Configuration Manual 08/2005 Edition

simodrive

Hollow-Shaft Motors for
Main Spindle Drives
1PM6/1PM4

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Hollow-Shaft Motors for Main Spindle Drives 1PM6/1PM4

Configuration Manual

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Safety Guidelines

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



Danger

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



Warning

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



Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:



Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Disclaimer of Liability

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

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Automation and Drives
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Technical data subject to change

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. The documentation list, which includes all Advertising Brochures, Catalogs, Overviews, Short Descriptions, Operating Instructions and Technical Descriptions with Order No., 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.

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 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.

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Fax:	+49 (0) 180 5050–223
Internet:	http://www.siemens.com/automation/support-request

Please send any questions about the documentation (e.g. suggestions for improvement, corrections) to the following fax number or email address:

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Fax form:	Refer to the correction sheet at the end of the document
E-mail:	motioncontrol@siemens.com

Information on the products

Up-to-date information about our products can be found on the Internet at the following address:

http://www.siemens.com/motioncontrol

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, is in full compliance with the specifications of Directive 98/37/EC.

Only appropriately qualified personnel may commission/start-up the SIMODRIVE units and the motors.

This personnel must carefully observe the technical customer documentation associated with 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.

When the machine or system is operated, hazardous axis movements can occur.

All of the work carried-out on 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).

SIMODRIVE drive units with motors may only be connected to the line supply through residual-current operated circuit-breakers, if corresponding to EN 50178, Chapter 5.2.11.2, it has been clearly proven that the SIMODRIVE unit is compatible with the residual-current operated circuit-breaker.



Warning

The successful and safe operation of this equipment and motors is dependent on professional 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 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 temperature-sensitive components, e.g. cables or electronic components may neither be in contact nor be attached to the motor.

When connecting-up cables, please observe that they
– are not damaged
– are not subject to tensile stress
– cannot be touched by rotating components.



Caution

SIMODRIVE drive units with 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 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.

Motors should be connected-up according to the circuit diagram provided. They must not be connected directly to the three-phase supply because this will damage them.

Note

SIMODRIVE units with motors fulfill, when operational and in dry operating rooms, the Low-Voltage Directive 73/23/EEC.

SIMODRIVE units with motors fulfill, in the configuration specified in the associated EC Declaration of Conformity, the EMC Directive 89/336/EEC.

ESDS instructions



Caution

Electro**S**tatic-**S**ensitive **D**evices (ESDS) are individual components, integrated circuits, or modules that can be damaged by electrostatic fields or discharges.

ESDS regulations for handling boards and equipment:

When handling components that can be destroyed by electrostatic discharge, it must be ensured that personnel, the workstation and packaging are well grounded!

Personnel in ESD zones with conductive floors may only touch electronic components if they are
– grounded through an ESDS bracelet and
– wearing ESDS shoes or ESDS shoe grounding strips.

Electronic boards may only be touched when absolutely necessary.

Electronic boards may 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 to screens > 10 cm).

Measurements may only be carried-out on electronic boards and modules if
– the measuring instrument is grounded (e.g. via a protective conductor) or
– before making measurements with a potential-free measuring device, the measuring head is briefly discharged (e.g. by touching an unpainted blank piece of metal on the control cabinet).

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Description of the Hollow-Shaft Motor

1

1.1 Features of the 1PM6

Overview

Air-cooled 1PM6 motors have been specially designed for direct mounting on mechanical spindles. The hollow shaft permits the passage of coolant for tools with internal cooling.

The shaft is prepared on the non-drive end of the motor for connection of a turning bushing for input of the coolant.

The 1PM6 motors are rugged and maintenance-free 4-pole squirrel-cage asynchronous motors. They have been designed specifically for use in conjunction with the SIMODRIVE 611 converter system. A fan for providing separate ventilation is mounted either radially or axially on the rear side of the motor. The direction of air flow is from the drive end to the non-drive end in order to keep the exhaust heat of the motor away from the machine tool.

The motors have a built-in hollow shaft measuring system for recording the motor speed and indirect position.

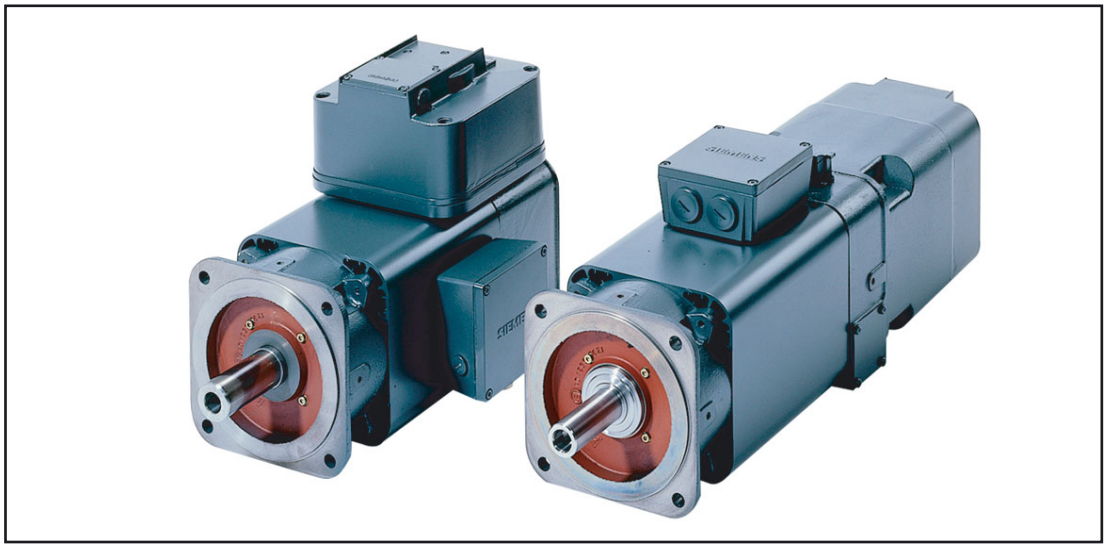


Figure 1-1 1PM6 motors with radial and axial fans

Benefits

- Hollow shaft for passage of coolant with direct spindle mounting
- Maximum speed up to 12000 RPM (18000 RPM for the version for increased maximum speed, option L37)
- Full rated torque is continually available - even at standstill
- Mounted axial or radial fans
- High rotational accuracy
- Short ramp-up and braking times

Applications

- Compact machining centers
- Directly driven tools with internal cooling
- Special machines

1.2 Features of the 1PM4

Overview

Liquid-cooled 1PM4 motors have been specially designed for direct mounting on mechanical spindles. The hollow shaft permits the passage of coolant for tools with internal cooling.

The shaft is prepared on the non-drive end of the motor for connection of a turning bushing for input of the coolant.

Given the compact design of modern machines, heat losses from electrical drives can have an adverse effect on machining accuracy. The consequential requirement for cold motors at high power densities led to the development of the liquid-cooled 1PM4 motors.

Furthermore, a combination of high torque and small unit volume (low mass inertia) results in short acceleration and braking times and thus in a reduction in non-productive time.

The motors have a built-in hollow shaft measuring system for recording the motor speed and indirect position.

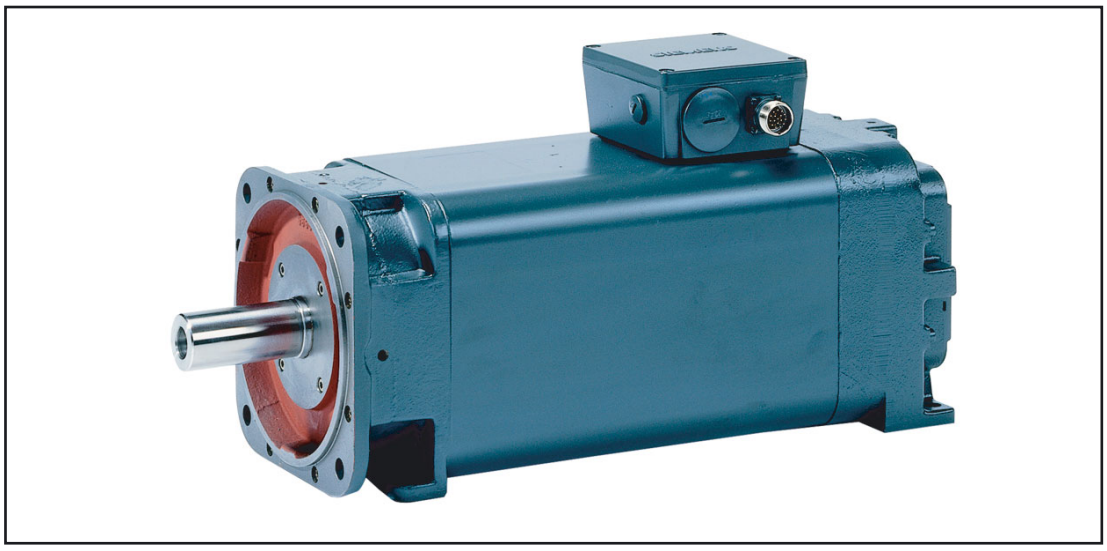


Figure 1-2 1PM4 motor, liquid-cooled

Benefits

- Hollow shaft for passage of coolant with direct spindle mounting
- Maximum speed up to 12000 RPM (18000 RPM for the version for increased maximum speed, option L37)
- Full rated torque is continually available - even at standstill
- Cooled flange to prevent thermal stressing of the mechanical power train
- Low noise level
- High rotational accuracy
- Short ramp-up and braking times

Applications

- Compact machining centers
- Directly driven tools with internal cooling
- Special machines

1.3 Technical design, 1PM6 and 1PM4

Table 1-1 Technical design

Technical feature	Design	
	1PM6	1PM4
Motor type	Squirrel-cage induction motor	
Type of construction (acc. to IEC 60034–7)	IM B5, IM V1, IM V3	IM B35, IM V15, IM V36
Hollow shaft	Connection for cooling-lubricating medium	
Degree of protection (acc. to IEC 60034–5)	IP 55, shaft outlet, IP 54	
Cooling	Air cooled	Liquid cooled • Oil • Water
Thermal motor protection (acc. to IEC 60034–6)	2 KTY 84 NTC thermistor temperature sensors in the stator winding, 1 as reserve	
Winding insulation acc. to EN 60034-1 (IEC 60034-1)	Temperature class F for a winding temperature rise of ΔT= 105 K	
Motor voltage	Max. 3-ph. 430 V AC	
Motor noise (acc. to DIN EN ISO 1680) tolerance +3 dB(A)	70 dB(A) for separately-driven fan when connected to the 50 Hz line supply 72 dB(A) for a separately driven fanwhen connected to a 60 Hz line supply 72 dB(A) for option L37	69 dB(A) 72 dB(A) for option L37
Connection type	Motor via the terminal box, encoder via signal connector	
Encoder system	Incremental encoder (hollow shaft encoder), sin/cos 1 Vpp, 256 S/R	
Shaft end	Cylindrical smooth, tolerance k6 (acc. to DIN 748), hollow shaft, bore diameter 11.5 mm	
Shaft and flange accuracy acc. to DIN 42955	Tolerance R	
Bearing version	Standard motors: Deep-groove ball bearings motors with option L37: Spindle bearings	
Vibration severity acc. to IEC 60034–14	Stage SR	
Shock resistance and permissible induced oscillation	Continuous shock acc. to IEC 60068 Part 2–29: For foot-mounting version, 10 g radial and 5 g axial, for flange versions 3 g radial and 5 g axial. Permissible vibration stressing acc. to IEC 60069 0.5 g for a max. speed in the range > 63 Hz.	
Paint finish	Anthracite	

1.4 Technical data

1.4.1 Technical data 1PM6

Table 1-2 Selection and ordering data 1PM6 (Part 1)

SH	Rated speed		Max. contin. speed	Max. speed [1]	Rated power for Y N_N=1500 RPM		Rated power for Δ N_N=4000 RPM		Induction motors 1PM6
	Y	Δ	n_{s1}	n_{max}	P_N		P_N		
					S1	S6-40%	S1	S6-40%	Order No., standard type
	RPM	RPM	RPM	RPM	kW	kW	kW	kW	
Forced ventilation									
100	1500	4000	12000	12000	3.7	5.3	3.7	6	1PM6101-2LF8□-1□□1
100	1500	4000	18000	18000	3.7	5.3	3.7	6	1PM6101-2LF8□-1□□1[2]
100	1500	4000	12000	12000	7.5	11	7.5	13	1PM6105-2LF8□-1□□1
100	1500	4000	18000	18000	7.5	11	7.5	13	1PM6105-2LF8□-1□□1[2]
132	1500	4000	10000	10500	11	16.5	11	19.5	1PM6133-2LF8□-1□□1
132	1500	4000	15000	15000	11	16.5	11	19.5	1PM6133-2LF8□-1□□1[2]
132	1500	4000	10000	10500	18.5	28	18.5	32	1PM6137-2LF8□-1□□1
132	1500	4000	12000	12000	18.5	28	18.5	32	1PM6137-2LF8□-1□□1[2]
132	1500	4000	10000	10500	22	33	22	39	1PM6138-2LF8□-1□□1
132	1500	4000	11000	11000	22	33	22	39	1PM6138-2LF8□-1□□1[2]

Type of construction	IM B5 IM V1 IM V3	1 4 5
Axial fan/air discharge bottom/air flow direction DE - NDE in conjunction with terminal box/metric cable entry	top/right top/DE top/NDE top/left	A R B R C R D R
Radial fan/air discharge direction NDE/air flow direction DE - NDE in conjunction with terminal box/metric cable entry	at the side, right/bottom at the side, right/DE at the side, right/NDE at the side right/top	E D F D G D H D

1) For continuous operation (with 30 % n_{max}, 60 %, 2/3 n_{max}, 10 % standstill) for a duty cycle duration of 10 min.

2) Option L37: Version for increased maximum speed.

Table 1-3 Selection and ordering data 1PM6 (Part 2)

Motor	Rated torque for Y		Rated torque for Δ		Moment of inertia	Weight, approx.	Rated motor current for Y		Required rated current (Order No. Power unit, refer to the Catalog)
	M_N		M_N		J	m	I_N		I_N
	S1	S6-40%	S1	S6-40%			S1	S6-40%	S1
	Nm	Nm	Nm	Nm	kgm^2	kg	A	A	A
Forced ventilation									
1PM6101-	24	34	9	14	0.011	45	13.5	17.5	24
1PM6101- 2)	24	34	9	14	0.011	45	13.5	17.5	24
1PM6105-	48	70	18	31	0.024	70	23	31	24
1PM6105- 2)	48	70	18	31	0.024	70	23	31	24
1PM6133-	70	105	26	47	0.046	94	41	58	45
1PM6133- 2)	70	105	26	47	0.046	94	41	58	45
1PM6137-	118	178	44	76	0.085	135	56	79	60
1PM6137- 2)	118	178	44	76	0.085	135	56	79	60
1PM6138-	140	210	53	93	0.104	156	58	80	60
1PM6138- 2)	140	210	53	93	0.104	156	58	80	60

2) Option L37: Version for increased maximum speed.

1.4.2 Technical data 1PM4

Table 1-4 Selection and ordering data 1PM4 (Part 1)

SH	Rated speed		Max. contin. speed	Max. speed [1]	Rated power for star N_N=1500 RPM		Rated power for Δ N_N=4000 RPM		Induction motors 1PM4	
	Y	Δ	n_{s1}	n_{max}	P_N		P_N			
					S1	S6-40%	S1	S6-40%	Order No., standard type	
	RPM	RPM	RPM	RPM	kW	kW	kW	kW		
Oil cooling[2]										
100	1500	4000	12000	12000	3.7	5.3	3.7	6	1PM4101-2LF86-1□S1	
100	1500	4000	18000	18000	3.7	5.3	3.7	6	1PM4101-2LF86-1□S1[3]	
100	1500	4000	12000	12000	7.5	11	7.5	13	1PM4105-2LF86-1□S1	
100	1500	4000	18000	18000	7.5	11	7.5	13	1PM4105-2LF86-1□S1[3]	
132	1500	4000	10000	10500	11	16.5	11	19.5	1PM4133-2LF86-1□S1	
132	1500	4000	15000	15000	11	16.5	11	19.5	1PM4133-2LF86-1□S1[3]	
132	1500	4000	10000	10500	18.5	28	18.5	32	1PM4137-2LF86-1□S1	
132	1500	4000	12000	12000	18.5	28	18.5	32	1PM4137-2LF86-1□S1[3]	
Water cooling [4]										
100	1500	--	12000	12000	5	6.5	--	--	1PM4101-2LW26-1□S1	
100	1500	--	18000	18000	5	6.5	--	--	1PM4101-2LW26-1□S1[3]	
100	1500	--	12000	12000	11	14.75	--	--	1PM4105-2LW26-1□S1	
100	1500	--	18000	18000	11	14.75	--	--	1PM4105-2LW26-1□S1[3]	
132	1500	--	10000	10500	15	21	--	--	1PM4133-2LW26-1□S1	
132	1500	--	15000	15000	15	21	--	--	1PM4133-2LW26-1□S1[3]	
132	1500	--	10000	10500	27	38	--	--	1PM4137-2LW26-1□S1	
132	1500	--	12000	12000	27	38	--	--	1PM4137-2LW26-1□S1[3]	
Without fan combined with terminal box/metric cable entry						top/right top/DE top/NDE top/left				A B C D

1) For continuous operation (with 30 % n_{max}, 60 % 2/3 n_{max}, 10 % standstill) for a duty cycle duration of 10 min.
2) Can be changed-over between star/delta.
3) Option L37: Version for increased maximum speed.
4) Only star operation possible.

Table 1-5 Selection and ordering data 1PM4 (Part 2)

Motor	Rated torque for Y		Rated torque for Δ		Moment of inertia	Weight, approx.	Rated motor current for Y		Required rated current (Order No. Power unit, refer to the Catalog)
	M_N		M_N		J	m	I_N		I_N
	S1	S6-40%	S1	S6-40%			S1	S6-40%	S1
	Nm	Nm	Nm	Nm	kgm^2	kg	A	A	A
Oil cooling[2)]									
1PM4101-	24	34	9	14	0.011	42	13.5	17	24
1PM4101- [3)]	24	34	9	14	0.011	42	13.5	17	24
1PM4105-	48	70	18	31	0.024	67	23	31	24
1PM4105- [3)]	48	70	18	31	0.024	67	23	31	24
1PM4133-	70	105	26	47	0.046	90	41	58	45
1PM4133- [3)]	70	105	26	47	0.046	90	41	58	45
1PM4137-	118	178	44	76	0.085	130	56	79	60
1PM4137- [3)]	118	178	44	76	0.085	130	56	79	60
Water cooling [4)]									
1PM4101-	32	41	--	--	0.011	42	18	22.5	24
1PM4101- [3)]	32	41	--	--	0.011	42	18	22.5	24
1PM4105-	70	94	--	--	0.024	67	38	47	45
1PM4105- [3)]	70	94	--	--	0.024	67	38	47	45
1PM4133-	95	134	--	--	0.046	90	55	74	60
1PM4133- [3)]	95	134	--	--	0.046	90	55	74	60
1PM4137-	172	242	--	--	0.085	130	85	114	85
1PM4137- [3)]	172	242	--	--	0.085	130	85	114	85

2) Can be changed-over between star/delta.

3) Option L37: Version for increased maximum speed.

4) Only star operation possible.

Electrical Data

2

2.1 Definitions

Maximum speed n_{max}

The max. permissible speed n_{max} is determined from the mechanical design (bearings, short-circuit ring of the squirrel cage etc.).

Notice

The maximum speed n_{max} may **not** be exceeded.

The speed must be reduced according to the following load duty cycle:

If the maximum continuous speed n_{S1} is less than the maximum speed n_{max}, then the motor may not be continuously operated at the maximum speed n_{max}. In this particular case, the speed must be reduced according to the following load duty cycle if no other load duty cycle is specified:

30 %	n_{max}
60 %	2/3 n_{max}
10 %	Standstill

for a cycle duration of 10 min.

Maximum continuous speed n_{S1}

The maximum permissible speed that is continuously permitted without speed duty cycles.

Speed n_2

Maximum speed that can be achieved at the rated power corresponding to the specified operating mode (duty type) according to IEC 60034-1. The specified values apply for regulated infeed units with a regulated (closed-loop controlled) DC link voltage of 600 V DC.

Maximum torque M_{max}

Torque that is briefly available for dynamic operations (e.g. accelerating).
$M_{max} = 2 \cdot M_N$

Max. current I_{max}

It involves the current (rms phase value) that can briefly flow for dynamic operations (e.g. when accelerating) without damaging the motor.

Rated torque M_N

The rated torque is the torque that is mechanically available at the shaft that can be thermally provided corresponding to the specified operating mode (duty type) according to IEC 60034-1.

Rated speed n_N

It involves the speed for which the rated power and the rated torque are defined corresponding to the specified operating mode (duty type) according to IEC 60034-1.

Rated current I_N

It involves the current (rms phase value) that flows at the rated speed and rated torque and can be thermally provided according to the specified operating mode (duty type) according to IEC 60034-1.

Rated voltage V_N

It involves the voltage between two motor phases for which the rated data (rated power, rated speed, ...) are defined. The rated voltage is defined, taking into account magnetic (iron saturation) and thermal perspectives.

Rated frequency f_N

It involves the frequency that is necessary to achieve the rated data (rated power, rated speed, rated voltage, ..).

Rated power P_N

The rated power is the power that is mechanically available at the shaft that can be thermally provided corresponding to the specified operating mode (duty type) according to IEC 60034-1.

No-load current I_μ

This involves the current (rms phase current), that is required in order to operate the motor under no-load conditions at rated speed without load torque. The no-load current defines the motor magnetization in the base speed range (low speed at the start of field weakening).

S1 duty (continuous operation)

Operation with a constant load the duration of which is sufficient so that the machine goes into a thermal steady-state condition.

S6 duty (intermittent load)

S6 duty is operation with comprises a sequence of similar load duty cycles; each of these load duty cycles comprises a time with constant motor load and a no-load time. If not otherwise specified, then the power-on time refers to a load duty cycle of 10 min.

e.g. S6 - 40 %:	4 min load
	6 min no-load time

Thermal time constant T_{th}

The thermal time constant defines the temperature rise of the motor winding when the motor load is suddenly increased (step increase) up to the permissible S1 torque. After T_{th}, the motor has reached 63 % of its S1 final temperature.

2.2 Mode of operation and power characteristics

Mode of operation

A constant torque M_N is available from standstill up to the rated operating point.

The constant power range starts at the rated operating point (refer to the P/n diagrams in the Planning Guides of the motor sections).

At higher speeds, i.e. in the constant power range, the maximum available torque M_{max} at a specific speed n is approximated according to the following formula:

$$M_{max}\,[\mathrm{Nm}] < \frac{P_{max}\,[\mathrm{W}] \bullet 9550}{n\ \mathrm{RPM}} \qquad P_{max}\,[\mathrm{W}] = 2 \bullet P_N$$

Induction motors have a high overload capacity in the constant power range. For some induction motors, the overload capacity is reduced in the highest speed range. The precise data can be taken from the motor characteristics in the appropriate Planning Guides of the motor sections.

The motor field remains constant over the base speed range up to the rated operating point of the motor. This is then followed by a wide constant power range.

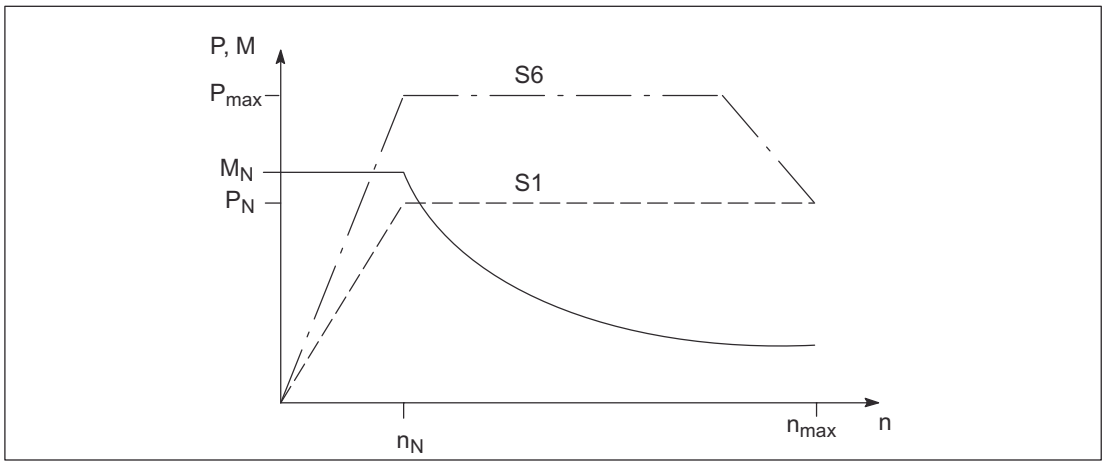


Figure 2-1 Principle characteristic of power P and torque M as a function of speed n (operating modes [duty types] acc. to IEC 60034, Part 1)

Power characteristics

For main spindle applications, the constant power range used to machine a workpiece with constant cutting power is extremely important. The required drive converter power can be reduced by optimally utilizing the constant power range.

The following limits and characteristics apply as basis for all induction motors fed from drive converters.

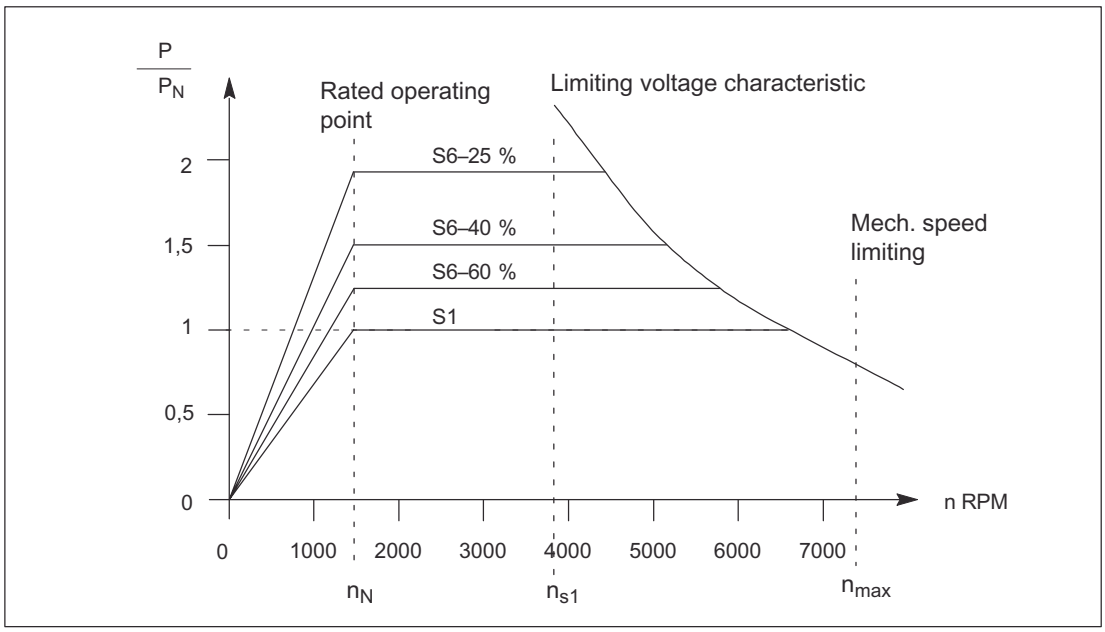


Figure 2-2 Power characteristics, limits and characteristics

Power–speed diagram

Power ratings for duty types S1 and S6

The operating modes are defined in IEC 60034, Part 1. For duty types S1 and S6, acc. to IEC 60034, Part 1, a maximum load duty cycle of 10 min is defined as long as no other information exists.

All rating plate data of induction motors refer to continuous operation and the appropriate duty type S1.

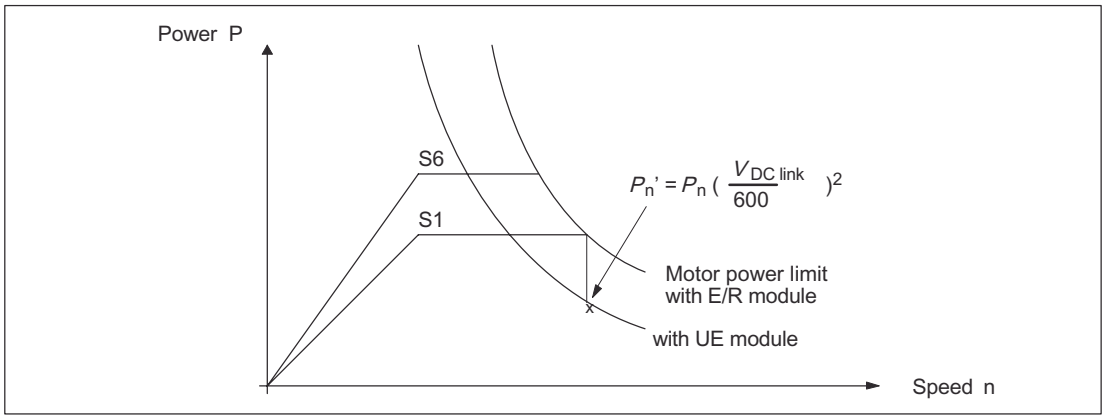


Figure 2-3 Power–speed diagram (using SIMODRIVE as example)

However, for many applications, duty type S1 does not apply, if e.g. the load varies as a function of time. For this particular case, an equivalent sequence can be specified which represents, as a minimum, the same load for the motor.

For shorter accelerating times, torque surges or drives which have to handle overload conditions, short-time or peak currents are available in a 60 second cycle. The magnitude of these currents and how the drive converter system is engineered can be taken from the documentation of the relevant drive converter power modules.

2.3 Operation on SIMODRIVE 611

The drive modules can be operated from both unregulated and regulated supply modules belonging to the SIMODRIVE 611 drive converter system. The engineering and power data of the Catalog refer to operation with the controlled infeed/regenerative feedback modules. This data should be corrected, if required, when operated from unregulated infeed modules.

When operating main spindle and induction drive modules with an uncontrolled (non-regulated) infeed (UI module), then a lower maximum motor output is available in the upper speed range than when using the regulated infeed/regenerative feedback module (refer to the diagram).

As a result of the lower DC link voltage of 490 V, for the UI module, the available continuous output is given by:

If $V_{DC\ link} < 1.5\ V_{N\ motor}$ then only the following continuous power

$$P_{Duration} = P_N \cdot \frac{V_{DC\ link}}{1.5 \cdot V_{N\ Mmotor}}$$ is possible at rated speed.

$V_{DC\ link}$ 490 V for UI module
$V_{DC\ link}$ 600 V for I/R module

These values apply for a 400 V line supply.

For the UI module, it must also be observed that the braking energy, which is fed-in, does not exceed the power rating of the pulsed resistor:

- Infeed module 5 kW
  200 W continuous power (regenerative feedback power)
  10 kW short-time power for 120 ms - once every 10 s load duty cycle without pre-load condition
- Infeed module 10 kW
  300 W continuous power (regenerative feedback power)
  25 kW short-time power for 120 ms - once every 10 s load duty cycle without pre-load condition
- Infeed module 28 kW
  max. 2 x 300 W continuous power
  max. 2 x 25 kW short-time power for 120 ms, once every 10 s load duty cycle without pre-load condition or
  or
  max. 2 x 1.5 kW continuous power
  max. 2 x 25 kW short-time power for 12 ms once for each 10 s load duty cycle without pre-load condition
  For higher regenerative feedback powers, a separate pulsed resistor module must be provided or the regenerative feedback power reduced by configuring longer braking times.

2.4 Motor drive converter assignment (power unit)

If the rated drive converter current exceeds the rated motor current, then the thermal characteristic (S1) of the motor determines the continuous power of the combination.

Result: The drive converter is therefore not fully utilized.

In the inverse case, the rated drive converter current defines the available continuous power.

Result: The motor isn't thermally fully utilized.

If the drive system is operated using load duty cycles, then the motor must be selected so that the RMS current values do not exceed the permissible S1 value of the motor.

The following generally applies:

If a range is defined by two limit values or characteristics, then the lower limit defines the usable range.

2.5 Motor limits

The speed and power of induction motors are limited for thermal and mechanical reasons[1)].
[1)] Stress on the shaft end, bearing stress

Thermal limiting

The characteristics for continuous duty S1 and intermittent operation S6-60 %, S6-40 % and S6-25 % describe the permissible power values for an ambient temperature of up to 40 °C. A winding temperature rise of approx. 105 K can occur.

Mechanical limiting

It is not permissible that the mechanical limit speed is exceeded. If this speed is exceeded, then this can result in damage to the bearings, short-circuit end rings, press fits etc. It should be ensured that higher speeds are not possible by appropriately designing the control or by activating the speed monitoring in the drive converter.

2.6 Connection system

Connecting motors

The type of the terminal box used, number of terminals, cross-sections that can be used, number of auxiliary terminals and cross-section for the PE connection are shown in the following table.

Table 2-1 Overview, connection system

Motor type	Shaft height	Terminal box type	Number of main terminals	Max. cross-section that can be connected	Terminal strip for temperature sensor	PE connection Size/cable lug width
1PM6 and 1PM4, oil cooling	100	gk 230	6 x M4	6 mm^2	3 terminals	M4/9 mm
	132	gk 330	6 x M5	25 mm^2 with cable lug connection	3 terminals	M5/15 mm
1PM4 water cooling	100	gk 233	3 x M5	16 mm^2	3 terminals	M4/9 mm
	132	gk 423	4 x M10	70 mm^2 with cable lug connection	3 terminals	M6/15 mm



Caution

Please carefully observe the current that the motor draws in your application!
Appropriately dimension the connecting cables corresponding to IEC 60204-1.

2.6.1 Star/delta circuit configuration

The star/delta circuit configuration is implemented using an external contactor circuit or as permanent setting (configuration) in the terminal box.

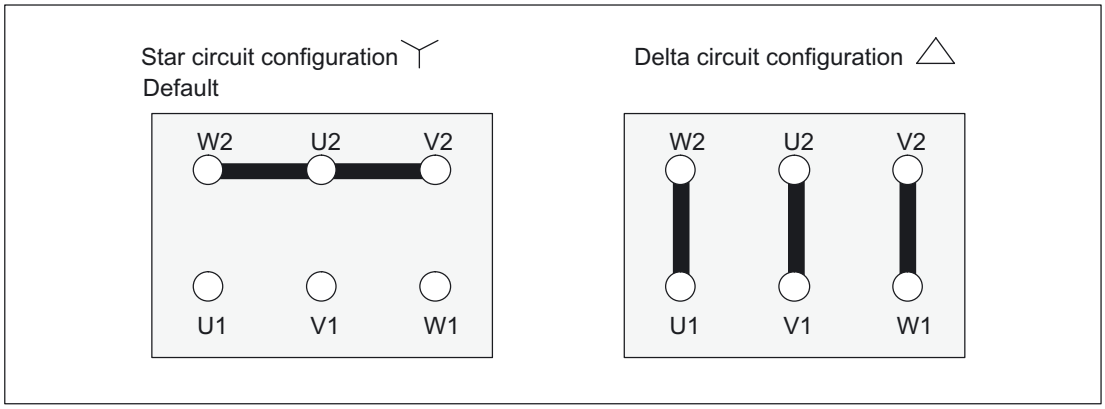


Figure 2-4 Permanent star and delta circuit configuration in the terminal box using the appropriate jumpers (these are provided in the terminal box)

Note

Water-cooled 1PM4 motors are only operated in the star circuit configuration. These motors cannot be changed-over to a delta circuit configuration.

2.6.2 Power cable

The power cables for the 1PM4 and 1PM6 motors are selected according to the rated motor current I_N at +40°C according to the table.

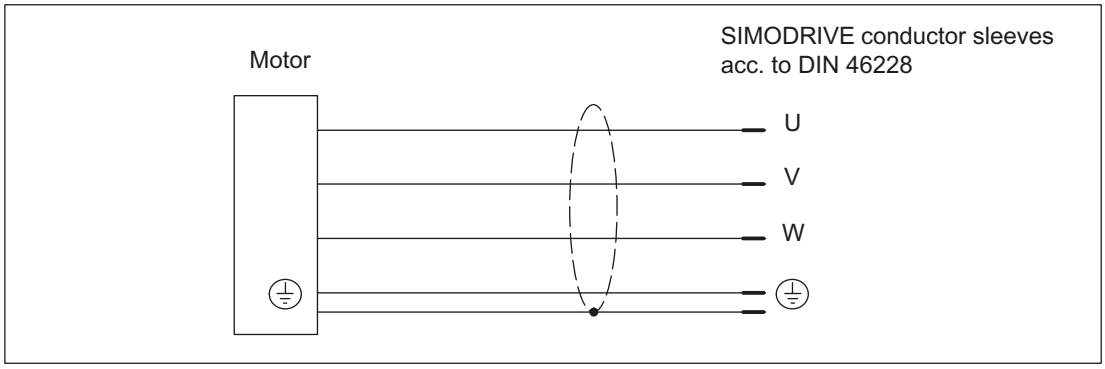


Figure 2-5 Power cable

Cross-sections

When connecting at the terminal board

- the connecting cables must be dimensioned according to the rated current and
- the size of the cable lugs must be selected corresponding to the dimensions of the terminal studs

Table 2-2 Current load capability acc. to IEC 60204-1 for PVC insulated cables with copper conductors for an ambient temperature of +40°C and routing type C (cables and conductors routed along walls/panels and in cable ducts).

I_{rms} at +40°C [A]	Required cross-section [mm²]	I_{rms} at +40°C [A]	Required cross-section [mm²]
15.2	1.5	84	25
21	2.5	104	35
28	4	123	50
36	6	155	70
50	10	192	95
66	16	221	120
Note: Correction factors with reference to the ambient temperature and routing type are specified in IEC 60204-1.			

Order Nos. for power cables without brake conductors

Table 2-3 MOTION-CONNECT power cables without brake conductors

No. of conductors x cross-section	D_{max}	D_{max}	Cables sold by the meter	Weight (by the meter)		Smallest permissible bending radius	
	6FX5-	6FX8-		6FX5-	6FX8-	6FX5-	6FX8-
mm^2	mm	mm	Order No.	kg/m	kg/m	mm	mm
4 x 1.5	10.1	10.4	6FX□□08-1BB11-…	0.18	0.16	185	100
4 x 2.5	11.5	12.1	6FX□□08-1BB21-…	0.24	0.24	210	120
4 x 4	13.3	13.2	6FX□□08-1BB31-…	0.32	0.31	240	130
4 x 6	15.6	16.0	6FX□□08-1BB41-…	0.46	0.43	285	170
4 x 10	20.0	19.4	6FX□008-1BB51-…	0.73	0.63	360	210
4 x 16	24.2	23.6	6FX□008-1BB61-…	1.10	0.95	440	260
4 x 25	28.0	--	6FX5008-1BB25-…	1.42	--	505	--
4 x 35	31.5	--	6FX5008-1BB35-…	1.87	--	570	--
4 x 50	38.0	--	6FX5008-1BB50-…	3.42	--	685	--
4 x 70	42.6	--	6FX5008-1BB70-…	4.12	--	770	--
			Note: 6FX5 = MOTION-CONNECT 500 6FX8 = MOTION-CONNECT 800				

Order Nos. for power cables with brake conductors

Table 2-4 MOTION-CONNECT power cables with brake conductors

No. of conductors x cross-section	D_{max}	D_{max}	Cables sold by the meter	Weight (by the meter)		Smallest permissible bending radius	
	6FX5-	6FX8-		6FX5-	6FX8-	6FX5-	6FX8-
mm^2	mm	mm	Order No.	kg/m	kg/m	mm	mm
4 x 1.5 + 2 x 1.5	13.1	12.9	6FX□□08-1BA11-…	0.22	0.25	240	125
4 x 2.5 + 2 x 1.5	14.2	14.2	6FX□□08-1BA21-…	0.28	0.31	260	140
4 x 4 + 2 x 1.5	15.9	15.3	6FX□□08-1BA31-…	0.36	0.40	290	150
4 x 6 + 2 x 1.5	16.9	17.8	6FX□□08-1BA41-…	0.54	0.53	305	195
4 x 10 + 2 x 1.5	21.7	20.8	6FX□□08-1BA51-…	0.75	0.74	395	230
4 x 16 + 2 x 1.5	24.2	24.7	6FX□008-1BA61-…	1.10	1.10	440	275
4 x 25 + 2 x 1.5	29.4	27.9	6FX□008-1BA25-…	1.56	1.46	530	325
4 x 35 + 2 x 1.5	32.6	32.0	6FX□008-1BA35-…	2.01	2.10	590	380
4 x 50 + 2 x 1.5	38.0	35.8	6FX□008-1BA50-…	3.30	2.75	685	420
			Note: 6FX5 = MOTION-CONNECT 500 6FX8 = MOTION-CONNECT 800				

Note

The cables are available in a UL version. Technical data and cable lengths, refer to Catalog, Chapter "Connection system".

2.6.3 Connecting-up information

Note

The overall system compatibility is only guaranteed when using shielded power cables.

Shields must be incorporated in the protective grounding concept. Open-circuit or unused, conductors which can be touched, must be connected to protective ground.



Warning

Before carrying out any work on the motor, please ensure that it is powered-down and the system is locked-out so that the motor cannot re-start!

Please carefully observe the data on the rating plate and the circuit diagram in the terminal box. Appropriately and adequately dimension the connecting cables.

- Twisted or three-core cables with additional ground conductor should be used as motor feeder cables. The insulation should be removed from the ends of the conductors so that the remaining insulation extends up to the cable lug or terminal.
- The connecting cables should be freely arranged in the terminal box so that the protective conductor has an overlength and the cable conductor insulation cannot be damaged. Connecting cables should be appropriately strain relieved.
- Please ensure that the following minimum air distances are maintained: Supply voltages up to 500 V: Minimum air distance 4.5 mm
- After connecting-up, the following should be checked
  - The inside of the terminal box must be clean and free of any cable pieces
  - All of the terminal bolts must be tight (tightening torques, refer to the operating instructions)
  - The minimum air distances must be maintained
  - The cable glands must be reliably sealed
  - Unused cable glands must be closed and the plugs must be tightly screwed in place
  - All of the sealing surfaces must be in a perfect condition
- The cooling conditions must be carefully observed (refer to Chapter "Cooling")

2.6.4 Motor rating plate

2 motor rating plates are supplied with each motor:

- A rating plate is attached to the motor
- A rating plate is provided in the terminal box

SIEMENS

3~ Mot. 1PM6133 - 2LF81 - 1ED1 - Z Nr.YF. T531 98765 08 008

IM B5 IP 55 Th.Cl.F

V	A	kW	cos ϕ	Hz	RPM		Code
222 Y	41	11	0.82	51.4	1500	S1	
295 Δ	41	11	0.68	133.9	4000	S1	

Z: L37 max. 15000 RPM

Temp.Sensor KTY 84 - 130 ENCODER Q01 256 S/R

COOLING: AIR

m 94 kg

CE EN 60034

Made in Germany

Figure 2-6 Motor rating plate for the 1PM6 series

SIEMENS

3~ Mot. 1PM4105 - 2LF86 - 1AS1 - Z Nr.YF. T531 98765 09 009

IM B5 IP 55 Th.Cl.F

V	A	kW	cos ϕ	Hz	RPM		Code
300 Y	23	7.5	0.76	52.2	1500	S1	
375 Δ	24	7.5	0.59	134.4	4000	S1	

Z: L37 max. 18000 RPM

Temp.Sensor KTY 84 - 130 ENCODER Q01 256 S/R

COOLING: OIL 6 l/min

m 67 kg

CE EN 60034

Made in Germany

Figure 2-7 Motor rating plate for the 1PM4 series

2.7 Thermal motor protection

A KTY84 PTC thermistor is integrated in the stator winding to sense the motor temperature.

Type:	KTY 84
Resistance when cold (20 °C):	approx. 580 Ω
Resistance when hot (100 °C)	approx. 1000 Ω
Connection:	via signal cable
Response temperature:	Pre-alarm at 120 °C
	Shutdown (trip) at 155 °C ± 5 °C

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.

The PTC thermistor function is monitored. When a fault occurs, an appropriate signal is output to the control/drive converter. When the motor temperature increases, a signal "Alarm motor overtemperature" is output; this must be externally evaluated. If this signal is not observed, the drive converter shuts down with the appropriate fault signal when the shutdown temperature is exceeded.

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



Warning

If the user carries-out an additional high-voltage winding 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 a temperature sensor terminal, then it will be destroyed.

When connecting-up the temperature sensor, carefully ensure that the polarity is correct.

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

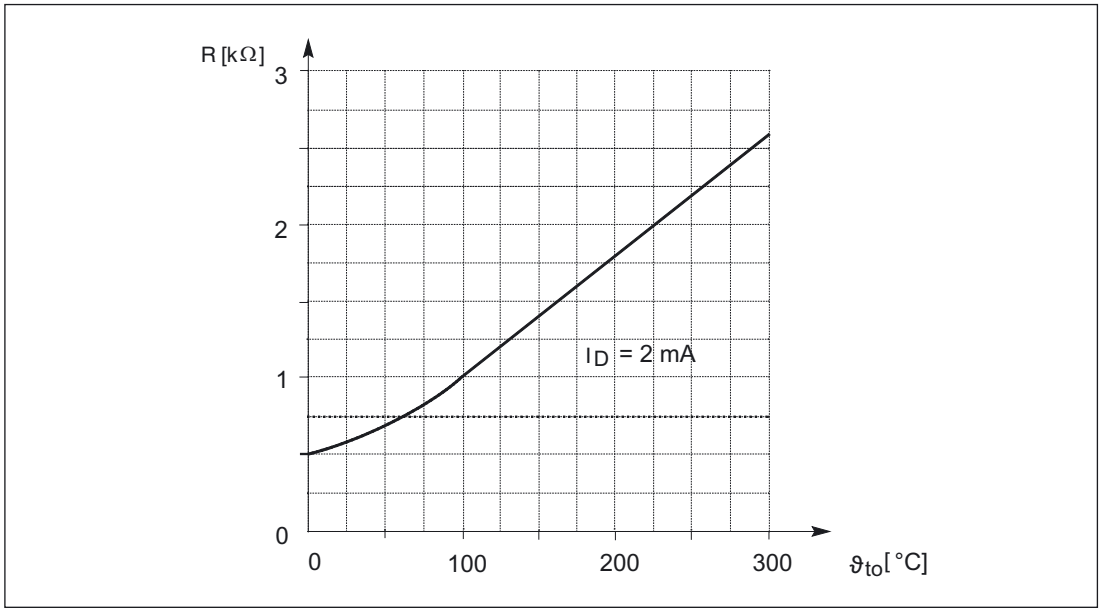


Figure 2-8 Resistance characteristic as a function of the KTY 84 thermistor temperature

2.8 Encoders

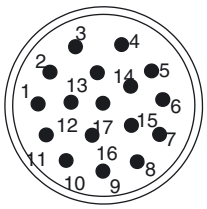
A hollow-shaft encoder is integrated on the non-drive end bearing endshield to sense the speed and rotor position.

Table 2-5 Technical data, sin/cos 1Vpp incremental encoder

Characteristics	Incremental encoder sin/cos 1 Vpp (I–256)
Resolution, incremental	256
Incremental signals	1 Vpp

The encoder is connected using the flange-mounted socket at the terminal box.

Table 2-6 Connection assignment, 17-pin flange-mounted socket

PIN No.	Signal	
1	A+	 When viewing the plug-in side (pins)
2	A–	
3	R+	
4	not connected	
5	not connected	
6	not connected	
7	M encoder	
8	+1R1 (KTY 84)	
9	–1R2 (KTY 84)	
10	P encoder	
11	B+	
12	B –	
13	R –	
14	not connected	
15	0 V sense	
16	5 V sense	
17	Inner shield	

Signal cable

Pre-assembled cables offer many advantages over cables assembled by customers themselves. In addition to the security of perfect functioning and the high quality, there are also cost benefits.

In order to avoid interference/noise (e.g. due to EMC), and guarantee protective separation, the power cables and signal cables must be separately routed.

Note

The maximum cable lengths should be carefully observed.

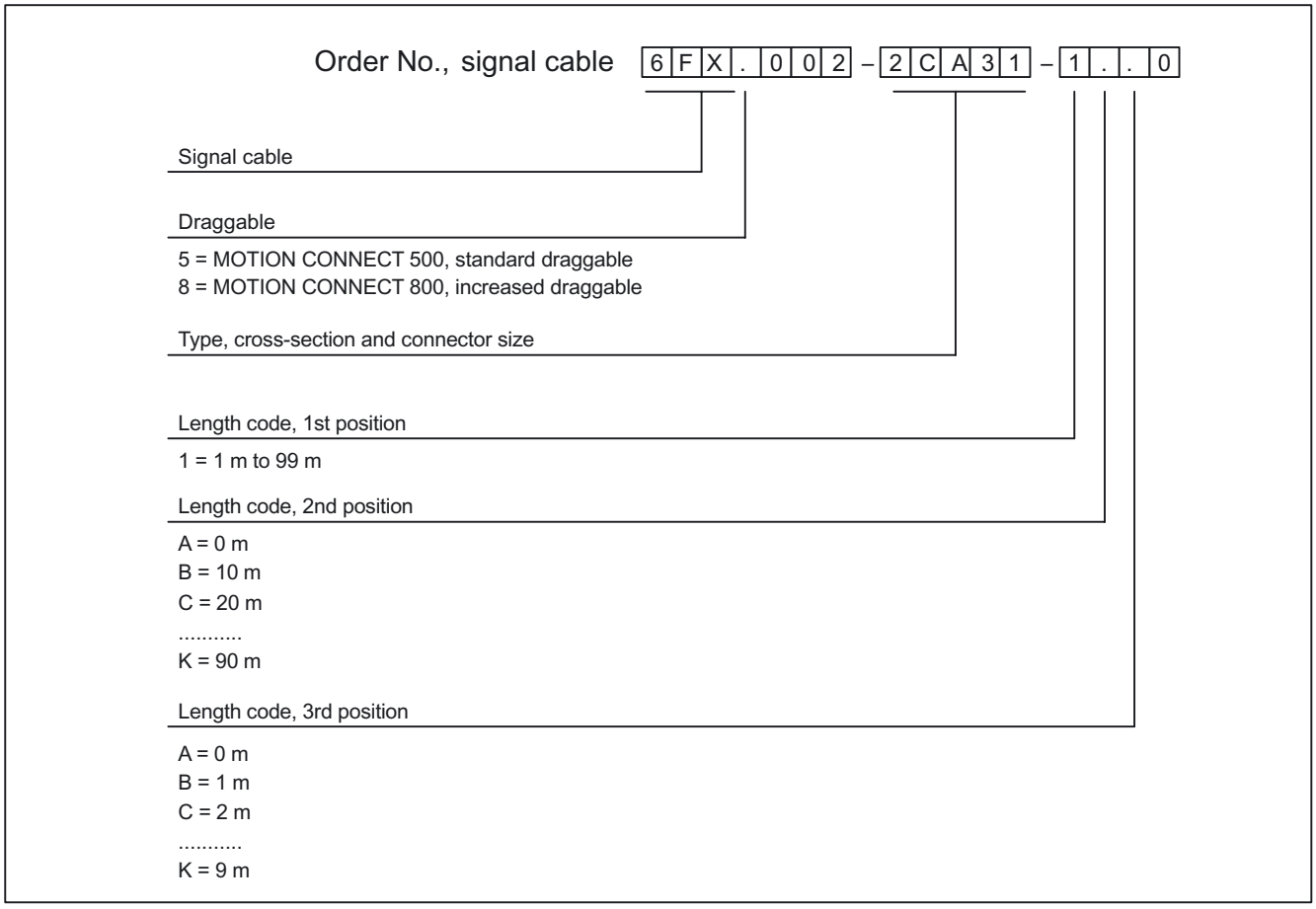


Figure 2-9 Order designation, signal cable

Mechanical Data

3

3.1 Types of construction

The 1PM6 and 1PM4 motor series are available in various types of construction.

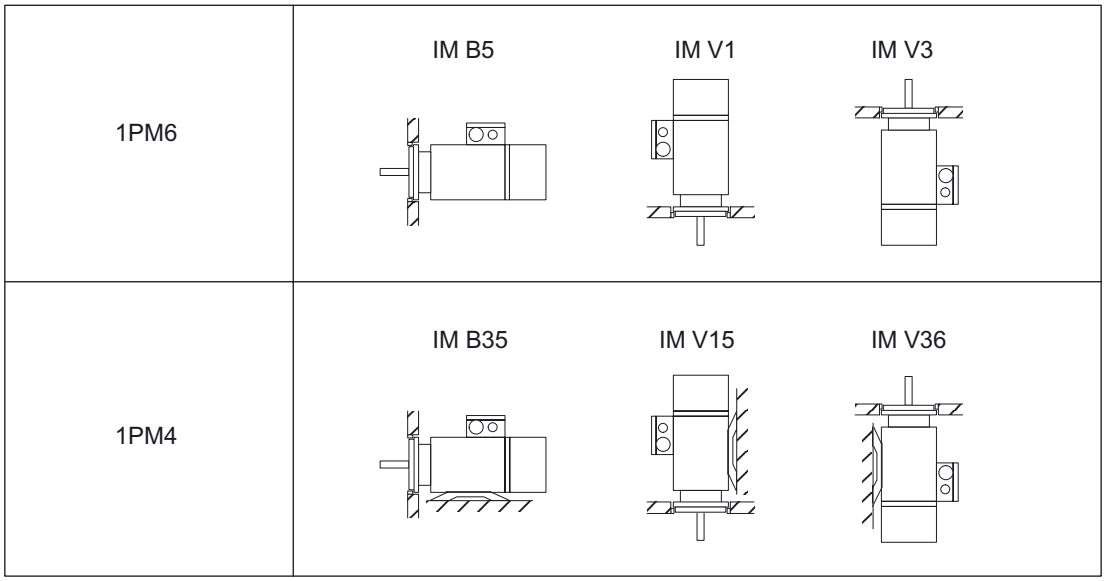


Figure 3-1 Types of construction for 1PM6 and 1PM4

For all 1PM4/1PM6 motors, it is possible to provide support at the non-drive end bearing endshield.

Note

For 1PM610□ with fan, the motor can only be supported using the threads for the lifting lugs located at the side.

3.2 Vibration severity limit values

The vibration severity grade limit values are always grade SR in the 1PM6 and 1PM4 series.

Generally, a high cantilever force load capability cannot be realized at the same time as a high operating speed and high vibrational quality.

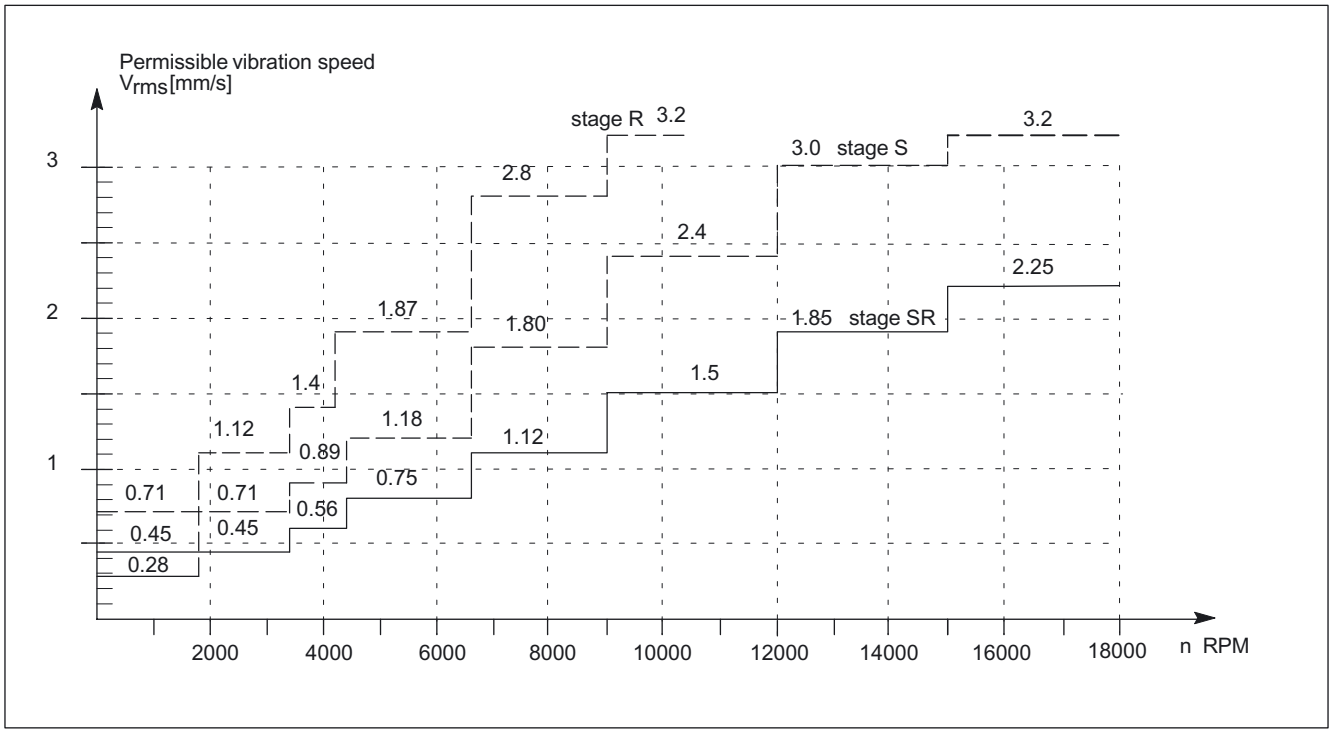


Figure 3-2 Diagram, vibration severity grade limit values, shaft heights 100 to 132

Requirements placed on the balancing process for mounted components

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

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

The requirements placed on the balancing process for the mounted component is described in the following table.

Table 3-1 Balancing processes, mounted component

Balancing equipment/process step	Motor with smooth (no keyway) shaft end
Auxiliary shaft to balance the mounted component	Auxiliary shaft, without key, use, if necessary, a tapered auxiliary shaft, balancing quality of the auxiliary shaft ≤ 10% of the required balancing quality of the mounted component
Attaching the mounted component to the auxiliary shaft for balancing	Attach the component as far as possible without any play, e.g. using a light press fit on the tapered auxiliary shaft
Position of the mounted component on the auxiliary shaft for balancing	No special requirements

Natural frequency when mounted

When the motor is mounted to the machine/system (flange-mounting is predominantly used) and coupled to the mechanical transmission shaft, vibration characteristics are obtained according to the specific system.

The vibration characteristics depend on the stiffness of the motor foundation. For a rigid coupling, the smooth running characteristics of the drive mechanical transmission are also important. These factors can result in increased vibration values at the motor and for example, for machine tools, in poor machining quality.

Measures to reduce vibration levels

Depending on the actual operating conditions, vibration can be reduced by applying the following measures:

- Stiffer motor foundation
- Additionally supporting the motor on the B side (for flange mounting)
- By de-coupling the system from the source of vibration or damping the drive mechanical shaft

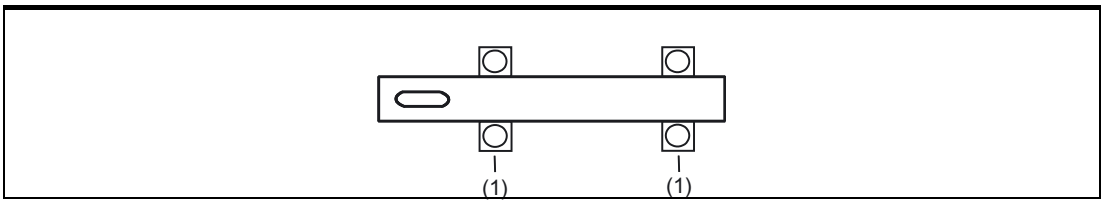
3.3 Bearing design

3.3.1 Drive output types and bearing versions

Bearing version for 1PM□ standard: Deep-groove ball bearings

Bearing version for 1PM□ with option L37: Spindle bearings

A drive output without any cantilever force is required, e.g. a coupling drive output.



Single-row (race) bearings with deep-groove ball bearings (1) or spindle bearings for option L37

Max. speed and max. continuous speed

Table 3-2 Max. speed and max. continuous speed

Shaft height	Standard motors		Motors with option L37	
	Max. speed [RPM]	Max. continuous speed [RPM]	Max. speed [RPM]	Max. continuous speed [RPM]
1PM□101	12000	12000	18000	18000
1PM□105	12000	12000	18000	18000
1PM□133	10500	10000	15000	15000
1PM□137	10500	10000	12000	12000
1PM6138	10500	10000	11000	11000

3.3.2 Bearing change intervals

Bearing change interval t_{LW}

`The value for t_{LW} in the following tables refers to the following data:

- Average operating speed n_m
- Cooling-medium temperature of +30 °C for liquid cooling or +40 °C for air cooling
- Bearing temperature ≤ 85 °C
- Horizontal mounting position

Table 3-3 Bearing change interval for 1PM□ standard

Shaft height [mm]	Average operating speed n_m [RPM]	Average operating speed n_m [RPM]
100	$n_m \leq 8000$	$8000 < n_m < 12000$
132	$n_m \leq 6000$	$6000 < n_m < 10500$
t_{LW} [h]	**16000**	**8000**

Table 3-4 Bearing change interval for 1PM□ with option L37

Shaft height [mm]	Average operating speed n_m [RPM]	Average operating speed n_m [RPM]
100	$n_m \leq 12000$	$12000 < n_m < 18000$
132	$n_m \leq 10000$	$10000 < n_m < 15000$
t_{LW} [h]	**16000**	**8000**

The permissible speed n_{max} of the appropriate motor must be carefully observed.

Reducing the bearing change intervals

The bearing change intervals t_{LW} must be reduced for:

- Vertical mounting position (reduced by up to 50%)
- Operation predominantly above 75% of the limit speed n_{max}
- High vibration and surge loads
- Frequent reversing operation
- Higher bearing temperatures > +85 °C

3.3.3 Cantilever and axial forces

Cantilever force

In order to guarantee perfect operation, the cantilever force may not exceeded 200 N.

Axial force

The axial force acting on the locating bearing comprises the following components:

- Operational axial force
  - Axial forces externally acting on the motor
  - Axial forces from the cooling-medium pressure of the cooling-lubricating medium fed through the rotary gland
- Force due to pre-loaded bearings
- Possible force due to the rotor weight when the motor is vertically mounted

This results in a maximum axial force that is a function of the direction.



Caution

Carefully observe the axial force as a result of the effective hydraulic diameter (surface) of the rotary gland.
Force F [N] = A (surface m^2) x p (cooling-medium pressure in N/m^2); 1 bar = 10^5 N/m^2

For axial forces in the direction of the motor, the spring-loading of the bearings can be overcome so that the rotor moves corresponding to the axial bearing play present (up to 0.2 mm). The permissible axial force F_{AZ} in operation depends on the motor mounting position.

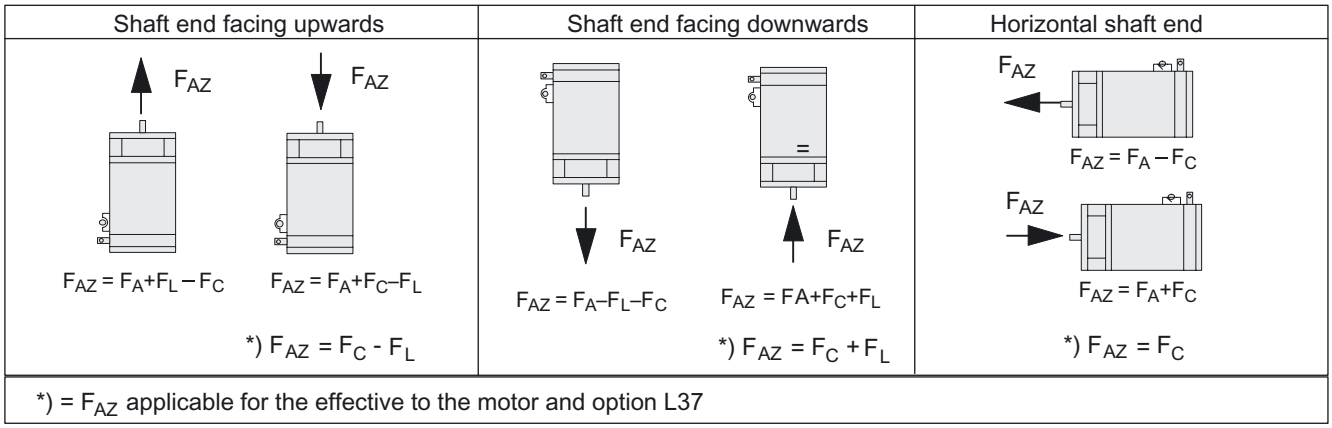


Figure 3-3 Calculating the permissible axial force acc. to the mounting position

Table 3-5 Explanation of the codes used:

F_{AZ}	Axial force in operation
F_A	Permissible axial force as a function of the average speed, refer to the table
F_C	Force due to spring-loaded bearings, refer to the table
F_L	Force due to the weight of the rotor, refer to the table

Table 3-6 Max. permissible axial force F_A [N] for a max. cantilever force FQ=200 N and a nominal bearing lifetime of 10000 hours

1PM□10□	Speed [RPM]	1500	3000	5000	7000	10000	12000	15000	18000
	Axial force F_A [N]	2120	1750	1510	1340	1180	1090	1020	960
1PM□13□	Speed [RPM]	1500	3000	5000	7000	10500	12000	15000	---
	Axial force F_A [N]	2320	1930	1650	1460	1310	1200	1130	---

For option L37: The perm. speed n_{max} of the appropriate motor must be carefully observed.

Table 3-7 Force due to the rotor weight F_L and force due to the spring-loaded bearings F_C

Motor type	F_L [N]	F_C [N]
1PM□101	100	550
1PM□105	160	550
1PM□133	235	600
1PM□137	390	600
1PM□138	455	600

3.4 Cooling

Hollow-shaft motors must be continually cooled independent of the duty type (S1, S6).

Force ventilated (1PM6 series)

For air-cooled motors, the cooling ducts, through which the ambient air flows, must be regularly cleaned depending on the degree of pollution at the mounting location. These air ducts can be cleaned, e.g. using dry, oil-free compressed air.

Liquid cooling (1PM4 series)

For liquid-cooled motors, the cooling conditions (intake temperature, water flow rate, cooling power) must be maintained.

For the 1PM4 series, either oil or water can be used as cooling medium.

- Oil cooling, refer to the Chapter "Liquid cooling (oil)"
- Water cooling, refer to Chapter "Liquid cooling (water)"

The cooling medium must be pre-cleaned and filtered in order to prevent the cooling circuit from becoming blocked. After filtering, the max. permissible particle size may be 100 µm.

Materials used in the cooling circuits

The anti-corrosion additives used should be harmonized with the cooling system manufacturer - i.e. the materials of the motor cooler and the materials of the fittings and cooling medium hoses listed in the table.

Table 3-8 Materials used in the motor cooling circuit

Motor type	Bearing end shield	Casing	Sealing agent
1PM6/1PM4	Gray cast iron	Al-profile DIN EN 12020	Terostat

Notice

Non-ferrous metals (e.g. copper or brass pipes) should not be used when water cooling is being used due to the formation of electrolytes. In combination with the motor materials, there is the danger of corrosion.

Cooling system

A cooling system is required for operation. Manufacturers of cooling systems, refer to Catalog NC 60.

3.4.1 Cooling-lubricating medium gland

The rotary gland for the cooling-lubricating medium must be mounted at the non-drive end shaft centering (screwed) - refer to the following diagrams.

The rotary gland is mounted carefully following the manufacturer's specifications.

- Gatt (Gesellschaft für Antriebstechnik mbH)
  Schloßbergstr. 19, D-65201 Wiesbaden
  URL: www.gat-mbh.de
- DEUBLIN GmbH,
  Postfach 400133, D-65708 Hofheim
  URL: www.deublin.com
- Ott-Jakob GmbH&Co
  Industriestraße 3-7, D-87663 Lengenwang
  URL: www.ott-jakob.de

For the 1PM6 series with mounted axial fan, when mounting the rotary gland, the fan - together with the adapter - must be removed. A recess/cut-out must be provided in the adapter (intermediate housing) for the cooling-lubricating medium feed. This opening must be clean.

Notice

When mounting the rotary gland, it must be carefully ensured that the thread is tightly screwed into the non-drive shaft end so that no cooling medium can leak.

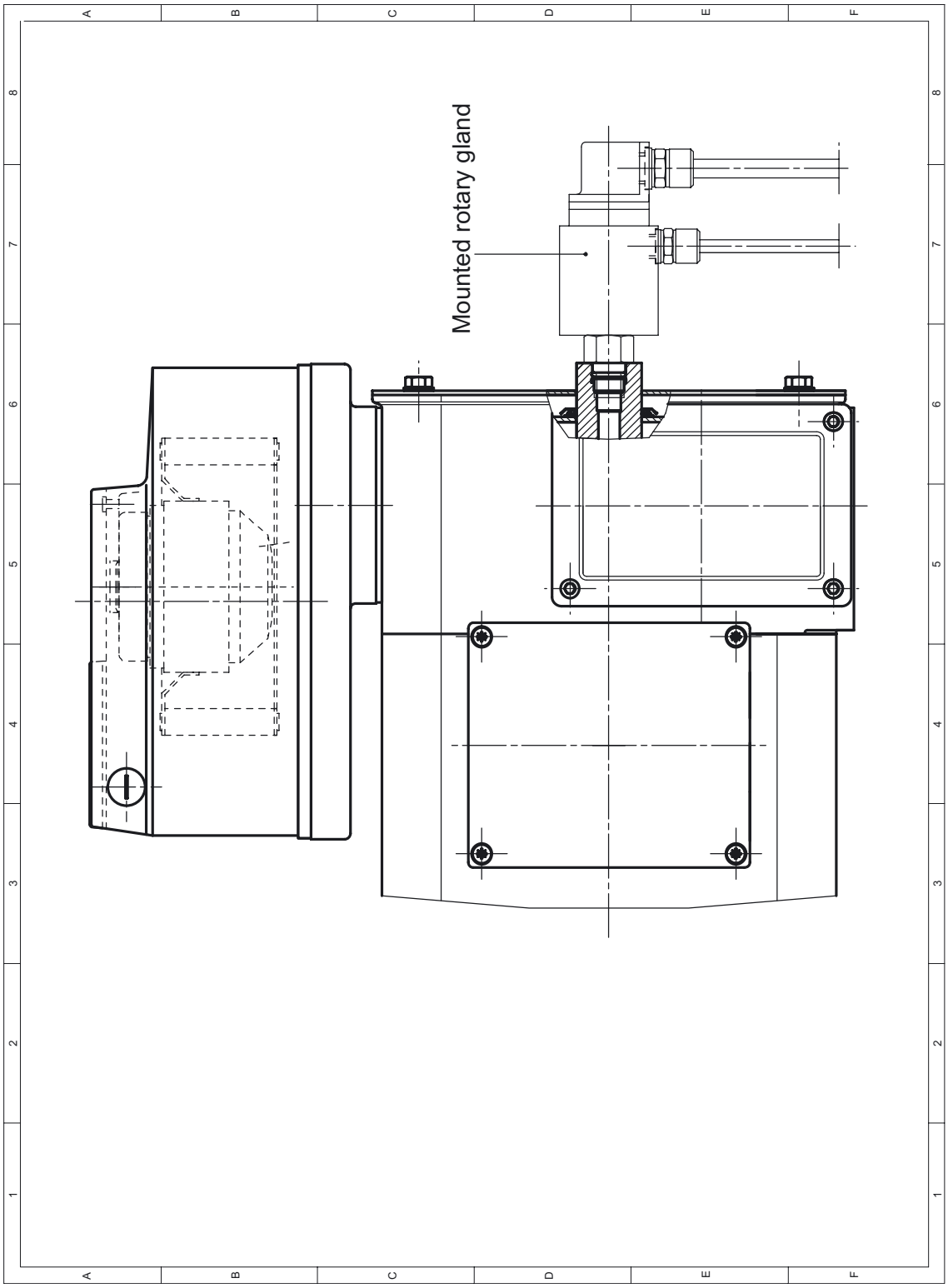


Figure 3-4 Rotary gland for 1PM6, radial fan

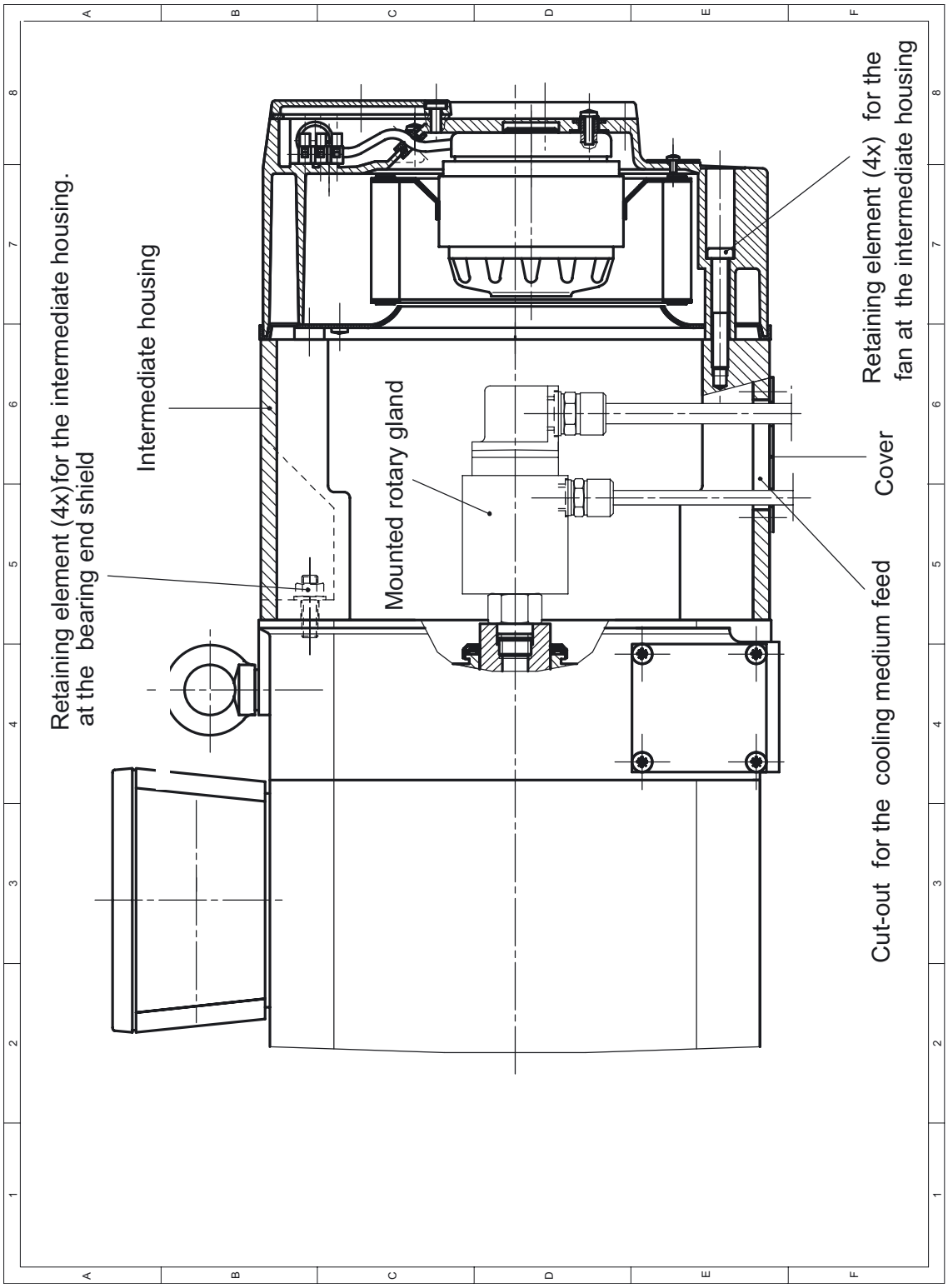


Figure 3-5 Rotary gland for 1PM6, axial fan

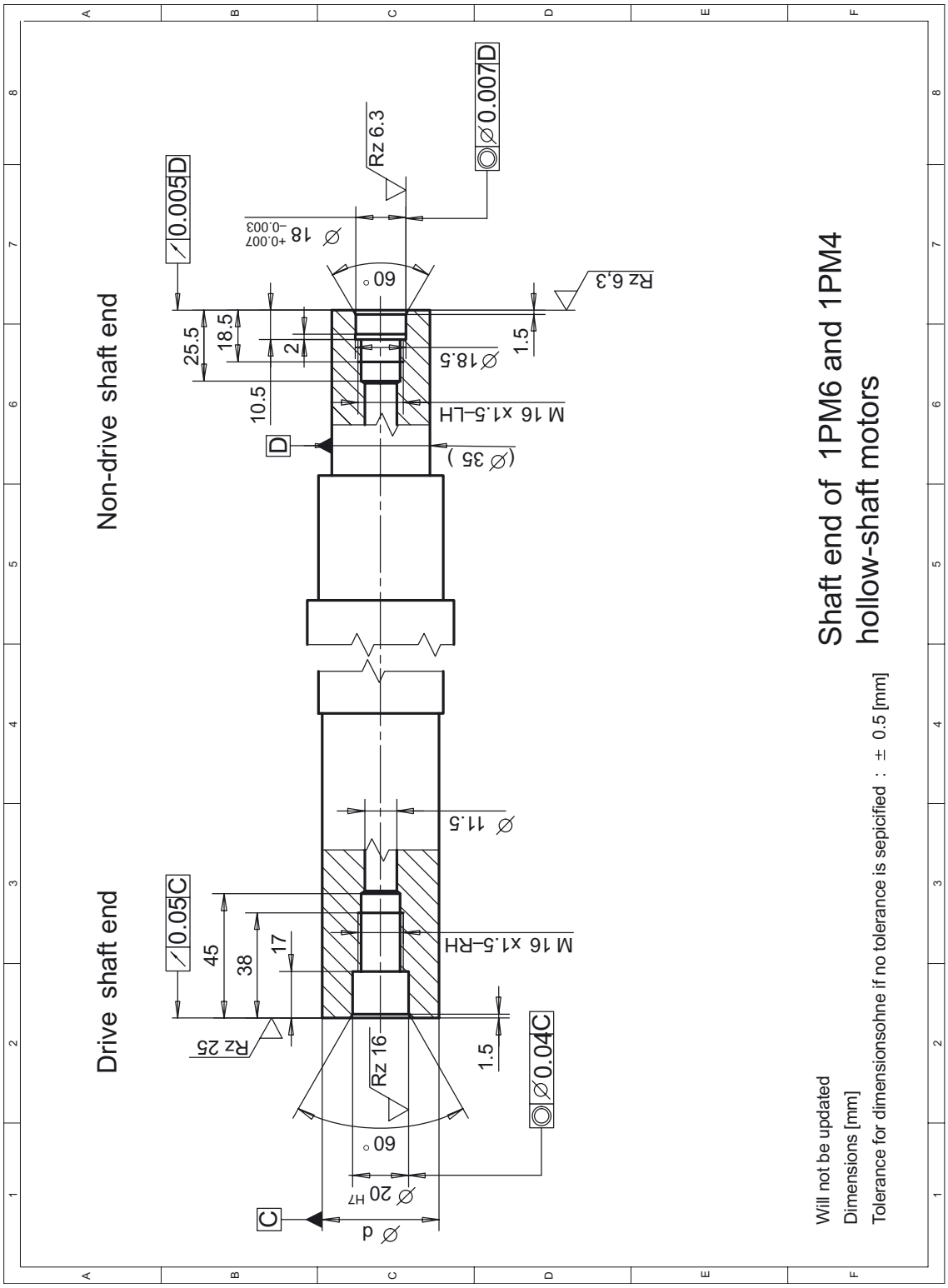


Figure 3-6 1PM6 and 1PM4, shaft end for the radial gland

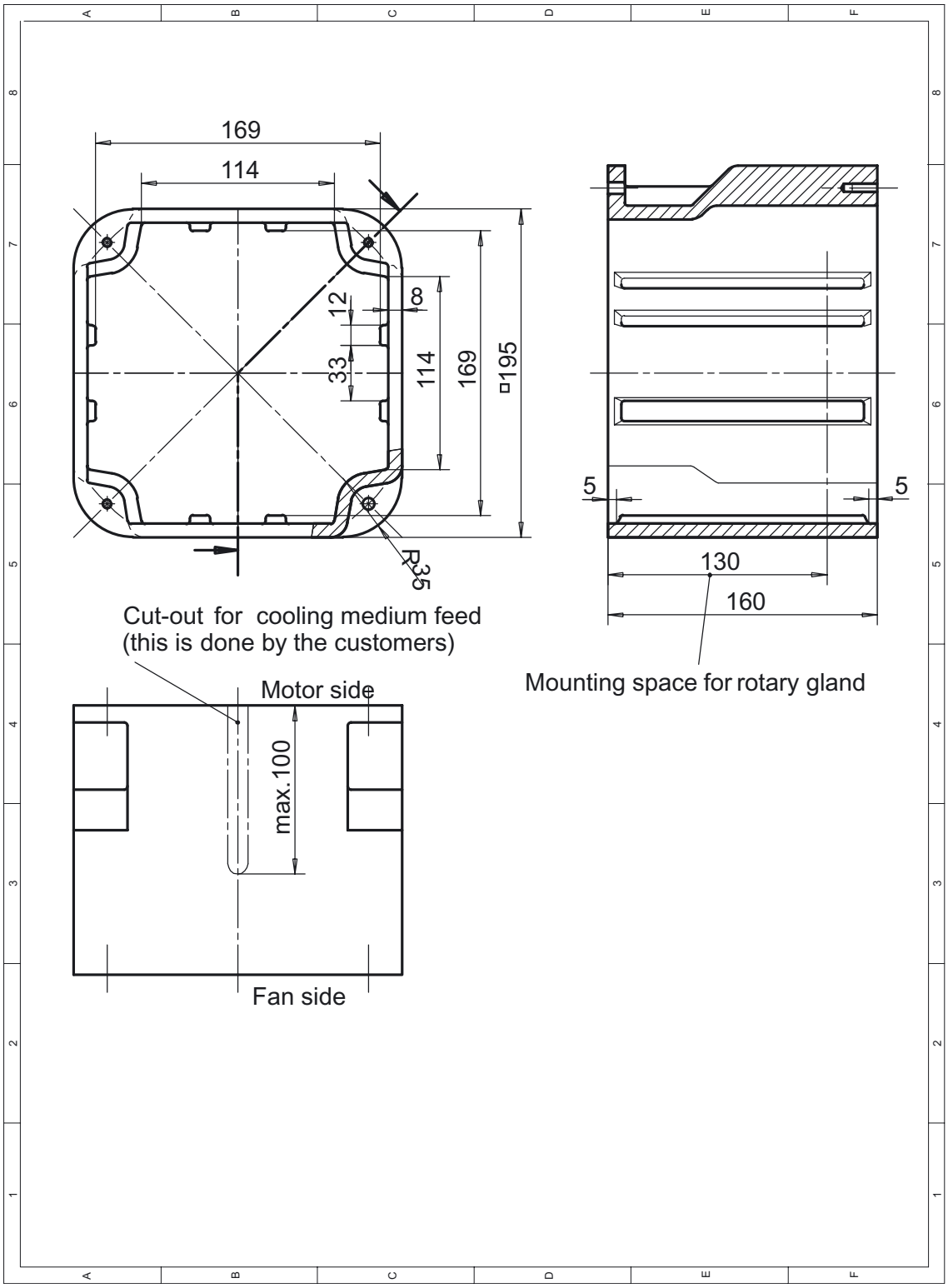


Figure 3-7 Adapter (intermediate housing) for 1PM6 10□

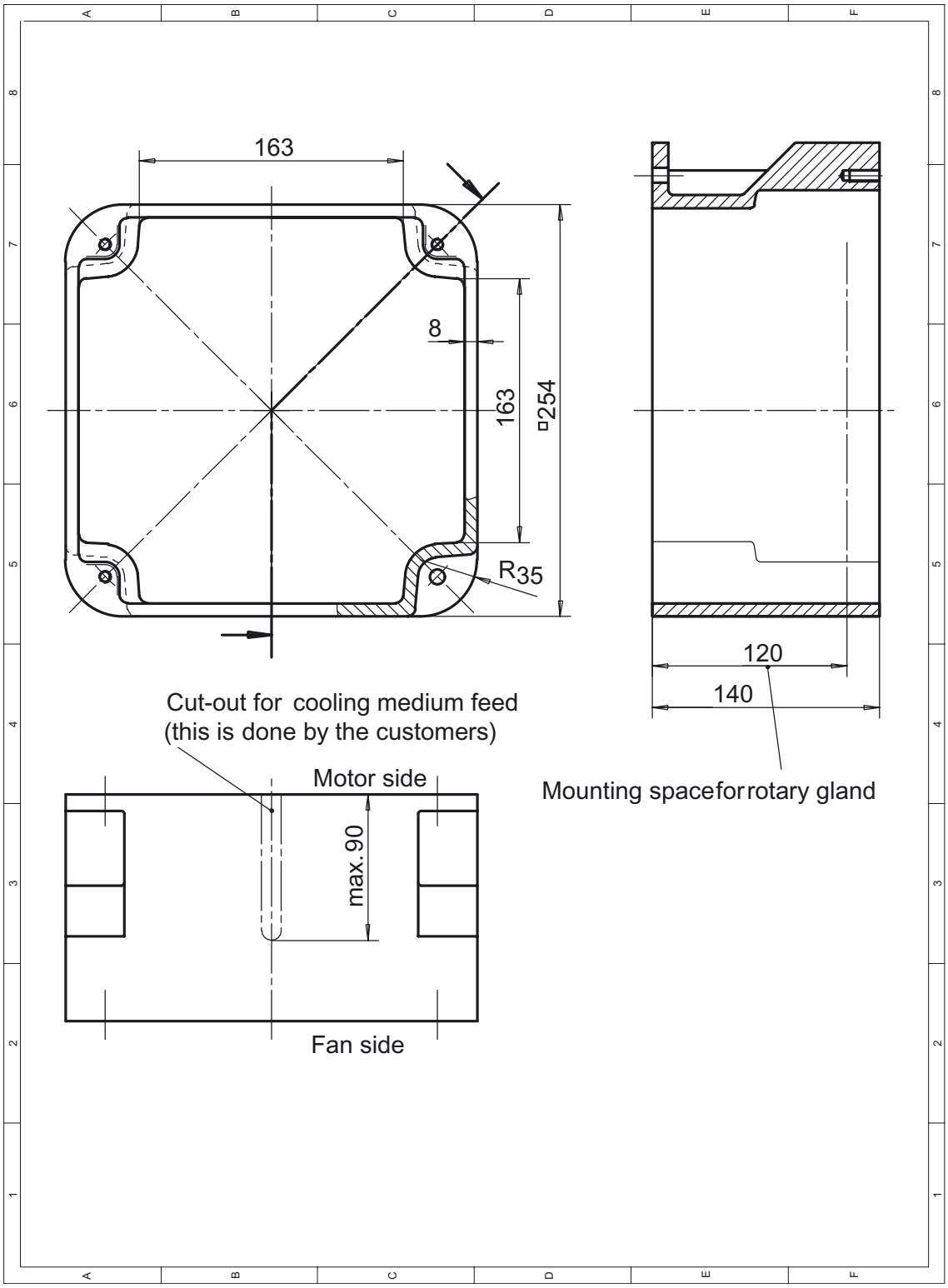


Figure 3-8 Adapter (intermediate housing) for 1PM6 13□

3.4.2 Liquid cooling (oil)

If the direction of the cooling-medium flow is not specified using arrows, then the intake and outlet openings can be freely selected.

The following minimum requirements must be carefully maintained:

Specific density:	ρ	$\geq 780\ kgm^{-3}$
Specific thermal capacitance:	c_p	$\geq 1870\ Jkg^{-1}K^{-1}$
Kinematic viscosity:	v	$\leq 10^{-5}\ m^2\ s^{-1}$

Cooling-medium intake temperature (recommended): up to +30 °C

When the cooling-medium temperature increases, then the rated power P_N decreases as follows:

Table 3-9 Reduction (de-rating) of the rated power as a function of the cooling-medium temperature

Cooling-medium temperature, intake [°C]	Reduction of rated power P_N [%]	Rated power P_N [%]
30	0	100
40	10	90
50	15	85

Table 3-10 Required cooling power and cooling quantity

Motor type	Oil flow [l/min]	Cooling power for oil [W]	Connection
1PM4 101	6	900	G 1/4
1PM4 105	6	1500	G 1/4
1PM4 133	8	1750	G 3/8
1PM4 137	8	2100	G 3/8
Note: The maximum permissible pressure is 3 bar.			

3.4.3 Liquid cooling (water)

If the direction of the cooling-medium flow is not specified using arrows, then the intake and outlet openings can be freely selected.

Cooling medium and anti-corrosion protection

An anti-corrosion additive must always be added to the cooling water (e.g. Tyfocor from Tyforop Chemie GmbH). Percentage, max. 25 %.

Note

Different anti-corrosion agents should not be mixed.

The cooling water should have the values/parameters:

Chemically neutral, clean, and free of solids	
Size of particles possibly in the flow of water (if required, use a filter to filter-out these particles):	Max. 100 µm
pH value:	6-7
Chloride:	< 50 ppm
Conductivity (only water):	< 500 mS/cm

Notice

If frost can be expected while the system is non-operational, is being transported or is in storage, then a commercially available antifreeze must be added.

The checking and change intervals for the cooling medium should be harmonized with the companies supplying the anti-corrosion agent and the cooling system.

When using another cooling medium (e.g. oil) de-rating may be required in order that the thermal motor limit is not exceeded. The de-rating can be determined using the following data:

Specific density:	ρ [kg/m³]
Specific thermal capacitance:	c_p [J/(kg K)]
Intake temperature:	t_v [°C]
Flow quantity:	v [l/min]

The enquiry must be sent to the manufacturer's plant (Hotline).

The motor power still does not have to be reduced for oil - water mixtures with less than 10 %.

Manufacturers of chemical additives

Table 3-11 Manufacturers of chemical additives

Company	Address	Telephone/Internet
Tyforop Chemie GmbH	Hellbrookstr. 5a, D–22305 Hamburg	www.tyfo.de
Joh.A. Beckiser Wassertechnik GmbH	Bergstr. 17 D-40699 Erkrath	Tel.: 02104 / 40075
CINCINNATI CIMCOOL Cincinnati 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 www.fuchs–oil.com
Hebro Chemie GmbH	Rostocker Straße D-41199 Mönchengladbach	Tel.: 02166 / 6009–0 www.hebro–chemie.de
Clariant	Refer to the Internet	www.clariant.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
Motorex Coolant F	Refer to the Internet	www.motorex.ch

Note

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

Cooling-medium intake temperature, required cooling power

Cooling-medium intake temperature (recommended): up to +30 °C

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

When the cooling-medium temperature increases, then the rated power P_N decreases as follows:

Table 3-12 Reduction (de-rating) of the rated power as a function of the cooling-medium temperature (intake)

Cooling medium temperature, intake [°C]	Rated power P_N [%]
30	100
40	90
50	85

Table 3-13 Required cooling power and cooling quantity

Motor type	Cold water flow [l/min]	Cooling power for water [W]	Connection
1PM4 101	6	1400	G 1/4
1PM4 105	6	2600	G 1/4
1PM4 133	8	2750	G 3/8
1PM4 137	8	3300	G 3/8
Note: The maximum permissible pressure is 3 bar.			

3.4.4 Forced ventilation

1PM6 motors are force-ventilated. The fan is mounted at the NDE.

Caution

Temperatures of over 100°C can occur at the surface of the motors.

Air flow direction and air discharge, air flow (rate) and ambient/cooling medium temperature

Table 3-14 Technical data for forced ventilation

	Shaft height 100	Shaft height 132
Air flow direction	From DE to NDE	From DE to NDE
Air discharge	Axial, fan can be rotated through 4x90 degrees	Axial, fan can be rotated through 4x90 degrees
Air flow rate	40 l/s	105 l/s
Ambient/cooling medium temperature	Operating mode: T = –15 °C to +40 °C (without any restrictions) Storage: T = –20 °C to +70 °C When the temperature increases, the rated power decreases as follows: T > 40 °C to 50 °C → Decreases down to 92 % P_N	

Minimum clearance for a customer-specific environment

The minimum clearance S between the intake and discharge openings and adjacent components must be maintained (refer to the example diagram: Radial fan, air discharge axially at the non-drive end)

For shaft height 100 mm: S = 30 mm
For shaft height 132 mm: S = 60 mm

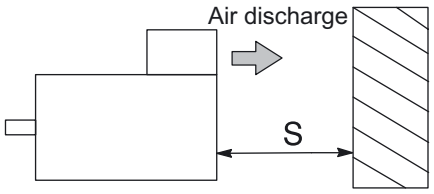


Figure 3-9 Minimum clearance to the intake and discharge openings

Connection values, separately-driven fan and current drain

Table 3-15 Connection values, separately driven fan

Shaft height [mm]	Voltage [V]
100	3-ph. 50 Hz 400 V AC (± 10 %) 3-ph. 60 Hz 400 V AC (±10 %) 3-ph. 60 Hz 480 V AC (+6% / –10%)
132	3-ph. 50 Hz 400 V AC (± 10 %) 3-ph. 60 Hz 400 V AC (±10 %) 3-ph. 60 Hz 480 V AC (+6% / –10%)

Table 3-16 Current consumption

Motor type	I_N [A], at 400 V, 50 Hz	I_N [A], at 480 V, 60 Hz	Current drain I_{max} [A]
1PM6 10□	0.15	0.15	0.3
1PM6 13□	0.25	0.30	0.36

Recommended connection

The connection is established through the terminal box. The fan must be fed through a motor protection circuit-breaker. The direction of rotation of the fan must be carefully checked.

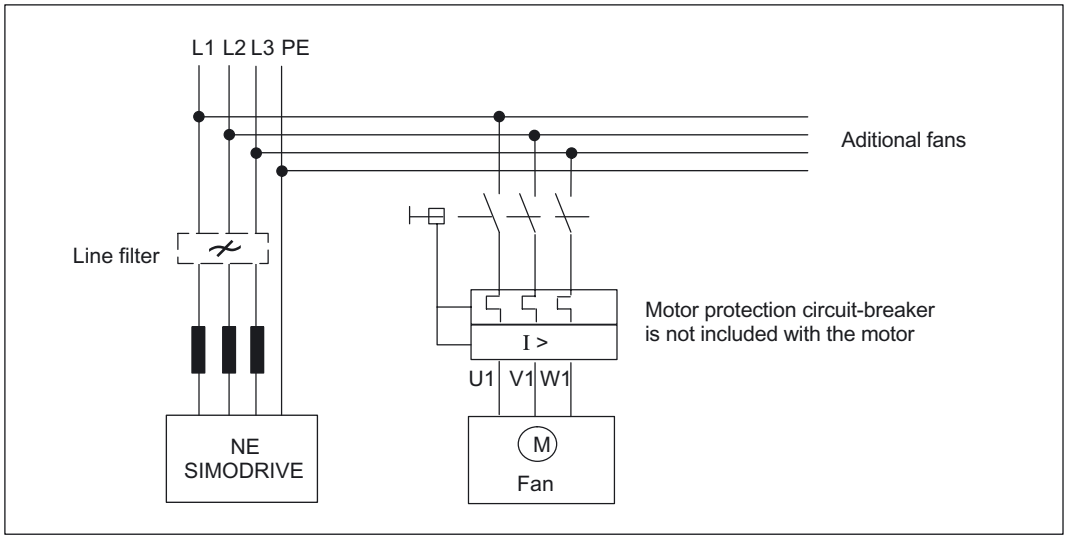


Figure 3-10 Recommended connection

Note

The motor protection circuit-breaker should be set to value $I_{max.}$ of the fan.

Order Designation

4

4.1 Order No. 1PM6

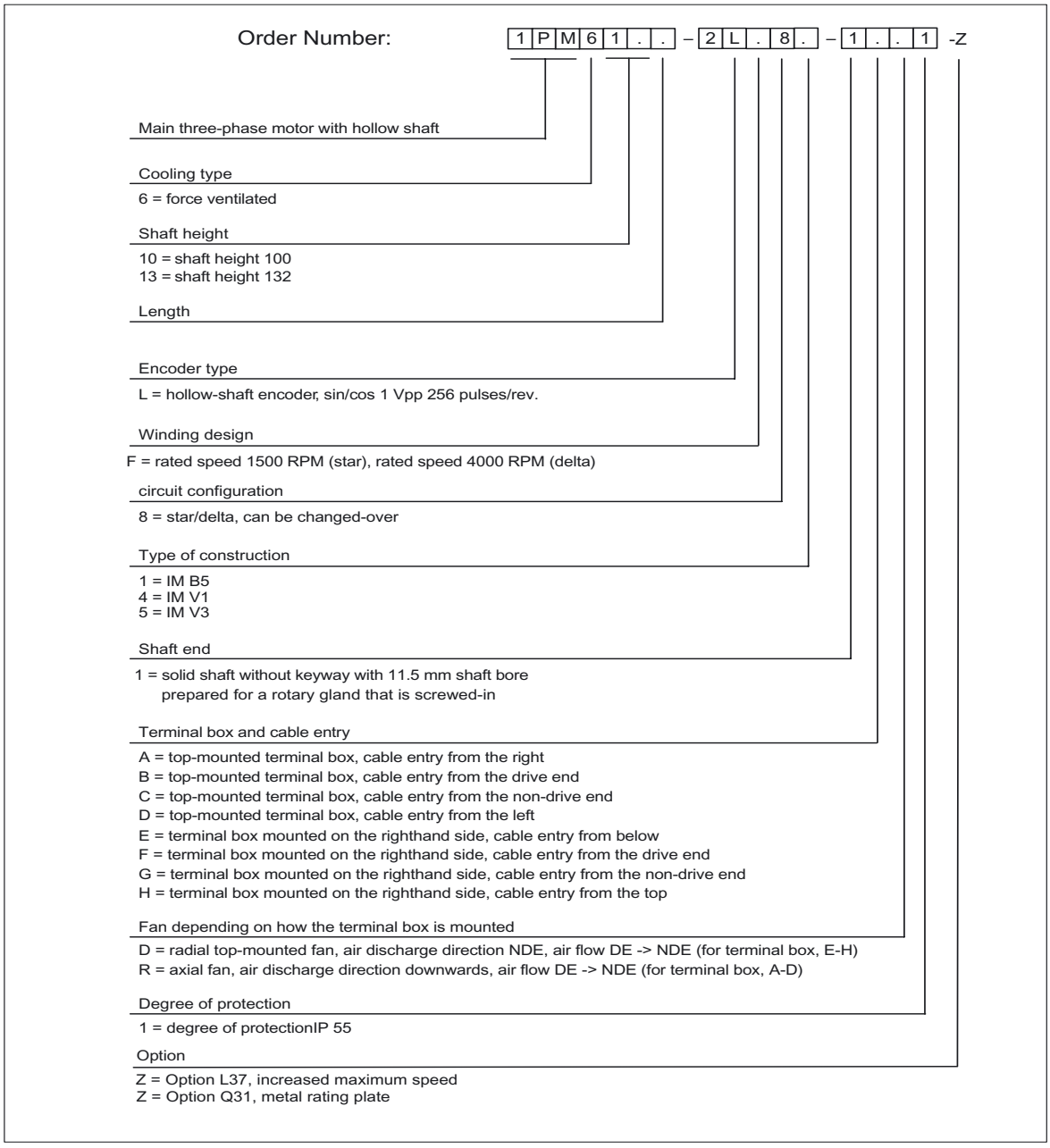


Figure 4-1 Order No. for 1PM6

4.2 Order No. for 1PM4

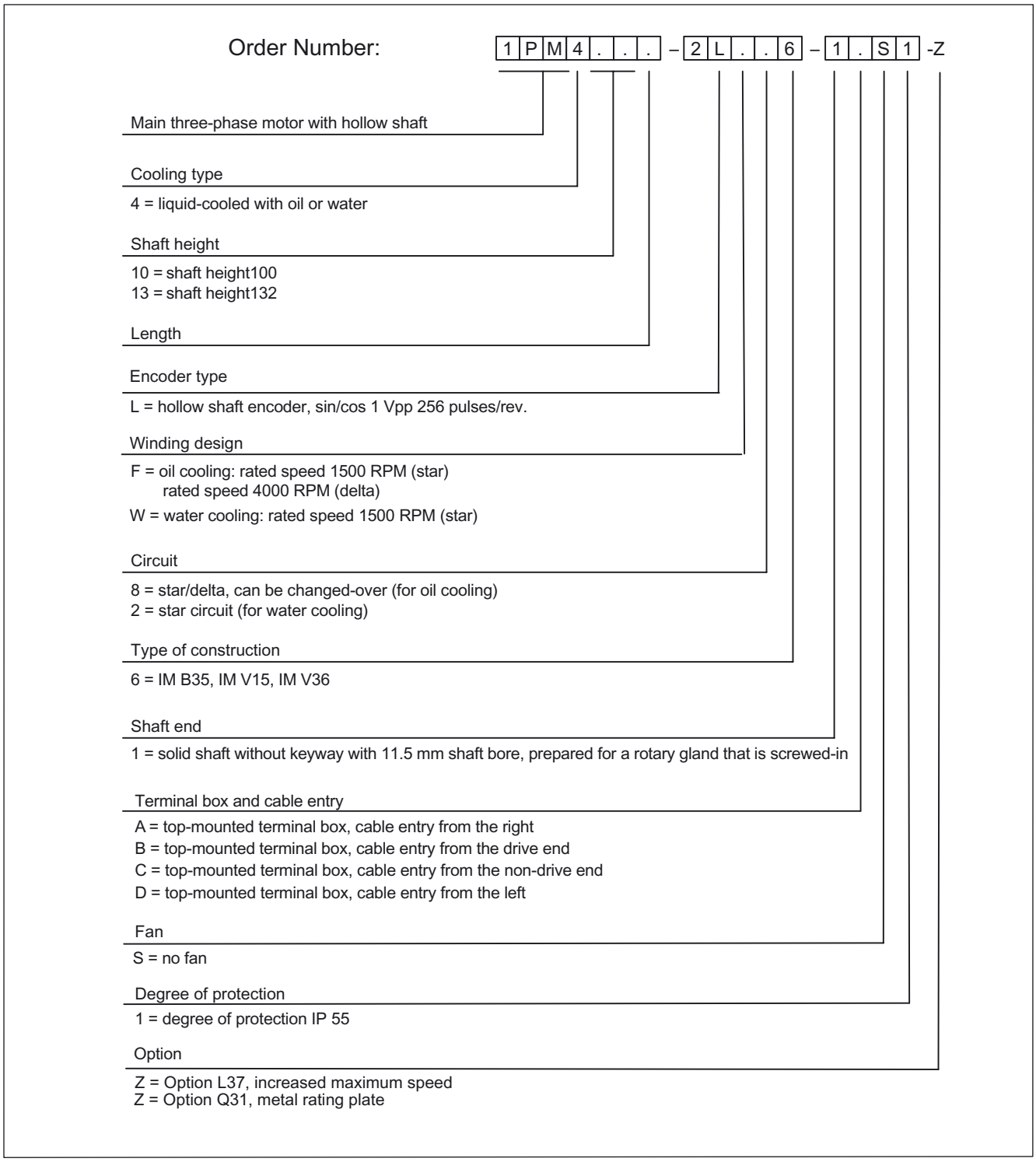


Figure 4-2 Order No. for 1PM4

4.3 Ordering examples for the 1PM4 series

1PM4, oil-cooled

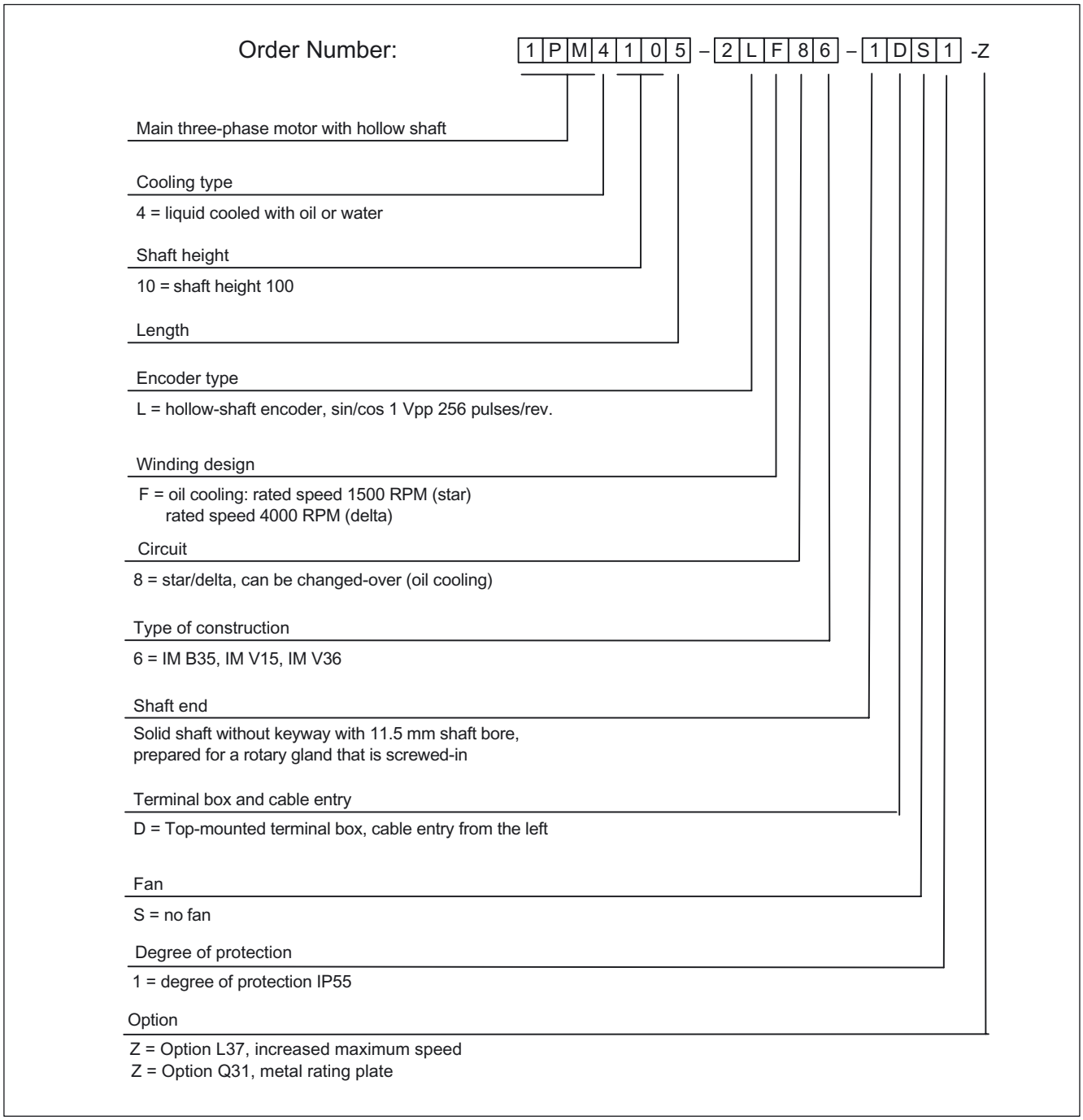


Figure 4-3 Order No. for 1PM4, oil-cooled

1PM4, water-cooled

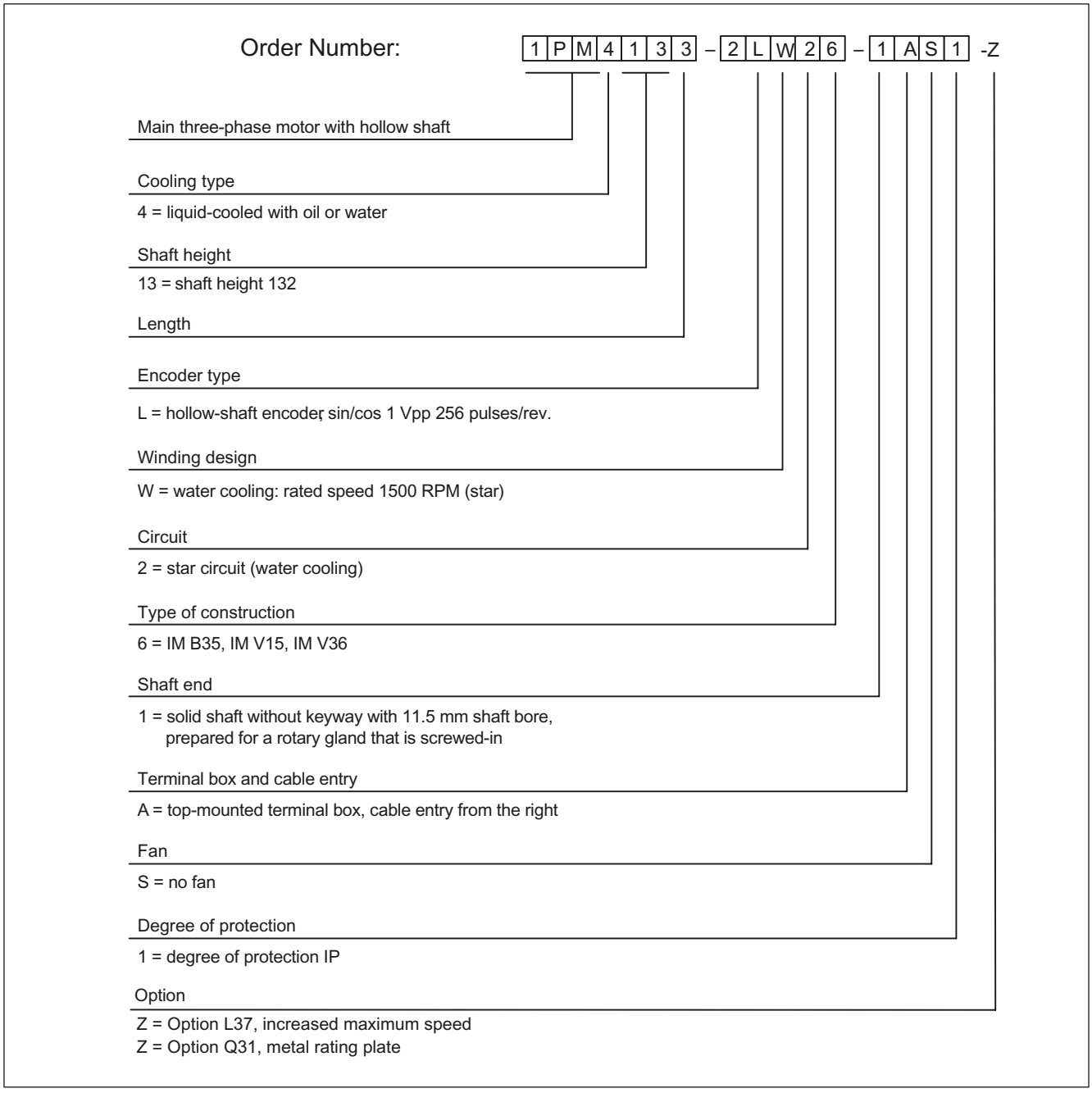


Figure 4-4 Order No. for 1PM4, water-cooled

Technical Data and Characteristics

5

5.1 Power-speed and torque-speed diagrams

Power ratings for duty types S1 and S6

The operating modes (duty types) are defined in IEC 60034, Part 1. A maximum load duty cycle of 10 min. is defined here - the S6 power data in the characteristics are referred to this.

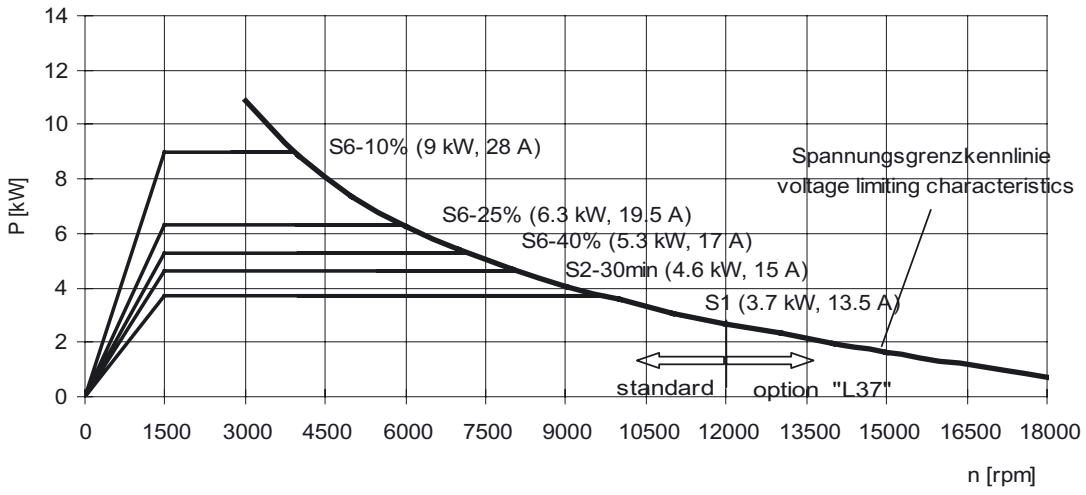
Table 5-1 Explanation of the codes in alphabetical order

Abbreviation	Units	Description
f_N	Hz	Rated frequency
I_{max}	A	Maximum current
I_N	A	Rated current
I_μ	A	No-load current
M_N	Nm	Rated torque
n_2	1/min (rpm)	Speed for field weakening with constant power
n_{max}	1/min (rpm)	Maximum rotational speed
n_N	1/min (rpm)	Rated speed
P_N	kW	Rated power
T_{th}	min	Thermal time constant
U_N	V	Rated voltage

5.1.1 1PM6 force-ventilated, 1PM4 oil-cooled

Table 5-2 1PM6101 force-ventilated, 1PM4101 oil-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	3.7	24	13.5	278	52.7	9711	18000	25	6.8	28



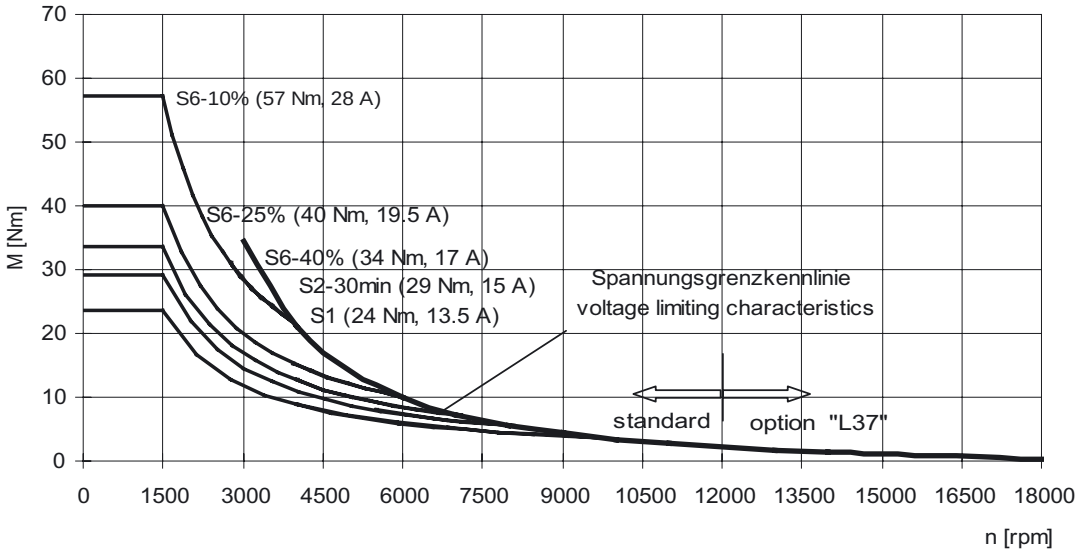


Table 5-3 1PM6101 force-ventilated, 1PM4101 oil-cooled, Δ circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
4000	3.7	9	14	336	134.7	12000	18000	25	9.6	26

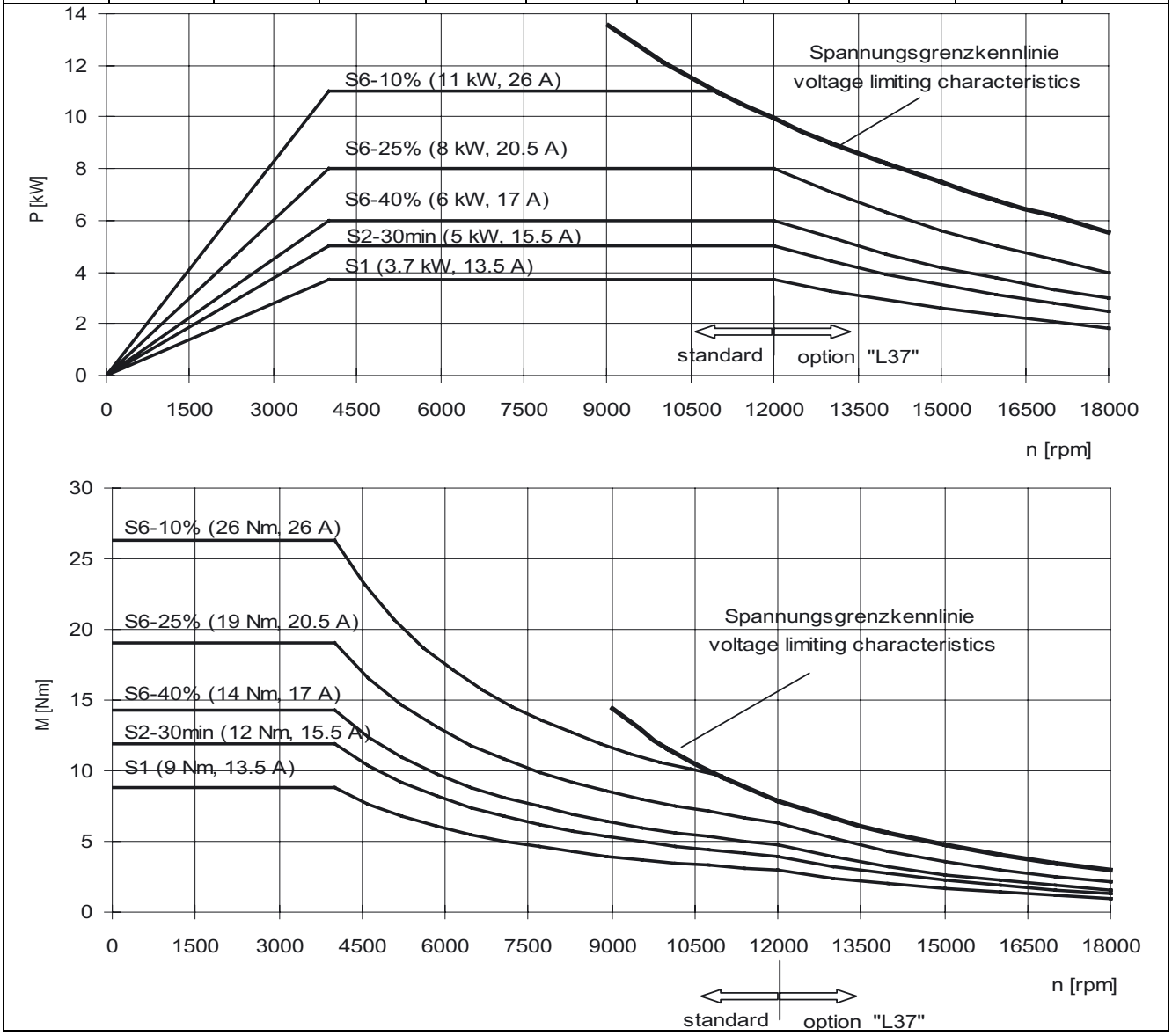


Table 5-4 1PM6105 force-ventilated, 1PM4105 oil-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	7.5	48	23	300	52.2	9008	18000	25	12.3	52

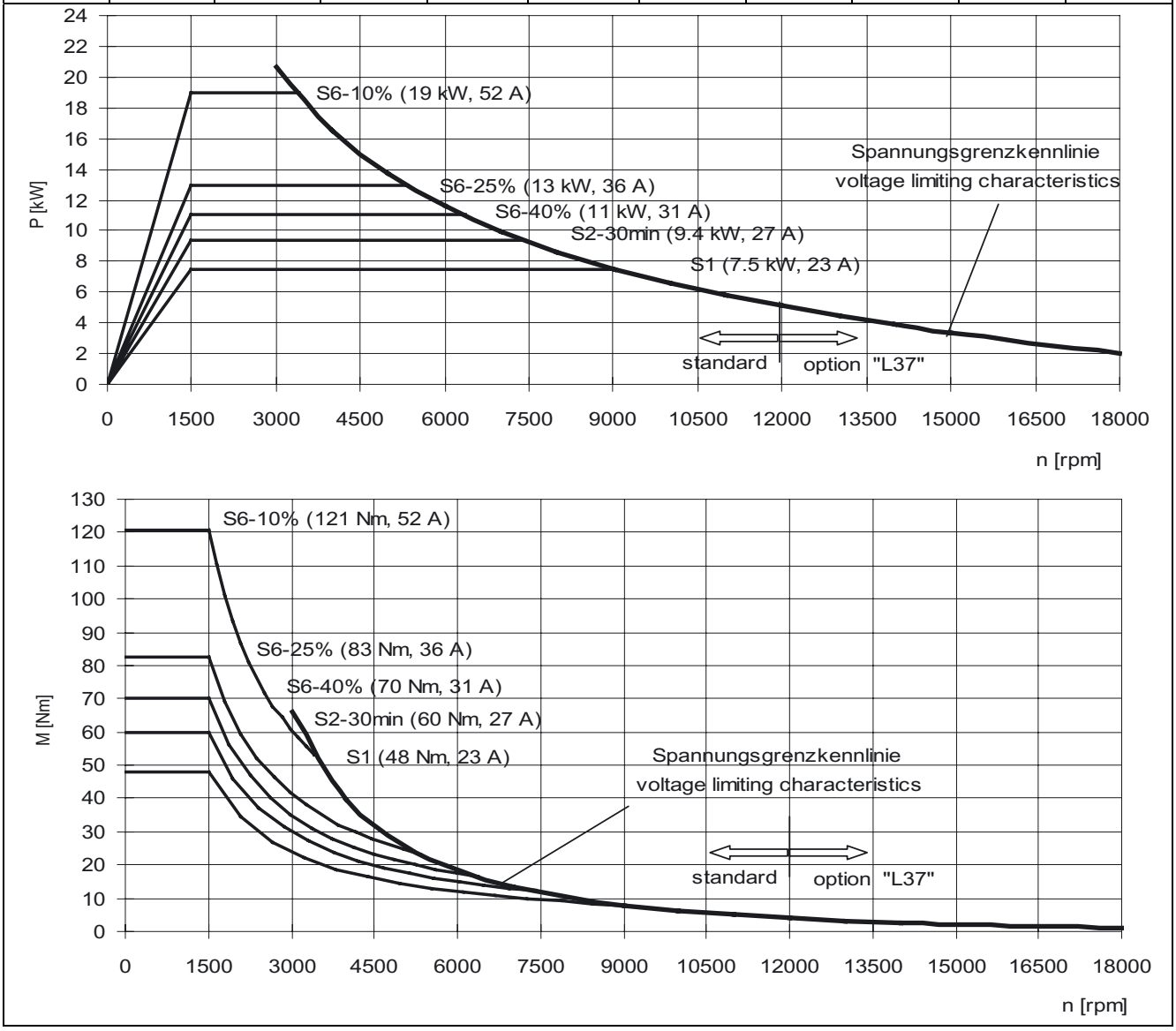


Table 5-5 1PM6105 force-ventilated, 1PM4105 oil-cooled, Δ circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
4000	7.5	18	24	375	134.4	12000	18000	25	17.9	47

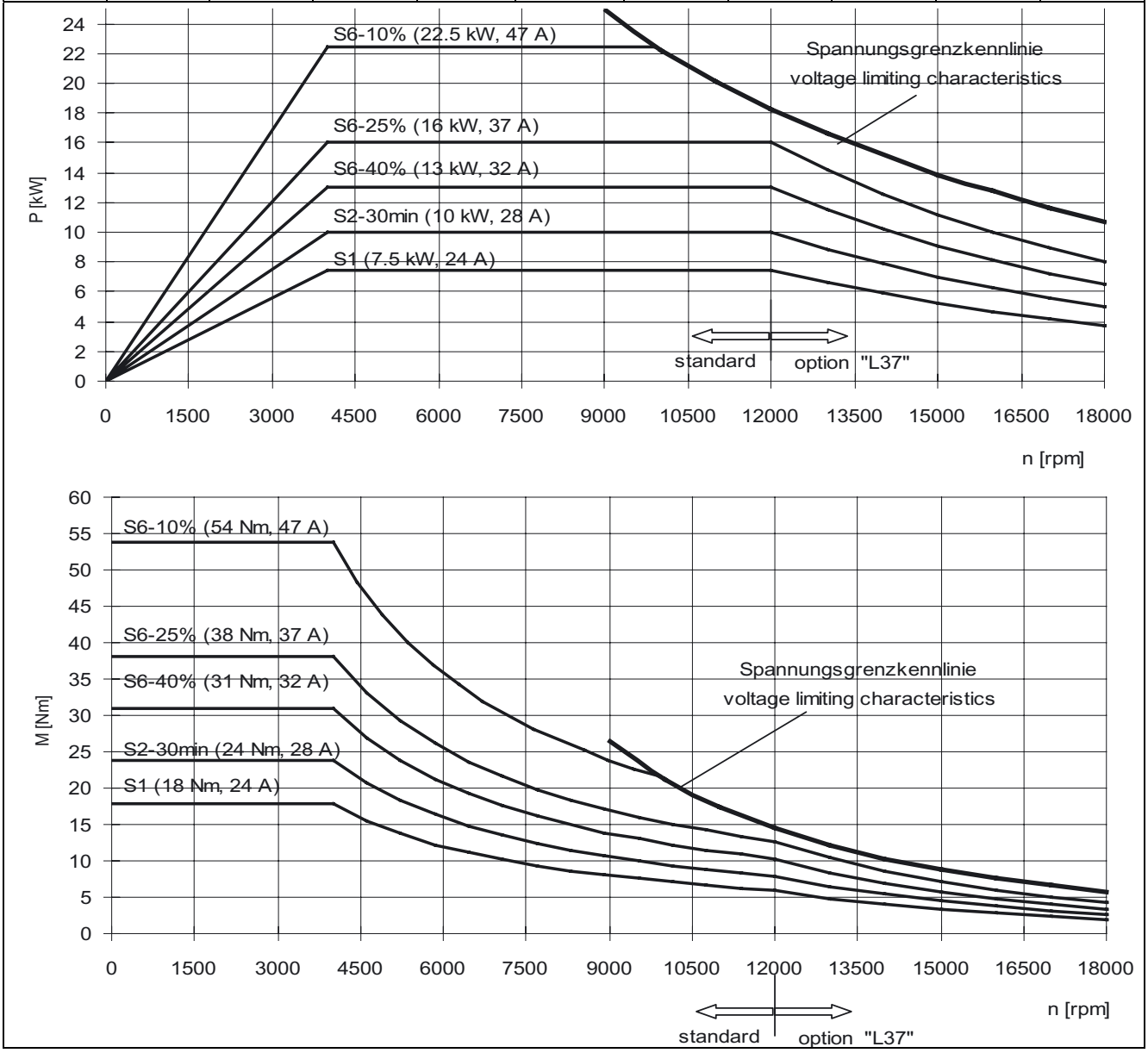


Table 5-6 1PM6133 force-ventilated, 1PM4133 oil-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	11.0	70	41	222	51.4	8000	15000	30	17.0	101

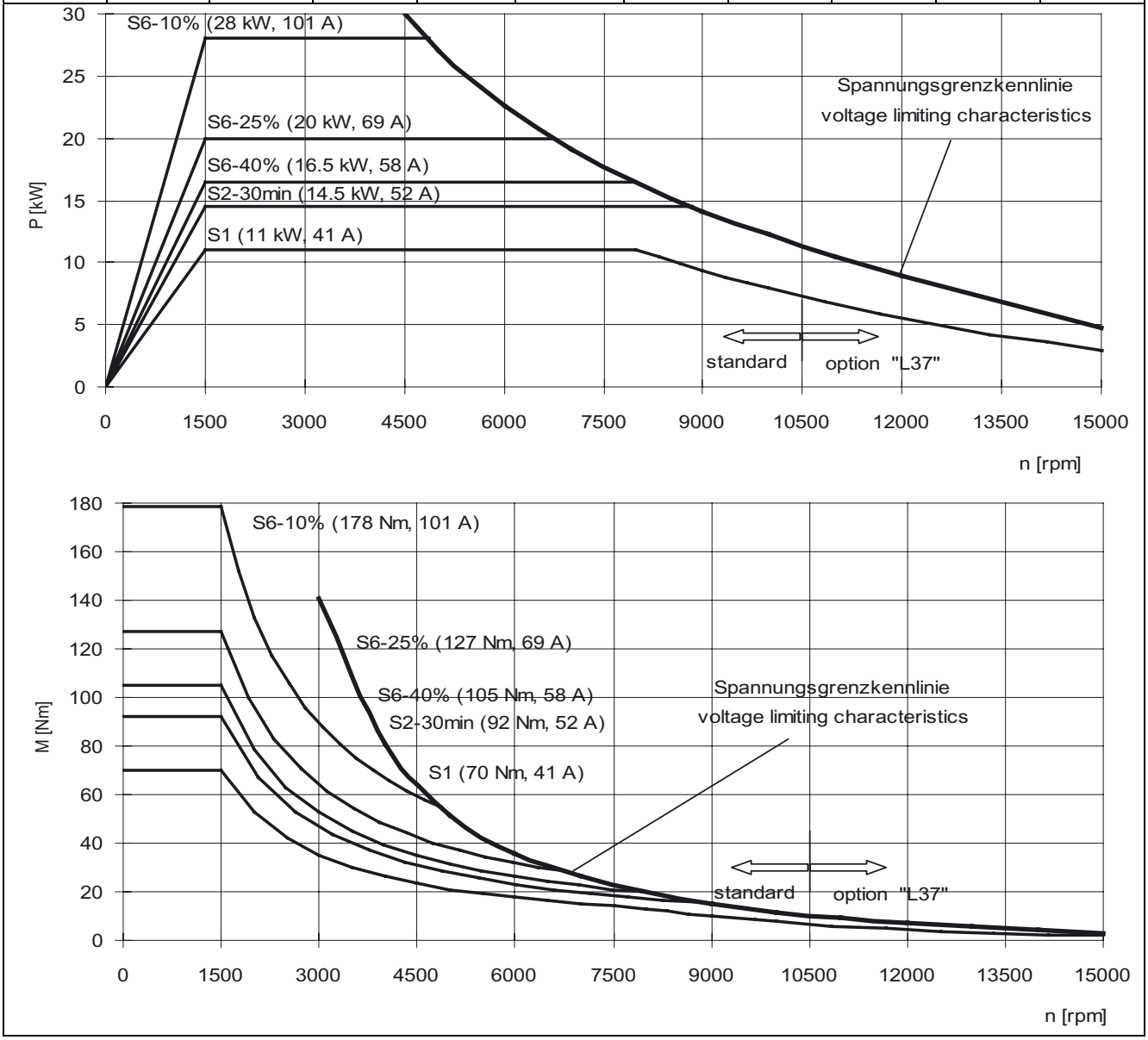


Table 5-7 1PM6133 force-ventilated, 1PM4133 oil-cooled, Δ circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
4000	11.0	26.3	41	295	133.9	10500	15000	30	26.5	86

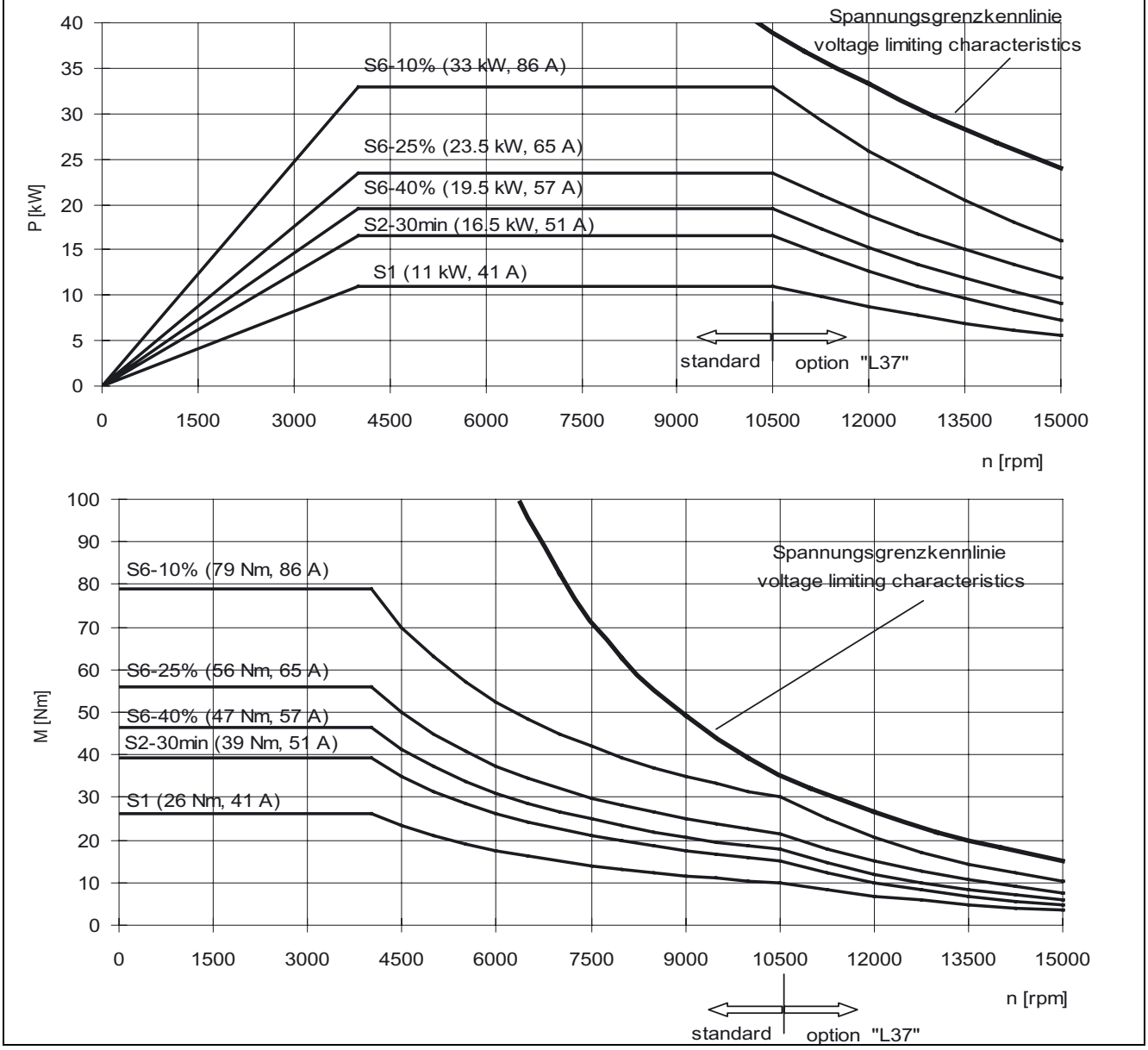


Table 5-8 1PM6137 force-ventilated, 1PM4137 oil-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	18.5	118	56	271	51.2	7000	12000	30	24.5	132

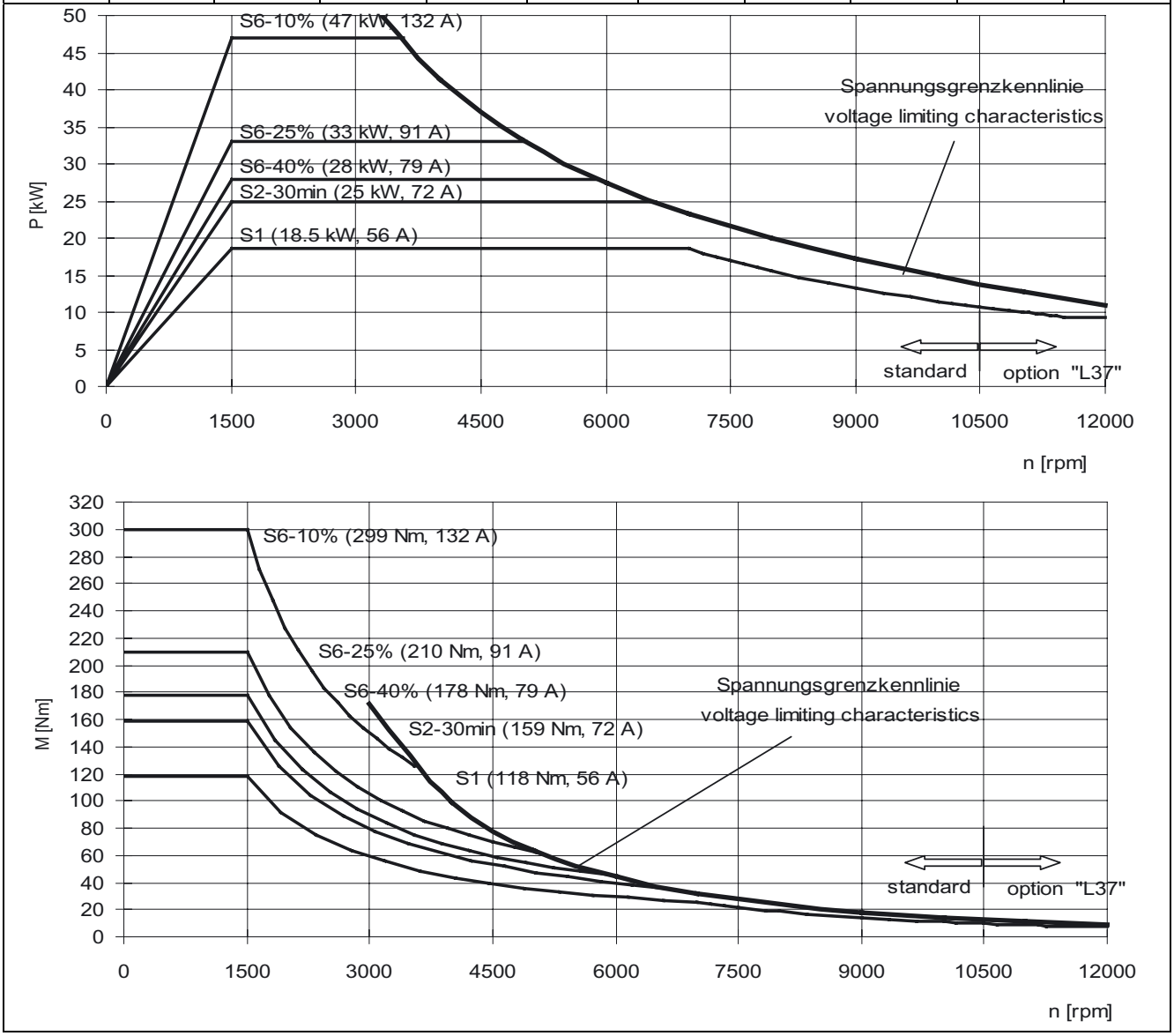


Table 5-9 1PM6137 force-ventilated, 1PM4137 oil-cooled, Δ circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
4000	18.5	44	56	366	133.8	10500	12000	30	37.0	114

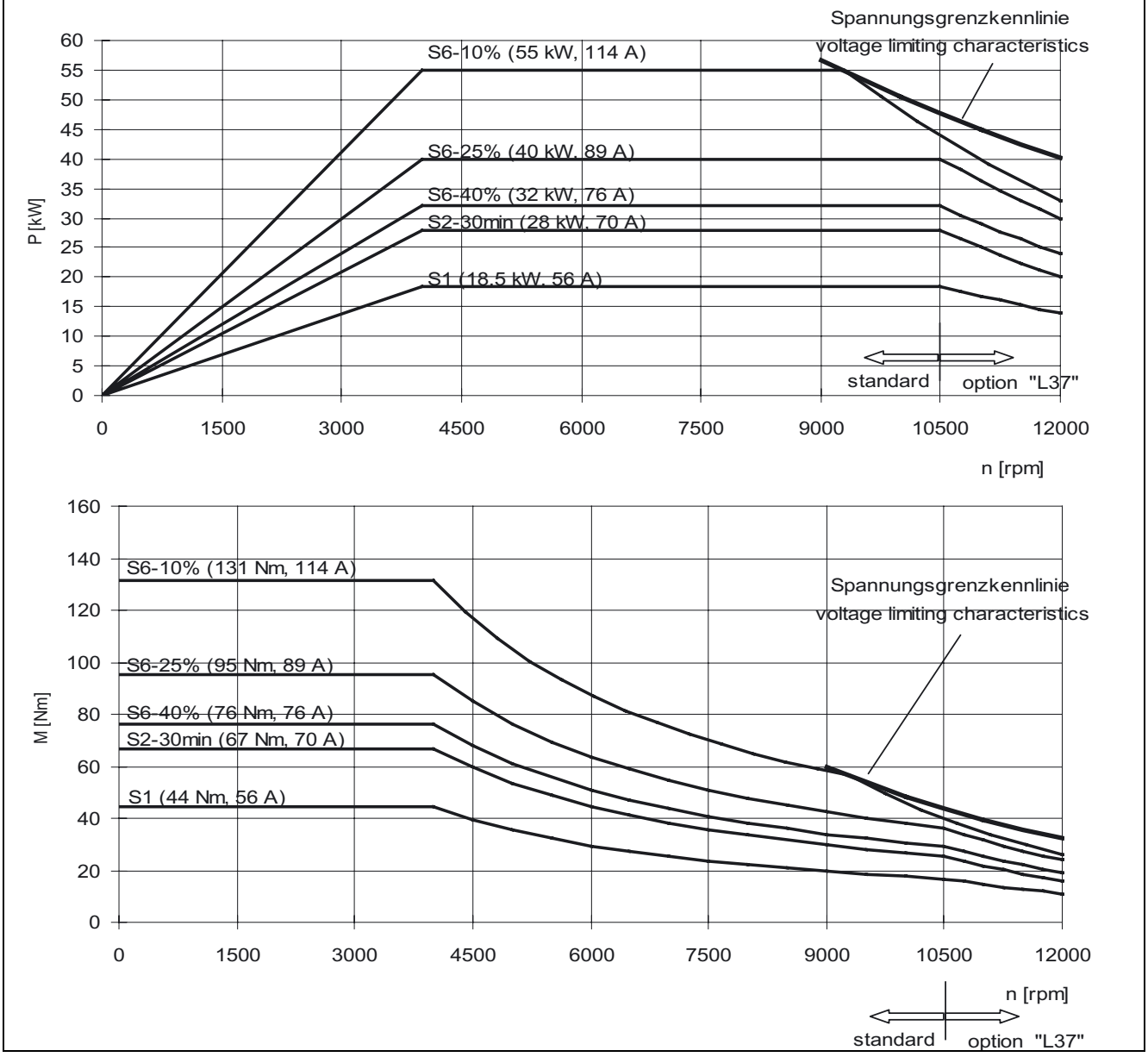


Table 5-10 1PM6138 force-ventilated, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	22.0	140	58	316	51.0	4000	11000	30	26.9	132

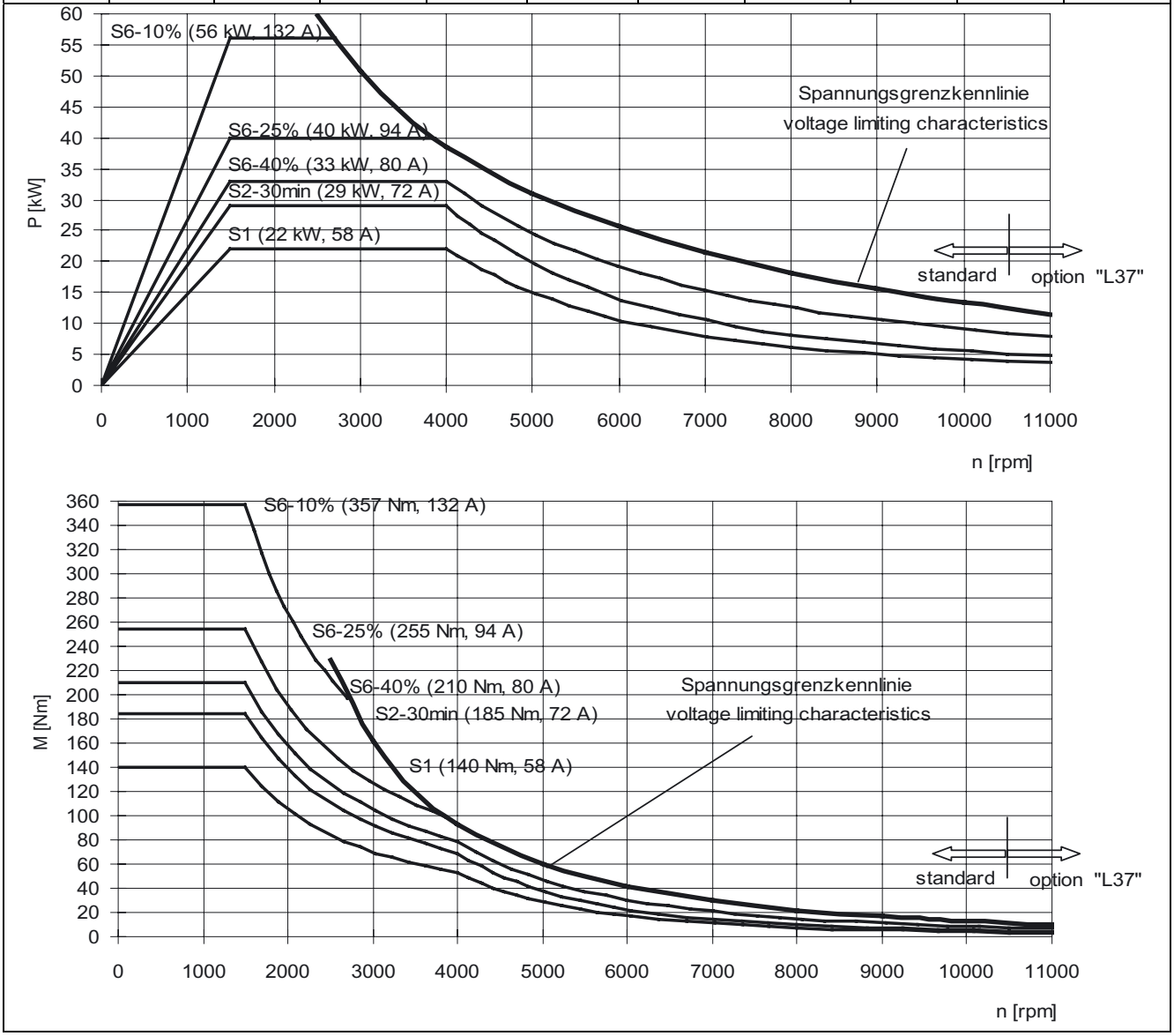
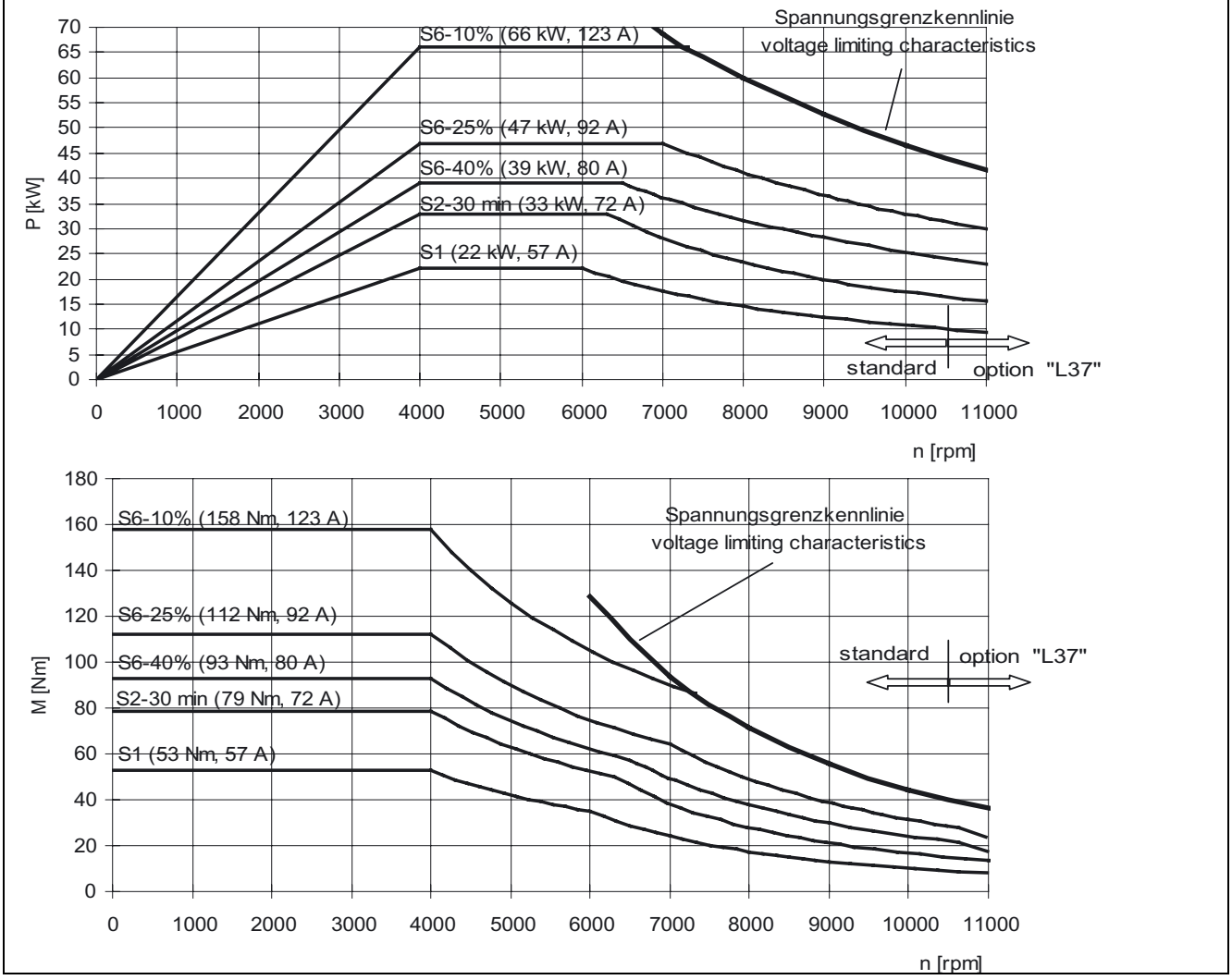


Table 5-11 1PM6138 force-ventilated, Δ circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
4000	22.0	53	57	400	133.9	6000	11000	30	36.1	123



5.1.2 1PM4 water-cooled

Table 5-12 1PM4101 water-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	5.0	32.0	18.0	259	53.6	9665	18000	6	8.1	36.5

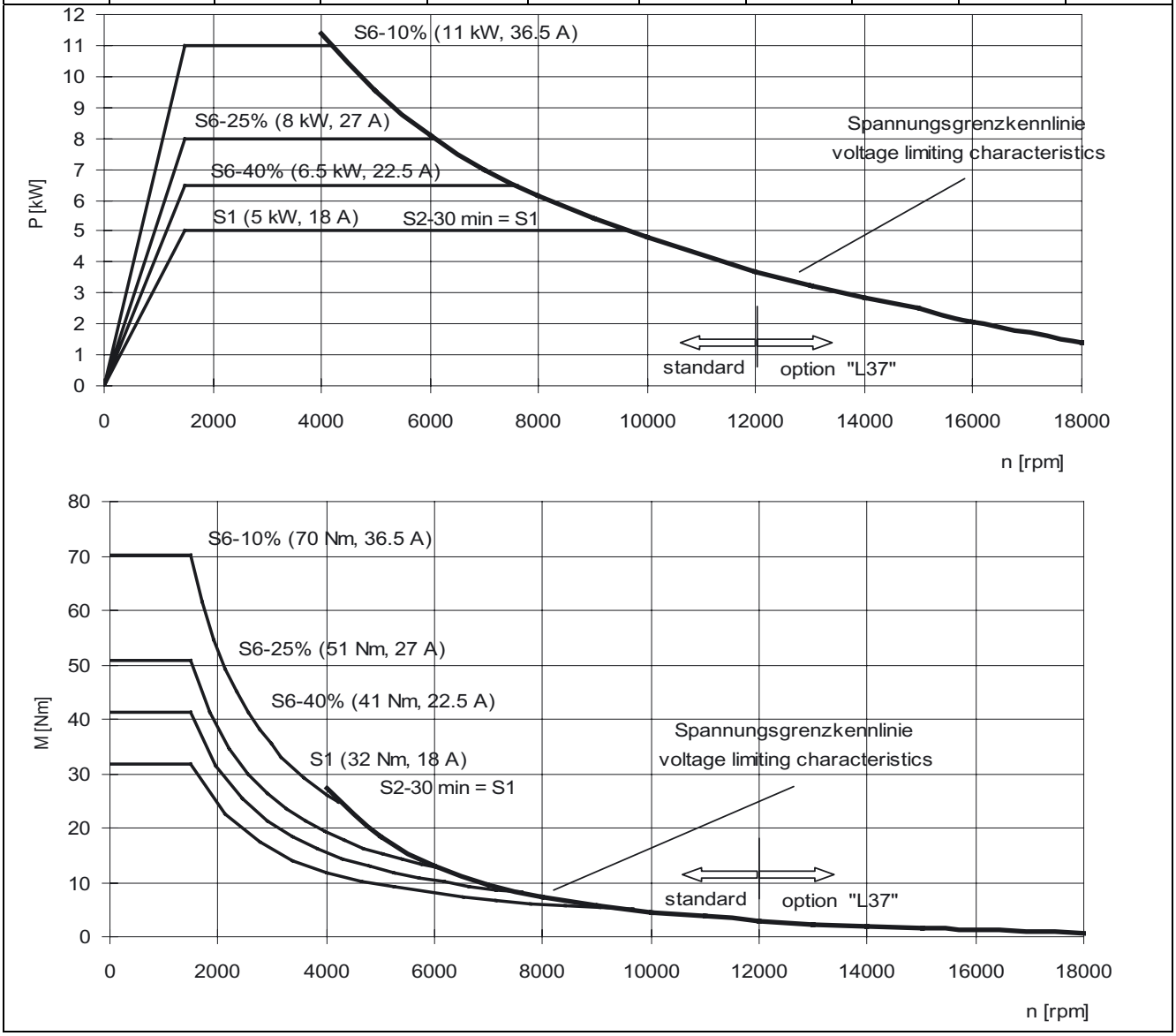


Table 5-13 1PM4105 water-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	11.0	70.0	38.0	263	53.2	9460	18000	6	16.4	72.0

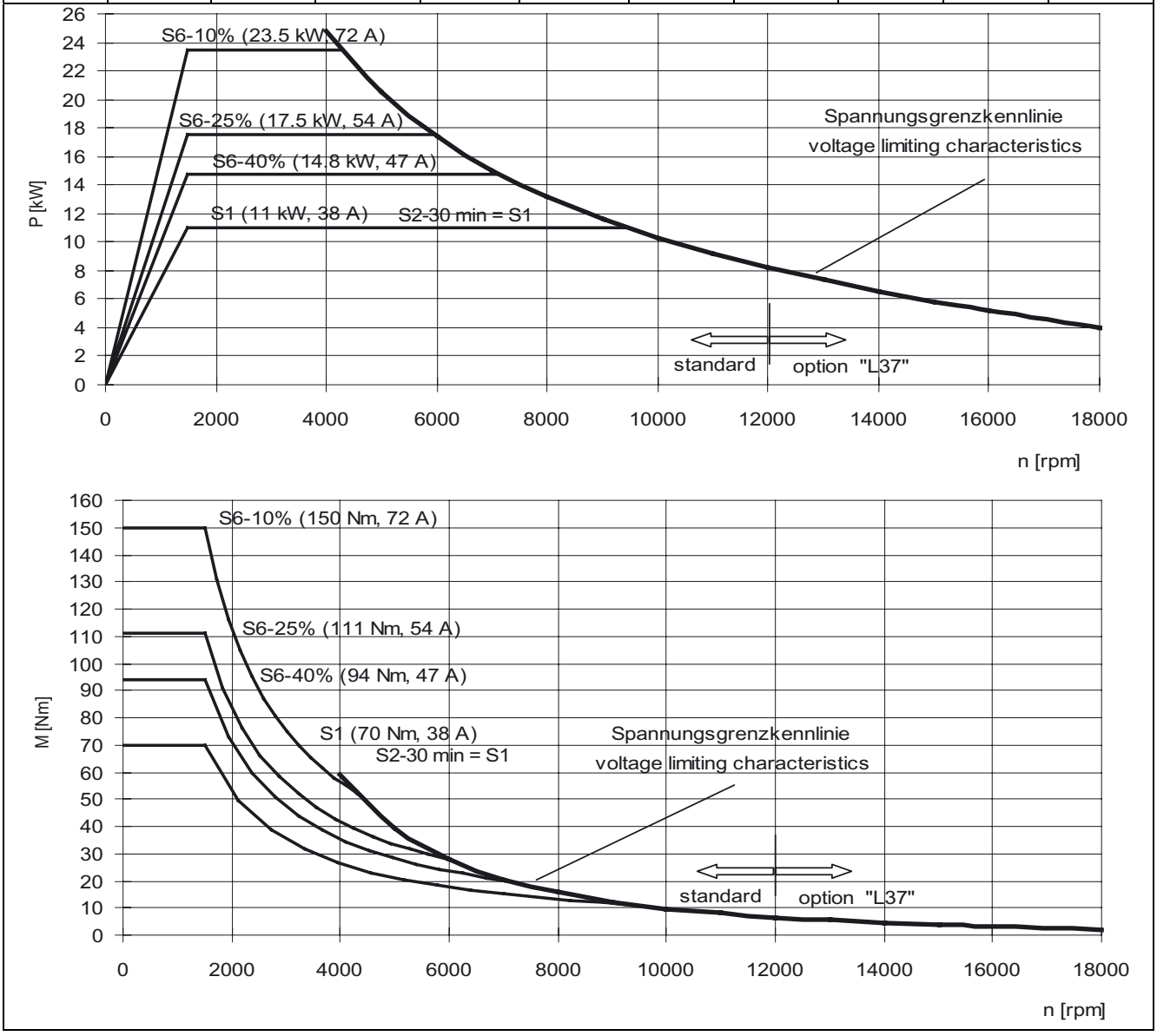


Table 5-14 1PM4133 water-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	15.0	95.5	55.0	229	51.9	8290	15000	11	17.4	116.0

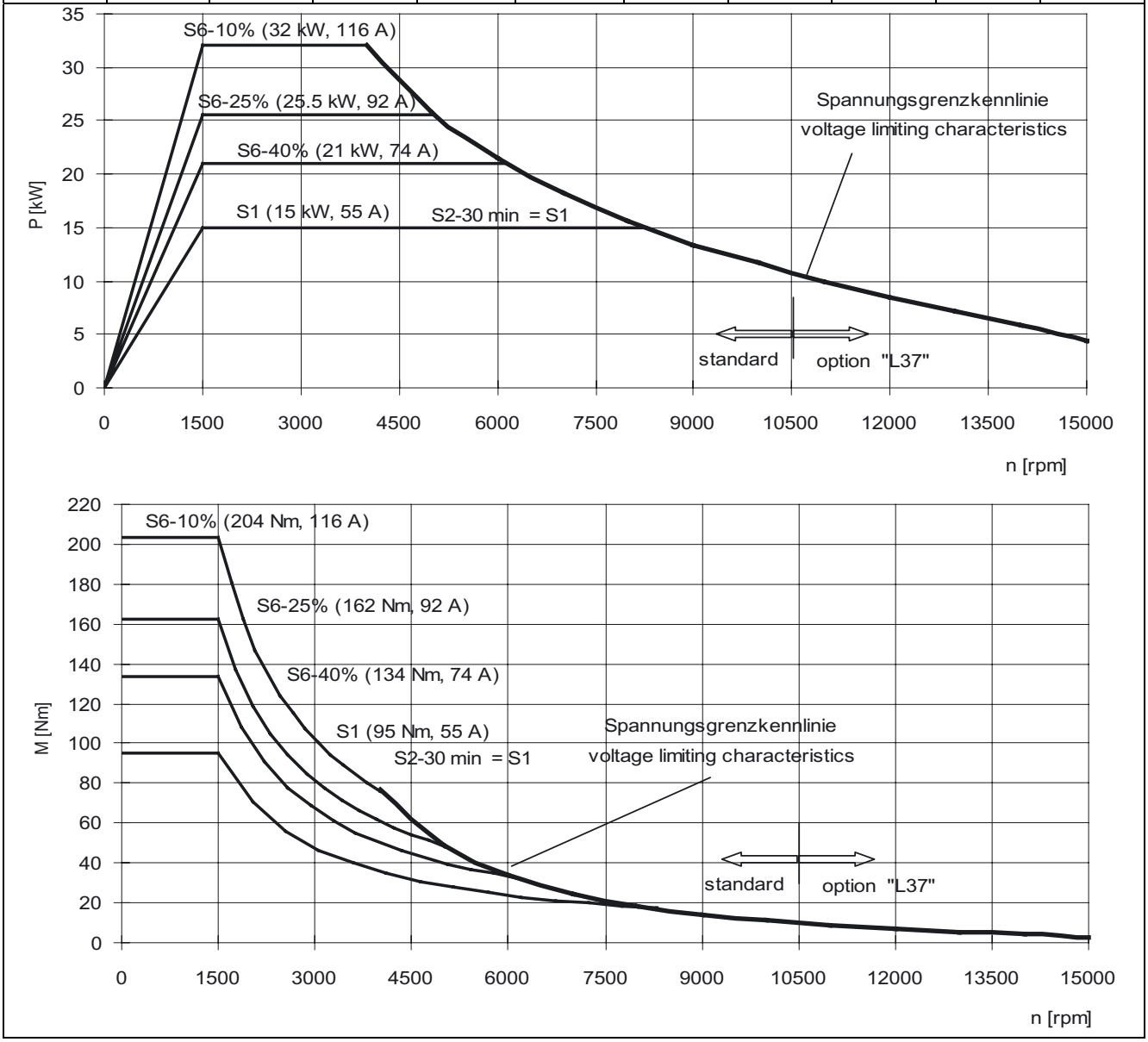
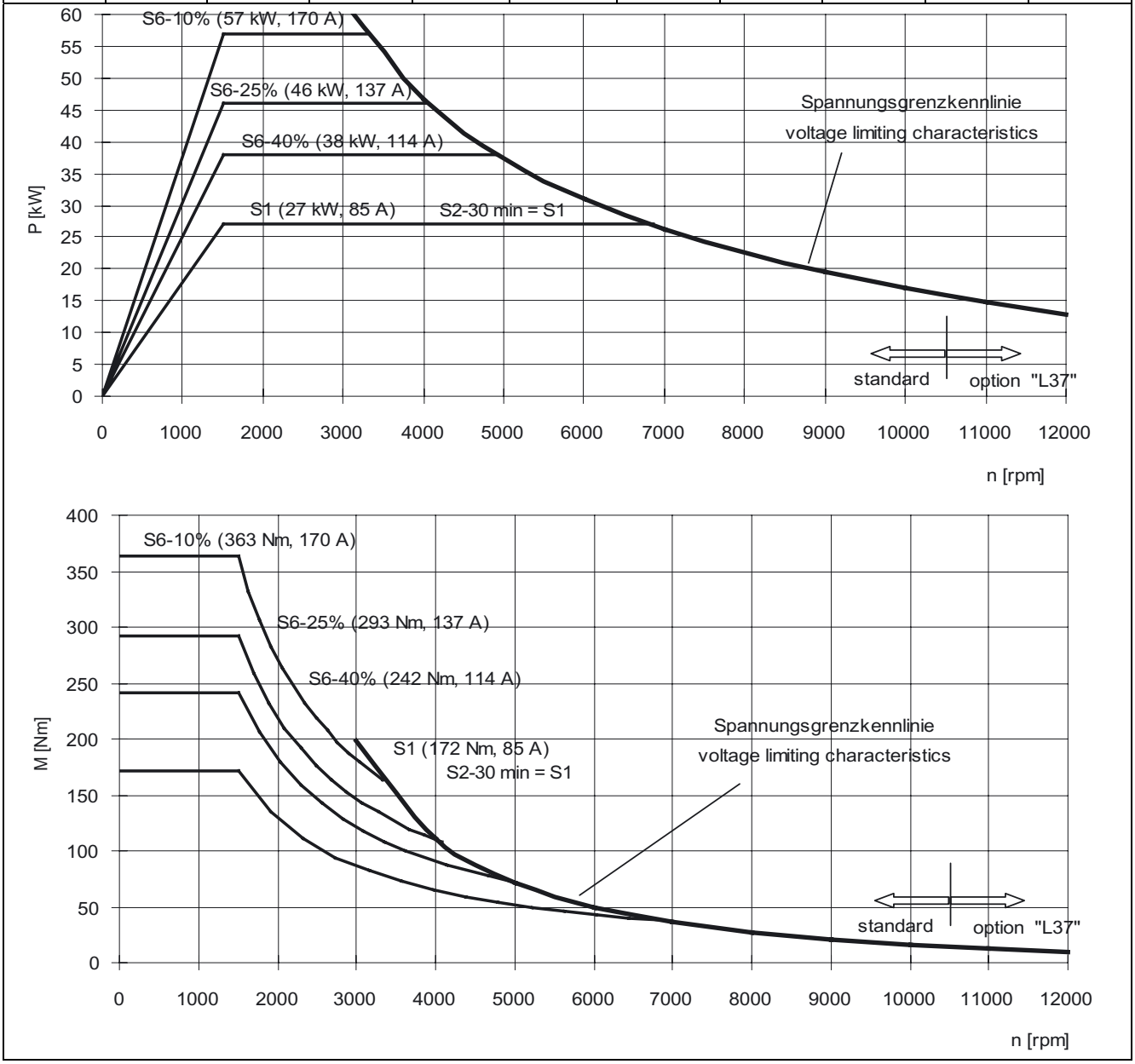


Table 5-15 1PM4137 water-cooled, Y circuit

n_N [rpm]	P_N [kW]	M_N [Nm]	I_N [A]	U_N [V]	f_N [Hz]	n_2 [rpm]	n_{max} [rpm]	T_{th} [min]	I_μ [A]	I_{max} [A]
1500	27.0	172.0	85.0	265	51.6	6863	12000	11	30.3	170.0



Dimension Drawings

6

Note

CAD CREATOR

Using a configuration interface that is very easy to understand, CAD CREATOR allows you to quickly find motor-specific

- technical data
- dimension drawings
- 2D/3D CAD data

and supports you when generating plant/system documentation regarding project-specific information and parts lists.

Internet: www.siemens.de/cad-creator

Note

Siemens AG reserves the right to change the dimensions of the motors as part of mechanical design improvements without prior notice. This means that dimensions drawings can go out-of-date. Up-to-date dimension drawings can be requested at no charge from your local SIEMENS sales department.

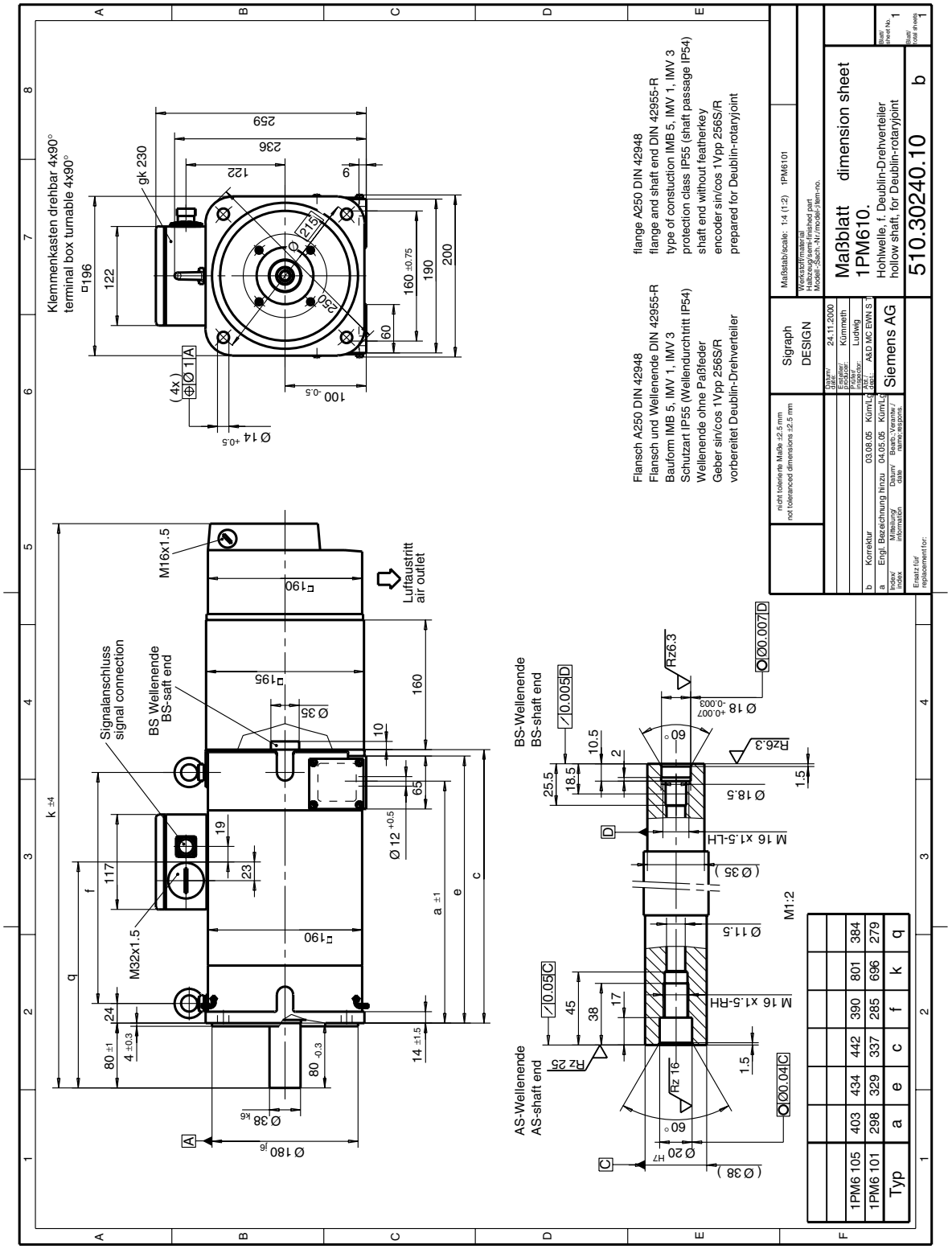


Figure 6-1 1PM6-10□ with axial fan

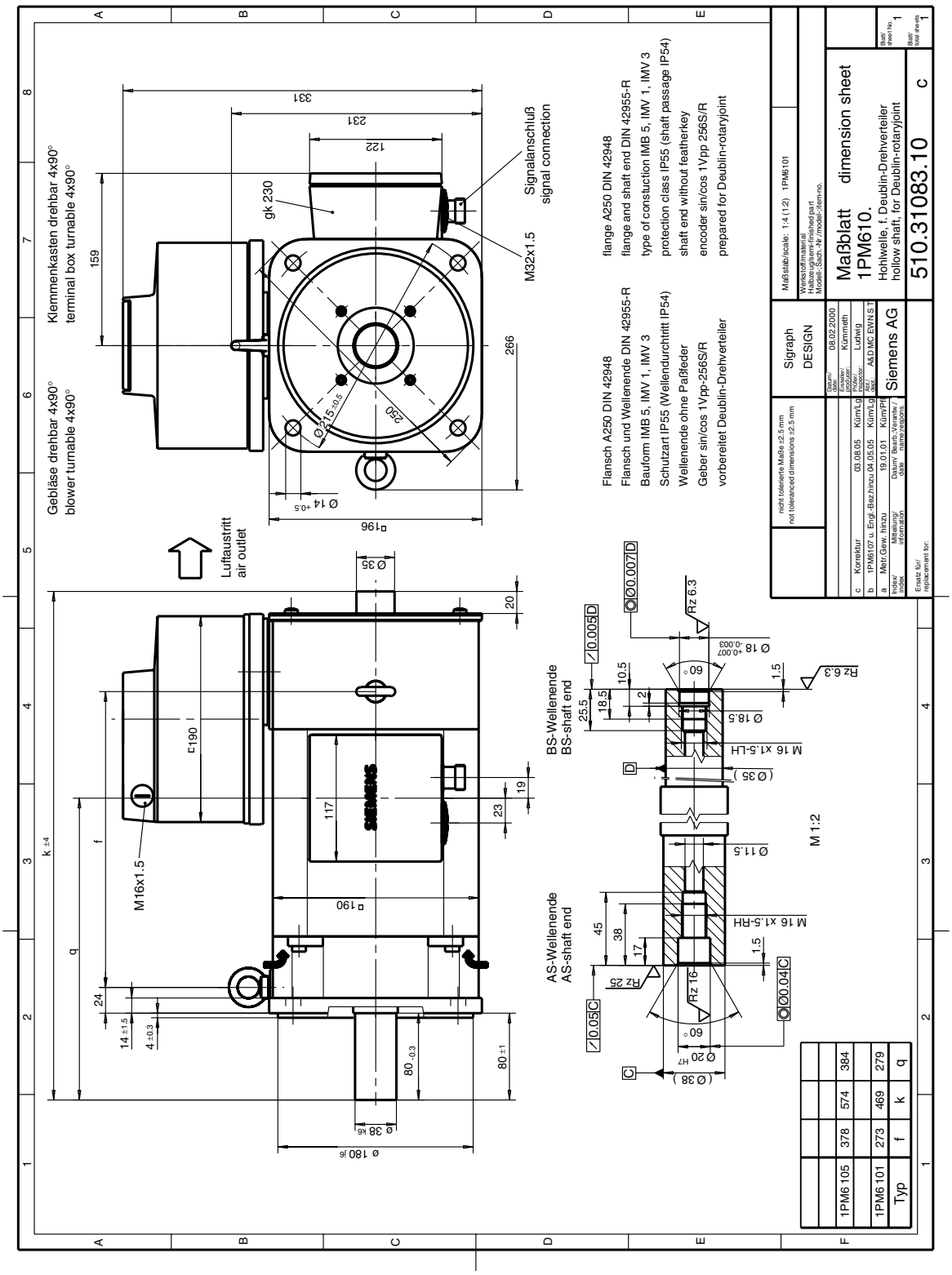


Figure 6-2 1PM6-10□ with radial fan

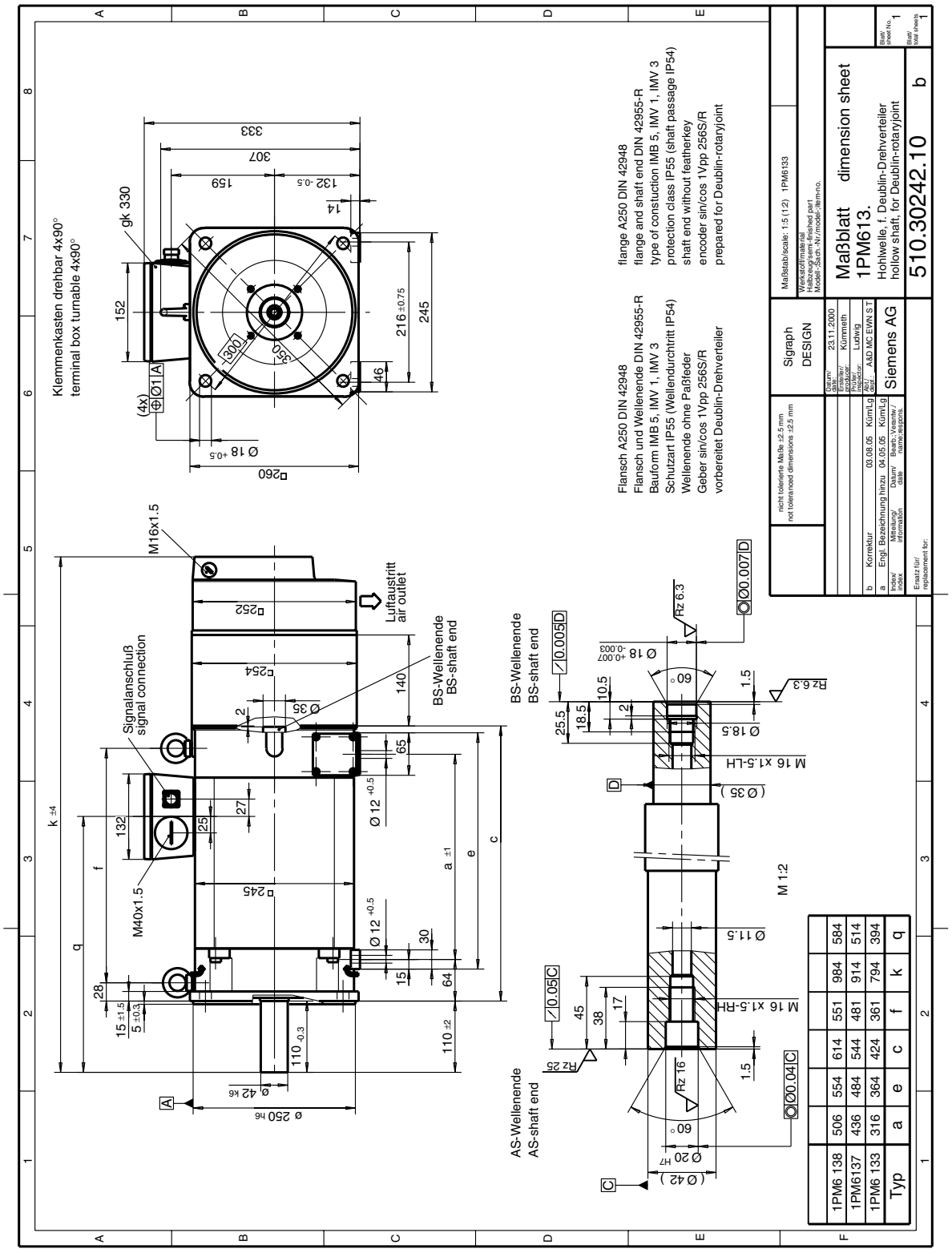


Figure 6-3 1PM6-13□ with axial fan

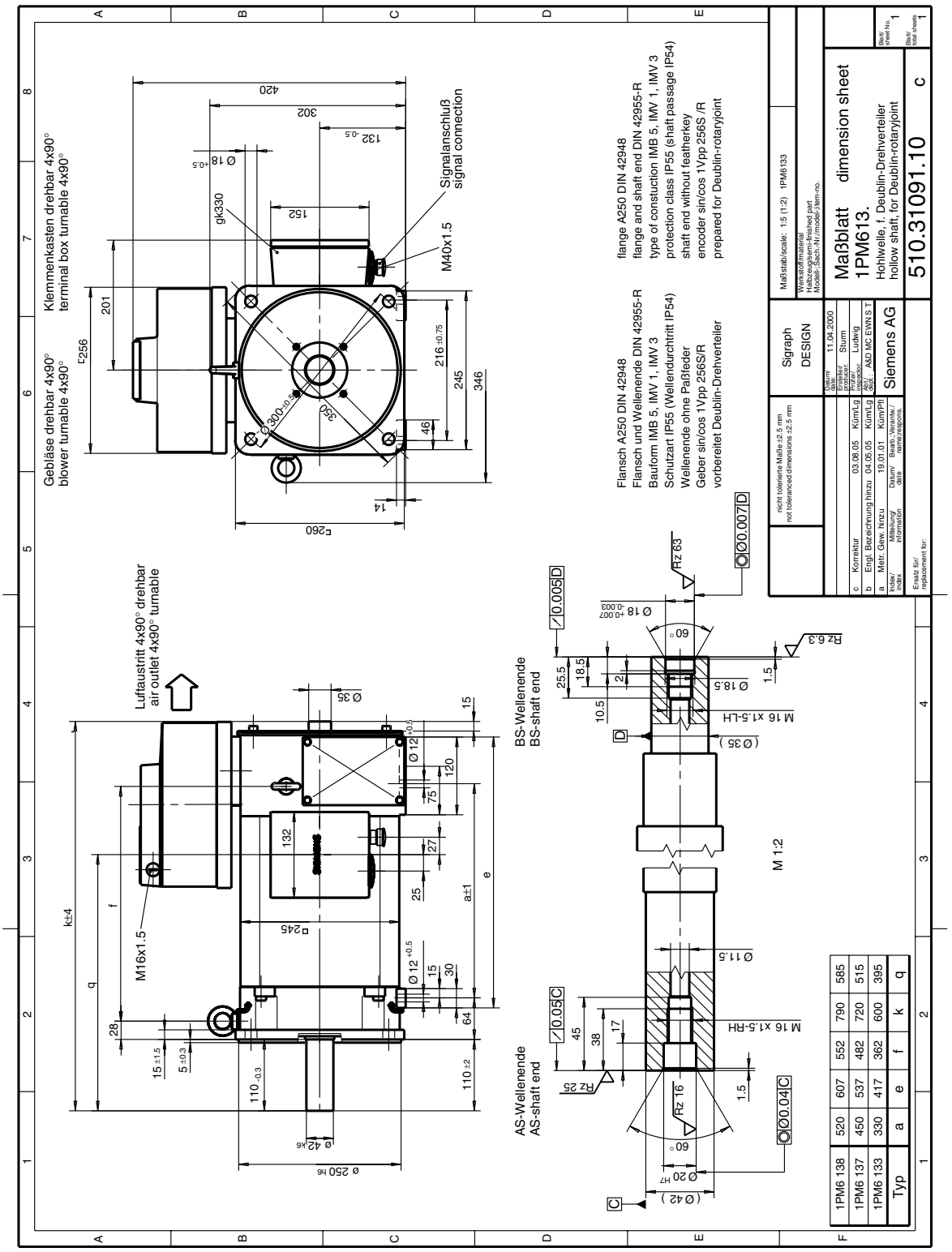


Figure 6-4 1PM6-13□ with radial fan

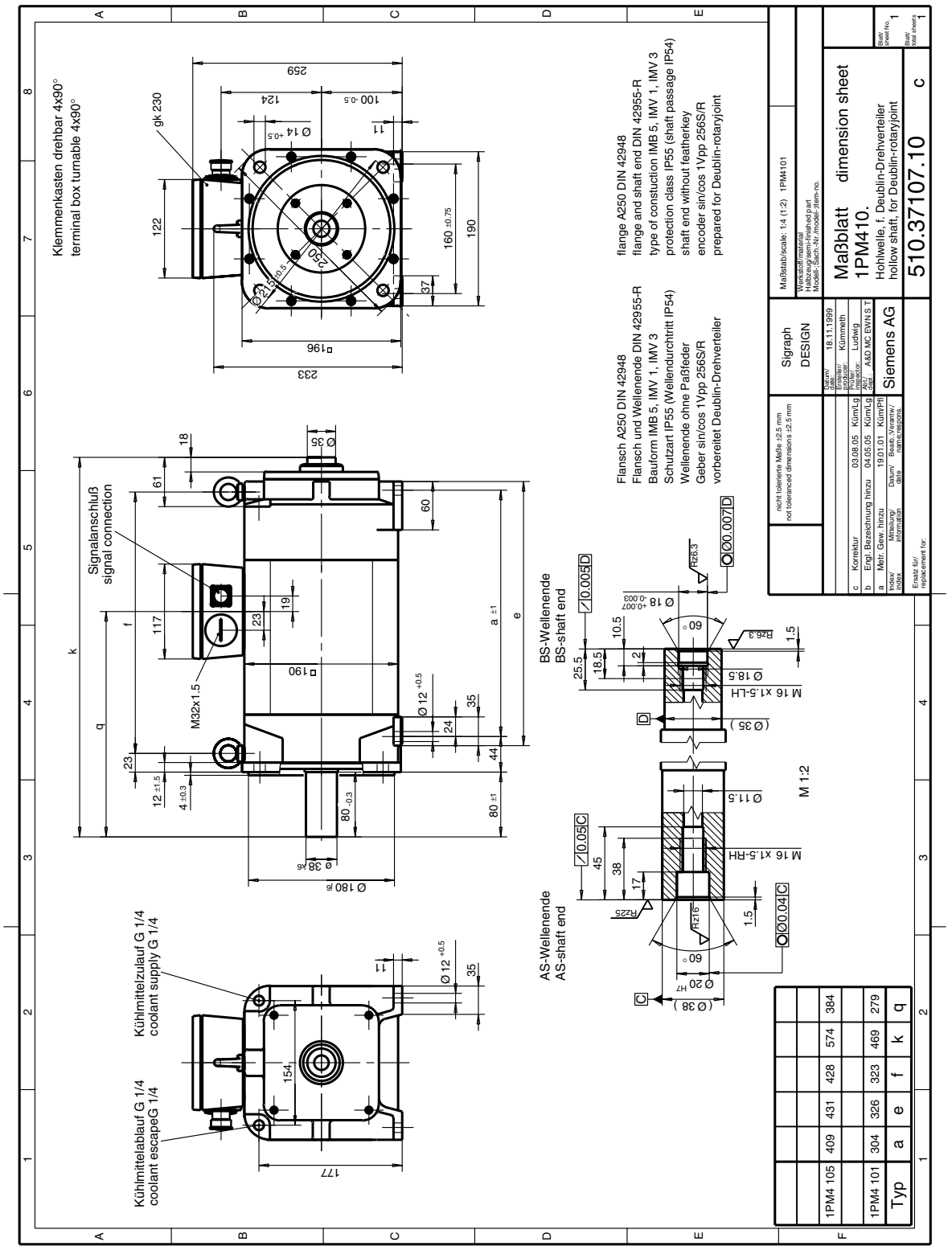


Figure 6-5 1PM4-10□ liquid cooled

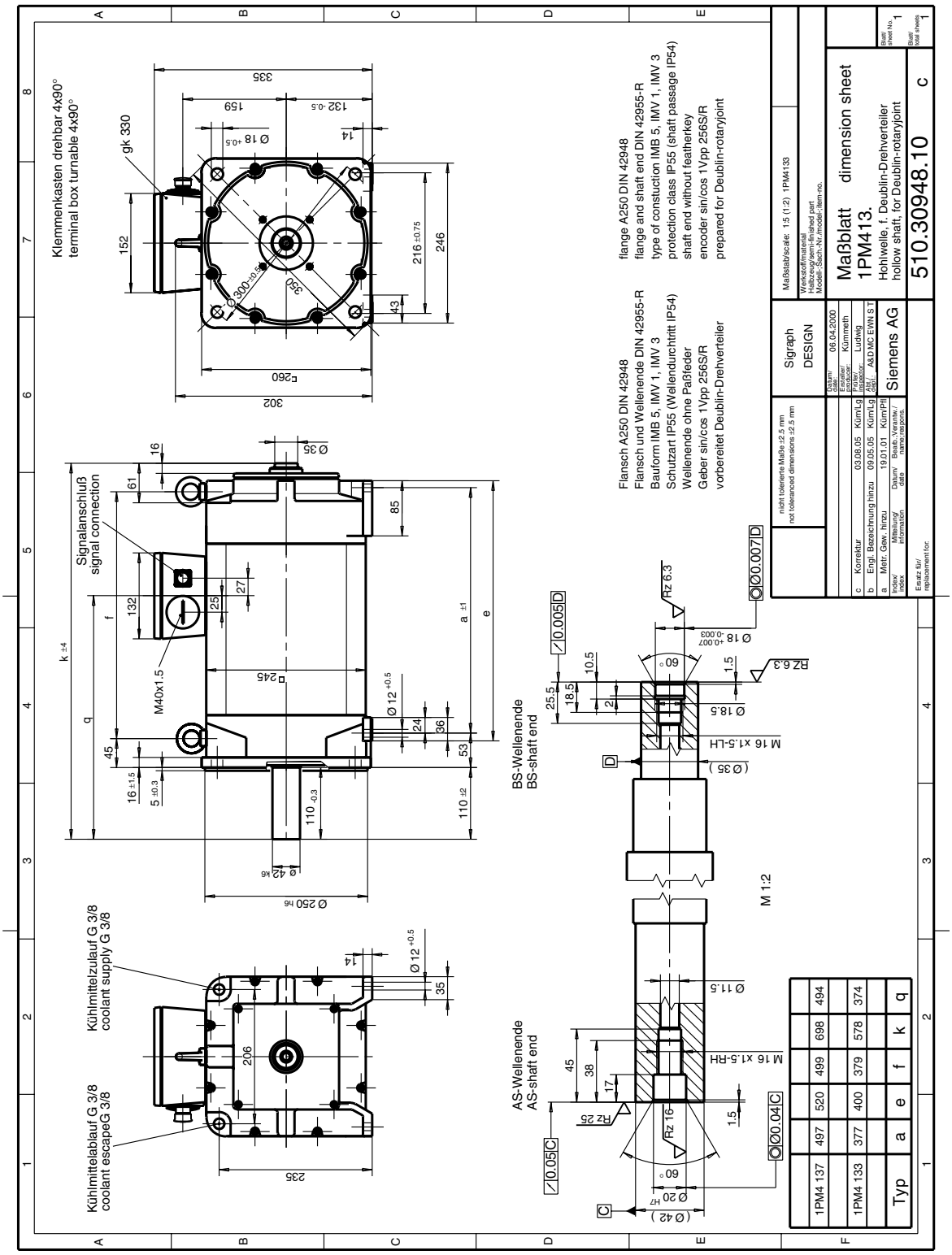


Figure 6-6 1PM4-13□ liquid cooled

Appendix

A

A.1 References

An overview of publications that is updated monthly is provided in a number of languages in the Internet at:

<http://www.siemens.com/motioncontrol>
through "Support", "Technical Documentation", "Documentation Overview"

General Documentation

/D 21.2/ **SINAMICS S120 Catalog**
SINAMICS S120
Servo Control Drive System

/NC 60/ **SINUMERIK and SIMODRIVE Catalog**
Automation Systems for Machine Tools

/DA65.3/ **SIMOVERT MASTERDRIVES Catalog**
Synchronous and Induction Motors for SIMOVERT MASTERDRIVES

Electronic Documentation

/CD1/ **DOC ON CD**
The SINUMERIK System
(includes all SINUMERIK 840D/810D and SIMODRIVE 611D)

/CD2/ **DOC ON CD**
The SINAMICS System

Manufacturer/Service Documentation

/PJAL/ **Configuration Manual, Synchronous Motors**
SINAMICS S120, SIMODRIVE 611, SIMOVERT MASTERDRIVES
Synchronous Motors General Section

/PFK7S/ **Configuration Manual, Synchronous Motors**
SINAMICS S120
1FK7 Synchronous Motors

/PFT6S/ **Configuration Manual, Synchronous Motors**
SINAMICS S120
1FT6 Synchronous Motors

/APH7S/ **Configuration Manual, Induction Motors**
SINAMICS S120
Servo Control/Vector Control
Induction Motors 1PH7

/PMH2/ **Configuration Manual, Hollow-Shaft Measuring System**
SINAMICS S120, SIMODRIVE 611, SIMOVERT MASTERDRIVES,
SIMAG H2 Hollow-Shaft Measuring System

/PJM2/ **Configuration Manual, Synchronous Motors**
SIMODRIVE 611, SIMOVERT MASTERDRIVES
Synchronous Motors General Section, 1FT5, 1FT6, 1FK6, 1FK7

/PFK7/ **Configuration Manual, Synchronous Motors**
SIMODRIVE 611, SIMOVERT MASTERDRIVES
1FK7 Synchronous Motors

/PFT6/ **Configuration Manual, Synchronous Motors**
SIMODRIVE 611, SIMOVERT MASTERDRIVES
1FT6 Synchronous Motors

/PFK6/ **Configuration Manual, Synchronous Motors**
SIMODRIVE 611, SIMOVERT MASTERDRIVES
1FK6 Synchronous Motors

/PFS6/ **Configuration Manual, Synchronous Motors**
SIMOVERT MASTERDRIVES
1FS6 Synchronous Motors, Explosion-Protected

/PFU/ **Configuration Manual, Synchronous Motors**
SINAMICS S120, SIMOVERT MASTERDRIVES, MICROMASTER
SIEMOSYN Synchronous Motors 1FU8

/ASAL/ **Configuration Manual, Induction Motors**
SIMODRIVE 611, SIMOVERT MASTERDRIVES
Induction Motors General Section

/APH2/ **Configuration Manual, Induction Motors**
SIMODRIVE 611
1PH2 Induction Motors

/APH4/ **Configuration Manual, Induction Motors**
SIMODRIVE 611
1PH4 Induction Motors

/APH7/ **Configuration Manual, Induction Motors**
SIMODRIVE 611
1PH7 Induction Motors

/PPM/ **Configuration Manual, Hollow-Shaft Motors**
SIMODRIVE 611
Hollow-Shaft Motors for Main Spindle Drives
1PM6 and 1PM4

/PJFE/ **Configuration Manual, Synchronous Build-in Motors**
SIMODRIVE 611
Synchronous Motors for Main Spindle Drives
1FE1 Synchronous Build-in Motors

/PJTM/ **Configuration Manual, Build-in Torque Motors**
SIMODRIVE 611
Build-in Torque Motors 1FW6

/PJLM/ **Configuration Manual, Linear Motors**
SIMODRIVE 611
Linear Motors 1FN1 and 1FN3

/PMS/ **Configuration Manual, ECO Motor Spindle**
SIMODRIVE 611
ECO Motor Spindle 2SP1

/APL6/ **Configuration Manual, Induction Motors**
SIMOVERT MASTERDRIVES
Induction Motors 1PL6

/APH7M/ **Configuration Manual, Induction Motors**
SIMOVERT MASTERDRIVES VC/MC
Induction Motors 1PH7

/PKTM/ **Configuration Manual, Complete Torque Motors**
SIMOVERT MASTERDRIVES
Complete Torque Motors 1FW3

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Suggestions

Corrections

For Publication/Manual:

Hollow-Shaft Motors for
Main Spindle Drives
1PM6/1PM4

Manufacturer/Service Documentation

From

Name

Company/Department

Address

Postal code: Town:

Telephone: /

Telefax: /

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Order No.: 6SN1197-0AD03-0BP1

Edition: 08.2005

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