Service Documentation

/PJAS/ **Planning Guide, AC Induction Motors**

SIMODRIVE, MASTERDRIVES VC/MC
Content: General Section, 1PH2, 1PH4, 1PH7 for SIMODRIVE, 1PH7 for MASTERDRIVES, 1PL6
Order No.: 6SN1197–0AC61–0BP0

/ASAL/ Planning Guide, AC Induction Motors

SIMODRIVE, MASTERDRIVES VC/MC
AC Induction Motors, General Section
Order No.: 6SN1197–0AC62–0BP0

/APH2/ Planning Guide, AC Induction Motors

SIMODRIVE
AC Induction Motors 1PH2
Order No.: 6SN1197–0AC63–0BP0

/APH4/ Planning Guide, AC Induction Motors

SIMODRIVE
AC Induction Motors 1PH4
Order No.: 6SN1197–0AC64–0BP0

/APH7S/ Planning Guide, AC Induction Motors

SIMODRIVE, MASTERDRIVES VC/MC
AC Induction Motors 1PH7
Order No.: 6SN1197–0AC65–0BP0

/APH7M/ Planning Guide, AC Induction Motors

SIMODRIVE, MASTERDRIVES VC/MC
AC Induction Motors 1PH7
Order No.: 6SN1197–0AC66–0BP0

/APL6/ Planning Guide, AC Induction Motors

MASTERDRIVES VC/MC
AC Induction Motors 1PL6
Order No.: 6SN1197–0AC67–0BP0

/PJM2/ Planning Guide, AC Servomotors

SIMODRIVE 611, MASTERDRIVES MC
Content: 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

/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.: 6SN1197–0AC00–0BP1

/PMS/ **Planning Guide, Motor Spindle**

SIMODRIVE
ECO Motor Spindle 2SP1
Order No.: 6SN1197–0AD04–0BP1

/PJTM/ **Planning Guide, Build–in Torque Motors**

SIMODRIVE
Build–in Torque Motors 1FW6
Order No.: 6SN1197–0AD00–0BP2

/PJLM/ **Planning Guide, Linear Motors**

SIMODRIVE
Linear Motors 1FN1, 1FN3
Order No.: 6SN1197–0AB70–0BP3

/PJU/ **Planning Guide, Drive Converters**

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

/EMC/ **Planning Guide, EMC Design Guidelines**

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

Operating Instructions 1PH2

Order No.: 610.43.424.21a

Order No.: A1A3433 DE

■

Index

Space for your notes

To
SIEMENS AG
A&D MC BMS
Postfach 3180

D-91050 Erlangen

Tel.: +49 (0)180 / 5050 – 222 [Service Support]
Fax: +49 (0)9131 / 98 – 2176 [Documentation]
email: motioncontrol.docu@erlf.siemens.de

Recommendations

Corrections

For documentation:

AC Induction Motors
1PH2

Manufacturer/Service Documentation

Planning Guide

Order No.: 6SN1197-0AC63-0BP0
Edition: 10.2003

From

Name

Company address/Dept.

Street

Postal code: City:

Telephone: /

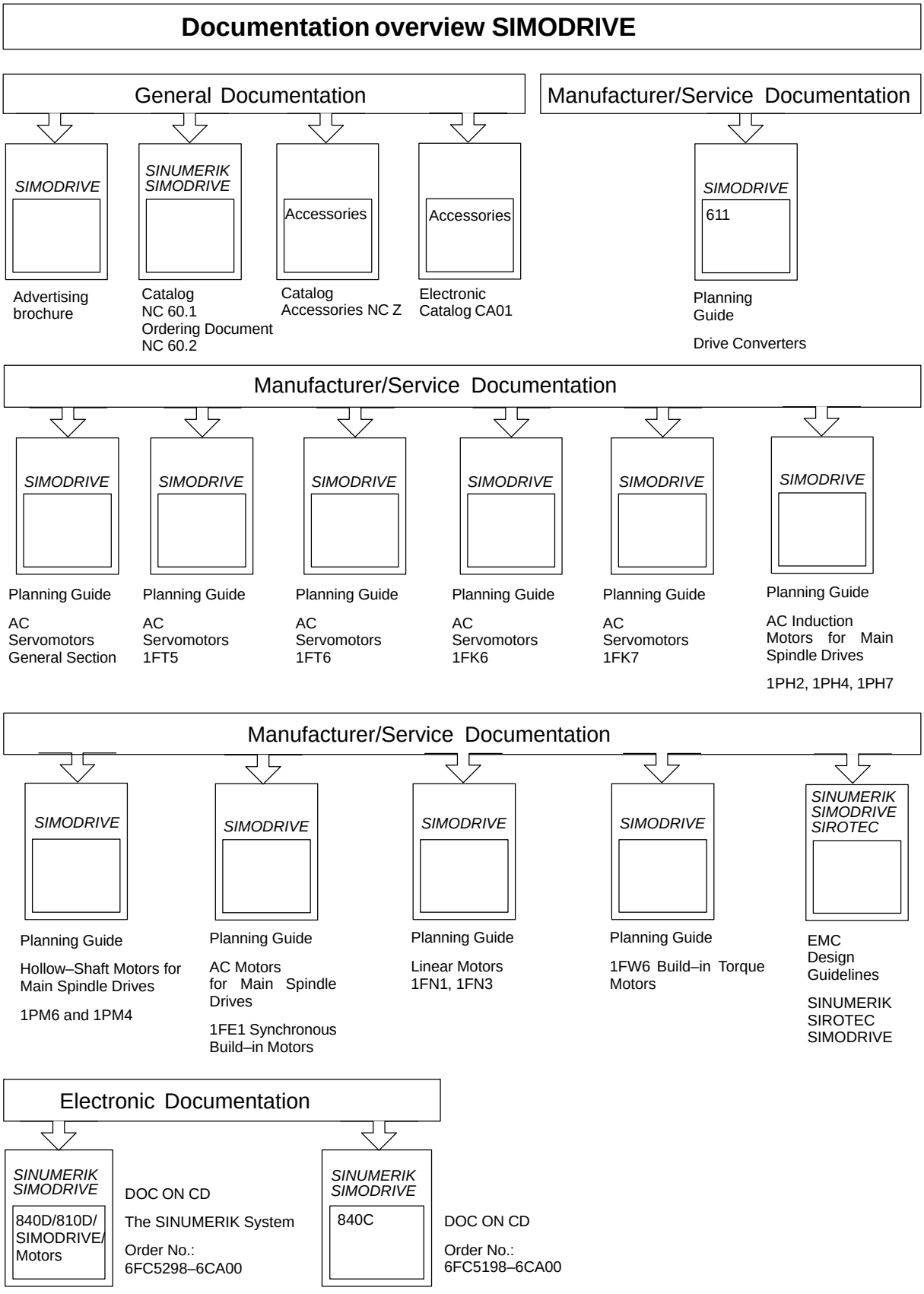
Telefax: /

If you come across printing errors in this document, please let us know using this form.

We would also be grateful for any recommendations and suggestions.

Recommendations and/or corrections

Documentation overview SIMODRIVE



Siemens AG
Automatisierungs- und Antriebstechnik
Motion Control Systems
Postfach 3180, D – 91050 Erlangen
Bundesrepublik Deutschland

www.ad.siemens.de

Order No.: 6SN1197-0AC63-0BP0

Printed in the Federal Republic of Germany