



Super Premium Standard Motors

**preliminary standard IEC/TS 60034-30-2,
efficiency class IE4/IE5**

**complete edition
Series MPM 4,4 – MPM 30
1,1kW – 30,0kW**



here: own notes

MPM motor manual history

Version	Ausgabegrund
I/16	first revision
II/16	4.0 Power range of the MPM motors: Y-connection / 8.3 Motor weight

Technical modification which are improving the motors are reserved.

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1.0 Table of content

2.0	MERKES GMBH PRODUCT LINIE	5
2.1	SYNCHRONOUS SERVO MOTORS	5
2.2	SUPER PREMIUM STANDARD MOTORS IE4, SYNCHRONOUS MOTORS	5
2.2.1	EXPLANATION TO THE DIVERSITY OF THE MPM MOTORS	5
3.0	WITH OR WITHOUT FEEDBACK, ENCODER	7
3.1	SYNCHRONOUS TECHNOLOGY INSIDE THE STANDARD-MOTOR HOUSING	7
3.1.1	MAGNETIC FLUX AND TORQUE RIPPLE	7
3.1.2	HIGH FREQUENCY INJECTION METHOD	7
4.0	POWER RANGE OF THE MPM MOTORS	10
4.1	THE EVOLUTION FOR PLANNING AND LOGISTICS	11
4.2	PARADIGM CHANGE IN MOTOR PROPERTIES	12
5.0	SAVETY ADVICES	13
5.1	WARNING NOTES FOR SYNCHRONOUS PERMANENT MAGNET MOTORS	14
5.2	NECESSARY NOTES TO RUN MPM MOTORS	14
5.3	MOTOR OPERATION	15
5.4	GENERATOR OPERATION	15
6.0	GENERAL	15
6.1	ABOUT THIS MANUAL	15
6.2	CONVENTIONAL USE	15
6.3	STRUCTURE OF THE MOTORS	15
6.3.1	SHAFT END LOAD SIDE (DRIVE SIDE)	16
6.3.1.1	SPECIAL FEATURE: INCREASED SPEED	17
6.3.2	DEGREE OF PROTECTION (WITHOUT SHAFT SEAL)	17
6.3.3	CONNECTION TECHNOLOGY	17
6.4	SELECTION CRITERIA	18
6.5	ORDER KEY FOR MPM STANDARD MOTORS WITH PERMANENT MAGNETS	19
7.0	MOUNTING / START UP	20
7.1	PLEASE TAKE CARE ABOUT	20
7.2	GENERALLY	20
7.3	ENVIRONMENTAL CONDITIONS	21
7.4	DRIVE SIDE PARTS	21
7.5	ELECTRONICAL CONNECTIONS	21
8.0	TECHNICAL DATA	22
8.1	MOTOR DIMENSIONS	22
8.2	MOTOR WEIGHT AND INERTIA	28
8.3	ELECTRICAL MOTOR DATA	28
8.3.1	DATA Δ CONNECTION	28
8.3.2	DATA Y CONNECTION	28
9.0	TERMS AND DEFINITIONS	30

2.0 Merkes GmbH product line

For nearly 20 years the Merkes GmbH developed itself successfully as a supplier of special motors.

2.1 Synchronous servo motors

- Series MT
from 0,1Nm up to 115Nm, the inertia is optimized for a good concentric runout
- Series MN
from 0,28Nm up to 60Nm, dynamic and mounted with high automation grade
6/10 poles, top product in relation of energy concentration

All servomotors are available with a high diversity of options:
keyway, holding brake, resolver, about 50 different encoders ...

2.2 Super premium standard motors IE4, synchronous-motors

In the year 2012, the Merkes GmbH was one of the first suppliers of super premium standard motors in reference to the preliminary standard IEC/TS 60034-31 from 2010. They were introducing synchronous motors in the dimensions of standard standard motors to the market and were delivering ex stock.

Now the re-design is finished. The required optimizing of the efficiency progress up to an area from 1.000 rpm to 4.000 rpm is reached. At the same time, we have now four different motor types available with a power of 1,1kW up to 30kW. In the meanwhile renewed preliminary standard was taking as basis, in dependence to the preliminary standard IEC/TS 60034-30-2, with permanent magnet rotor and without feedback unit. The conception is for use in Y/Δ- connection at a frequency inverter with a 400V AC power supply and the possibility of „sensor less - vector – control “inside the control unit.

The MPM (Merkes-Permanentmagnet-Motor) - motors are able to run 4.000 rpm with nominal torque in continuous operation (S1-mode). For acceleration procedure the motors are able to run with the double of torque continuously for 1 minute from the standstill up to 4.000 rpm. Please consider the inverter possibilities of nominal and maximum current.

2.2.1 Explanation to the diversity of the MPM motors

The execution of the classic standard-motor based on IEC/TS 60034-1 is generally in asynchronous technology. That is valid up to the advanced efficiency class IE3. Millions of motors have been and still are constructed like this. It is the most popular electric motor type in the world and has with its excellent price/performance relationship and the high reliability best requirement for standard applications. They are able to run direct at the 3-phase electrical network. To reduce the starting current, it is possible to use the star-delta connection, soft-starter (electronic) or frequency inverters.

During operation at standard 3-phase electrical network such as 3 x 400 VAC the adaption to different speed requirement is done by:

- a different numbers of poles inside the motor (2,4,6 ... and more), with which you get a synchronous speed of 3.000, 1.500, 1.000 ... rpm, reduced by a few percent of slip
- a gearbox, toothed belt or other kind of gear reduction

- soft starter or frequency inverter

This means:

- different number of poles → different construction of motors, higher diversity
- gear reduction → additional costs and reduction of the effectivity
- soft starter or inverter → additional inertia costs, reduction of live time cost

With implementation of the IE4 efficiency class standard as per draft: IEC/TS 60034-30-2, the lawgiver is recommending another reduction of losses in electric standard motors to save energy during the process of transformation from electric into mechanic power. During the actually technical possibilities and new magnet material it is possible to reach and outreach the new standard with synchronous motors. That will reduce the losses inside the motor in relation to the asynchronous motor for about 50%.

The motor series MPM is taking the physical principle of synchronous motors and combining it with elements of the serial production of the standard asynchronous motor.

- Permanent magnet synchronous motors:
 - excellent motor efficiency up to 96,5%
 - MPM series enables the double of performance from 0 up to 4.000 rpm for at least 1 minute. That is caused by the possibility to drive the double of torque during the whole speed range. There is no limitation caused by the breakdown torque. This is not possible with standard asynchronous motors.
- In dependence to preliminary standard IEC/TS 60034-30-2:
 - Motor housing and power graduation IE4 super premium
- Designated for frequency inverters with function "sensorless vector control". The MPM motors are NOT able to run direct at the 3-phase electrical network!
 - Additional functions like:
 - speed control
 - torque control
 - position control (partial)
 - acceleration and deceleration programmable with the double of the nominal torque over the whole speed range from 0 rpm up to 4.000 rpm
 - speed- and performance adaption to actual needs (pumps, fans, ...)
- Increased efficiency up to 96,5 %
 - optimal to save energy, significant save of costs for the machine- and factory user
- Cos φ up to 0,98
 - current optimal, nearly no reactive power to the frequency inverter

3.0 With or without feedback, encoder

Synchronous servomotors are developed for applications with highest precision during position, speed or torque control. That applications are mostly not solvable without feedback like resolver, incremental encoder, SinCos encoder or another type. In much higher numbers you find standard motors in applications where it is enough to drive direct on the electrical network with constant speed or with frequency inverter and variable speed. Mostly without feedback. With modern frequency inverters it is possible to solve synchronous servomotor applications without feedback. This offers a lot of new possibilities to the constructor and machine manufacturer.

3.1 Synchronous technology inside the standard-motor housing

The connection between these two groups (standard motors and synchronous servo motors) is done by transmitting the technology of the synchronous servo motors inside the standard-motor housing and the advanced technology inside the modern frequency inverters. The combination of using parts from the DIN certified standard-motor housing and forward looking technology in the magnetic circuit gives Merkes the possibility to generate an absolutely new conception for their MPM motors. Advanced speed up to 4.000 rpm with constant torque over the whole speed range are unique in this combination. Basic for that is the knowledge about speed and position inside the frequency inverter. But how do the frequency inverter know that?

There are two common detection forms:

3.1.1 Magnetic flux and torque ripple

The inverters are detecting that parameters continually and use them to generate the vectors. Thereby parameters for building the actual value of speed and torque are available. For the startup the inverter mostly uses the auto detection function to measure the necessary parameters like resistance and inductivity.

For the manual input of the parameters Merkes provides the following three inductivities of their offered motors: the main inductivity phase-phase „ L_{pp} “, the longitudinal inductivity „ L_d “ and the transversal inductivity „ L_q “.

It is necessary to get the right type of inverter which is able to drive this sensorless mode for permanent magnet synchronous motors. Please inform yourself at the inverter manuals or contact the inverter manufacturer directly.

3.1.2 High frequency injection method

Another detection procedure to get the rotor position and speed is the injection of a high frequency signal at the stator winding. The principle of “buried magnets” we use at the MPM motors is helpful for that technology. In difference to the procedure at 3.1.1 the motor has no oscillation movement during the startup.

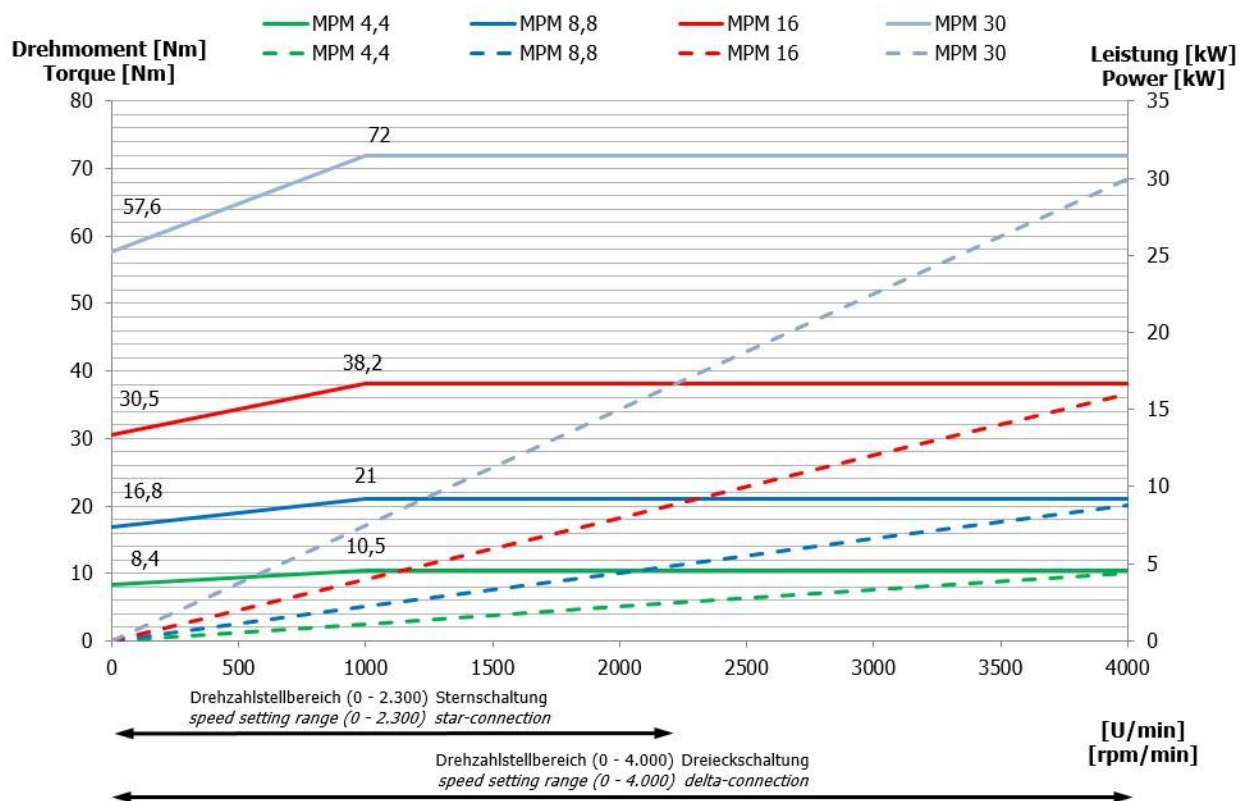
The startup sequence is similar to the procedure described at 3.1.1.

The „cold technology“ does enable a very positive torque progress

A lot of actions give the motor a constant torque progress! Following actions are mentioned:

- optimized concept of the magnetic flux
- number of motor poles
- optimized design of the fan wheel
- optimized back emf

Picture 1 shows us the torque- and electric power for the 4,4kW up to the 30,0kW MPM motor. The continuous lines represent the torque progression and the broken lines are for the electrical power of the equivalent motor. For the acceleration procedures is the double of torque for the whole speed range from 0 rpm up to 4.000 rpm available. Please take also care about the inverter nominal and maximum current.



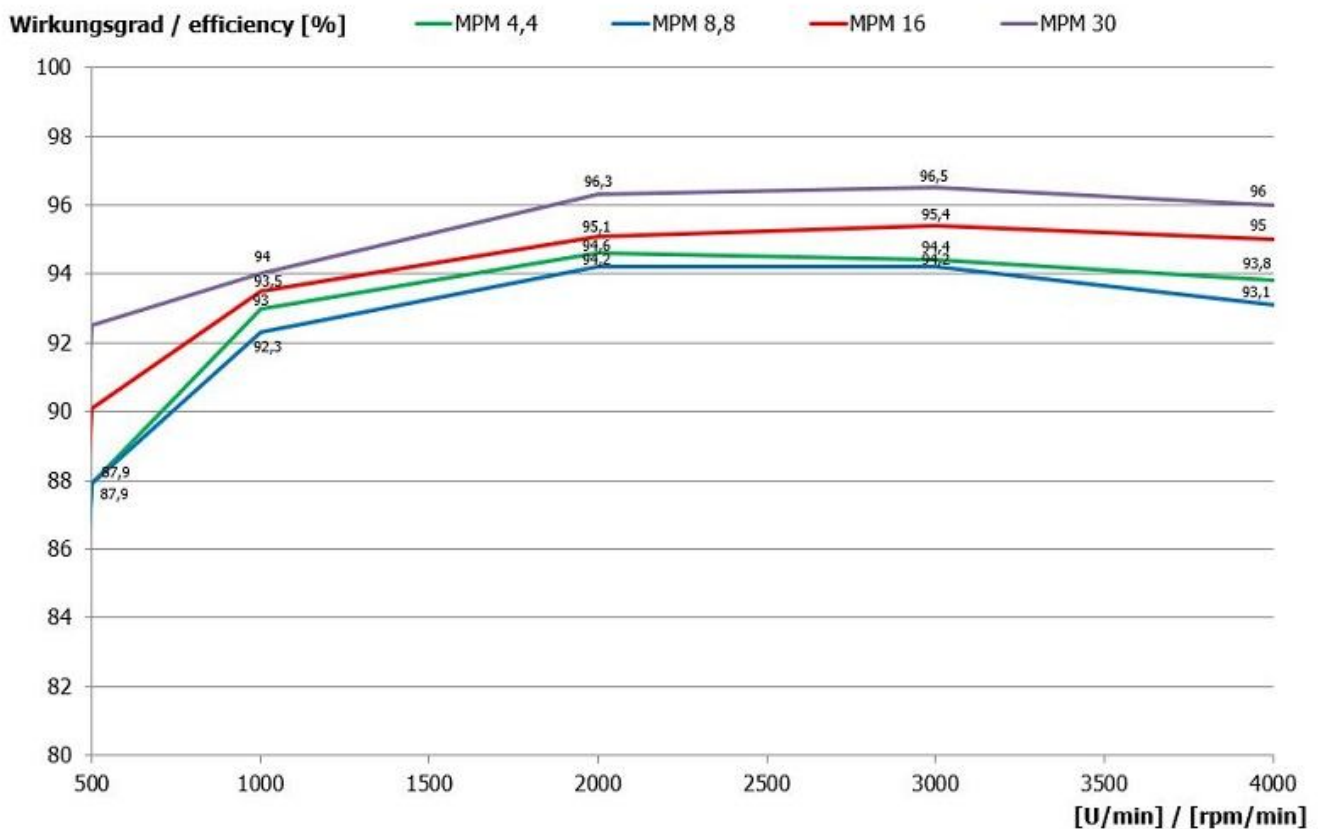
Picture 1: Representation of torque- and electric power characteristic of the MPM-series

MPM-motors switched in Δ are able to deliver the nominal torque over the whole speed range from 0 rpm up to 4.000 rpm with nearly the same winding temperature. Switching the motor into Y-connection will reduce the current which offers the choice of a smaller inverter. Wiring the motor in Y-connection will decrease the maximum speed at 400V AC inverter voltage to 2.300 rpm. Find the relationship at the following power formula:

$$P [kW] = \frac{M [Nm] \cdot n [rpm]}{9550} \quad (1)$$

The electrical power is proportional to the motor speed!

MPM motor efficiency by now better than IE4 super premium



Picture 2: Shows the gradient of the efficiency over the motor speed of the four MPM motors from 4,4kW up to the 30,0kW with output of the nominal torque. The detection of the data is judged to preliminary standard EN 60034-30-2.

With partial load between 40% and 80% of the nominal torque the efficiency is between 85 and 90%.

4.0 Power range of the MPM motors:

Δ – connection, operation mode S1

■ MPM 4,4

at 1.000 rpm: torque = 10,5 Nm \triangleq mechanical power = 1,1 kW
at 4.000 rpm: torque = 10,5 Nm \triangleq mechanical power = 4,4 kW
maximum torque from 0 rpm up to 4.000 rpm for 1 minute: 21 Nm

■ MPM 8,8

at 1.000 rpm: torque = 21 Nm \triangleq mechanical power = 2,2 kW
at 4.000 rpm: torque = 21 Nm \triangleq mechanical power = 8,8 kW
maximum torque from 0 rpm up to 4.000 rpm for 1 minute: 42 Nm

■ MPM 16

at 1.000 rpm: torque = 38,2 Nm \triangleq mechanical power = 4,0 kW
at 4.000 rpm: torque = 38,2 Nm \triangleq mechanical power = 16,0 kW
maximum torque from 0 rpm up to 4.000 rpm for 1 minute: 76,4 Nm

■ MPM 30

at 1.000 rpm: torque = 72 Nm \triangleq mechanical power = 7,5 kW
at 4.000 rpm: torque = 72 Nm \triangleq mechanical power = 30,0 kW
maximum torque from 0 rpm up to 4.000 rpm for 1 minute: 144 Nm

Y – connection, operation mode S1

Operation in Y – connection is possible, but the maximum speed is limited to a maximum of 2300 rpm (400 Voltage at the inverter input). The known torque and power defined by formula (1) remain. Connecting in Y does reduce the phase current about factor 1,73 and increase the phase voltage for about factor 1,73. The electrical power is the same.

Operation in Y – connection is a proper way to reduce the electrical current and the frequency inverter size if you drive not faster than 2300 rpm.

■ MPM 4,4

at 1.000 rpm: torque = 10,5 Nm \triangleq mechanical power = 1,1 kW
at 2.000 rpm: torque = 10,5 Nm \triangleq mechanical power = 2,2 kW
maximum torque from 0 rpm up to 2.300 rpm for 1 minute: 21 Nm

■ MPM 8,8

at 1.000 rpm: torque = 21 Nm \triangleq mechanical power = 2,2 kW
at 2.000 rpm: torque = 21 Nm \triangleq mechanical power = 4,4 kW
maximum torque from 0 rpm up to 2.300 rpm for 1 minute: 42 Nm

■ MPM 16

at 1.000 rpm: torque = 38,2 Nm \triangleq mechanical power = 4,0 kW

at 2.000 rpm: torque = 38,2 Nm \triangleq mechanical power = 8,0 kW

maximum torque from 0 rpm up to 2.300 rpm for 1 minute: 76,4 Nm

■ MPM 30

at 1.000 rpm: torque = 72 Nm \triangleq mechanical power = 7,5,0 kW

at 2.000 rpm: torque = 72 Nm \triangleq mechanical power = 15,0 kW

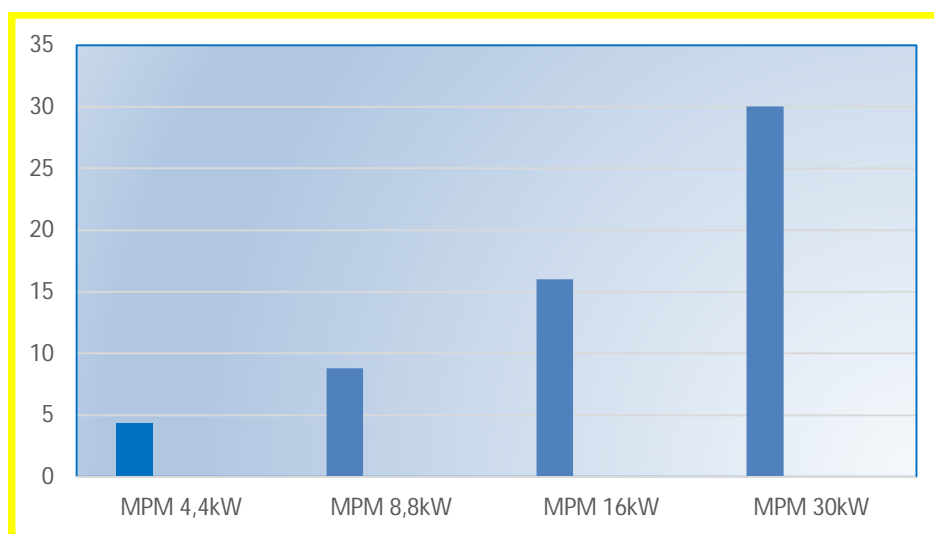
maximum torque from 0 rpm up to 2.300 rpm for 1 minute: 76,4 Nm

4.1 The evolution for strategy and logistics:

Only four motor types remain inside the power range from 1,1 kW up to 30,0 kW!

Using the present conventional motor type structure with a different numbers of poles inside, a multiplicity of motors up to 50 variations in the power range of MPM is possible.

The MPM motor of the Merkes GmbH, based on 4 basic types, is creating something new. The combination of new modern materials together with new efficiency and speed range is the base.



4.2 Paradigm change in motor properties:

- 1 to 2 motor sizes smaller
- at 30kW, size 132, about 100 kg less weight
- surface cooling in reference to IC 411.
- efficiency super premium better than IE4 up to 96,5%.
- 0 rpm up to 4.000 rpm without field weakening
- double torque for 1 minute over the whole speed range (acceleration)
- free inverter choice, tested with a lot of common inverter supplier
- the high efficiency helps to reduce the cable cross-section
- Energy saving in continuous mode by bisection the losses. A lot of applications are running up to 8.000 h a year. We like to support you with the determination of the potential saving.

Suitable applications:

All classic applications of standard motors are possible. In addition to that MPM offers you more possibilities in speed range, torque increase and efficiency for partial or continuous mode.

Examples:

- Motors with continuous power-on time like: fans, pumps, compressors, extruders, main drives in machines, generators.
- The return of invest with continuous power-on time applications can be reached in less than one year.

General safety instructions:

Turning of the motor shaft will generate electric voltage at the connecting terminal and the wires. Touching and working at the motor is allowed only during standstill.

5.0 Safety advices



- All operations on transport, assembly, start-up and maintenance have to be done by skilled and qualified personnel only. The qualified personnel must know and observe the following standards and guidelines:

DIN VDE 0105, IEC 364, accident prevention regulations

Deviant behaviour may cause serious injury to persons and may lead to damages.

- The machines comply with the standard IEC/EN 60034.
- Before mounting and start-up read the documents on hand very carefully. Follow the instructions for power supply (motor label and manual) and go by the rules of the technical data.
- Ensure a proper, low-impedance grounding of the motor housing with the PE-reference potential inside the switch cabinet, as otherwise personal safety is not assured.
- Take suitable steps, that unexpected false move will not lead to injury or damage.



- Power connection can also lead current, when motor is not rotating. Do not remove or pull off plugs during operation or power supply. This can lead to electric arcs which may harm people or damage contacts.
- Surface temperatures of more than 100°C can arise on the motors. Take care do not stick or fasten any temperature sensitive parts to it. Possibly make provisions for precautions against touch.
- Please take care of all safety advices in the technical instruction manual which is included in every motor package.

Symbols used in this manual



general warning

Significance: actual bodily harm and damage may occur if the respective precautions will not be taken.



danger by electricity

Significance: death, grievous bodily harm or considerable damage may occur, if the respective precautions will not be taken.

5.1 Warning notes for synchronous permanent magnet motors



Defined by the structure this motors have inside the rotor very strong magnets. Especially at the open motor there are serious danger for men and equipment near the rotor:

- people with pacemaker or defibrillator
- banker's card, personal id, safety cards with magnetic or electronic store can receive heavy damage
- sensible measuring devices are able to cause faulty data
- electronic or sensible mechanic watches can be damaged

This warning notes are necessary for prevention against imprudent handling of magnetic rotors. To reduce damage and danger the saver way is to consult a Merkes certified workshop. Customers and operators are able to return motors for inspection to the Merkes GmbH located at Solingen. We indicate you, that we have motors in standard design on stock. That gives you the possibility of replacement during a few days.

Inside the Merkes GmbH Know-how about the permanent magnet motors is available since 40 years. Under acceptance of the warning notes by the operator there is no risk for live or equipment. Synchronous motors for servo-applications are produced in lot of millions a year. Important problems are not known from us.

Incorrect handling or use can cause personal- or material damage. That can neither be controlled nor prohibited by Merkes GmbH. Caused by that we declare, that there generally is no disclaimer of warranty for losses, damages or costs caused by incorrect handling.

5.2 Necessary notes to run MPM motors

- The standard motors of the MPM series are precision motors. The MPM motors are NOT able to run direct at the 3-phase electrical network! The conception is for use in Y/ Δ - connection at a frequency inverter with an 400V AC power supply and the possibility of „sensor less - vector – control “inside the control unit. Direct connection to the net will destroy the motor.
- For the mounting of frictionally engaged output elements which are free from play you have to use the thread inside the shaft to tight them. Use appropriate tools only!
- Do not hit or push the motor flange or shaft. That can destroy the bearings.
- Take care of the correct alignment of the coupling. Follow the notes of the coupling manufacturer. Wrong alignment will cause vibrations and they are damaging coupling and bearings. The shaft and the connection elements have to be mounted in a line.
- Consider the allowed radial forces especially if you connect a belt or tooth-belt. Too high radial forces will extremely reduce the live time of the bearings.
- Take care that all necessary parameters for the frequency inverter are inside the inverter! Like the number of poles, the back EMF, nominal and maximum current. You will find that parameters inside chapter 8. Wrong parameters can cause overheat and lately destroy the motor.

5.3 Motor operation

Like mentioned above, MPM motors are only for use with frequency inverters. This inverter need the possibility of „sensor less - vector – control “. Reliable information about that you will receive from your inverter manufacturer. To reduce high frequency interferences, the motor wire must be shielded. The voltage in the three motor phases must be symmetric otherwise the voltage inside the windings can rise to much and destroy them. Find suitable solutions together with your inverter supplier.

Because of the magnets inside the rotor every MPM motor will generate voltage during turning. Take care, that the motor is standing still when working on the wiring!

5.4 Generator operation

The MPM motors of the Merkes GmbH are able to work as a generator under a few requirements. For example: isolated operation. Here the motor works as a generator and is turned by wind, water, gas- or oil- plant. The extracted energy can be rectified and injected into a D. C. – circuit or with a load controller into an electric circuit. In that cases take care about the following things:

- Use of a rectifier: There are retroactive affects to the generator. This effects are not allowed to cause an electric current which is higher as the maximum current of the motor. Only a few milliseconds are enough to cause a demagnetization of the magnets. After that the machine is not able to work as motor or generator.
- Use a load controller: Take care about local law and licenses.

6.0 General

6.1 About this manual

This manual describes the super premium standard motors series MPM with integrated permanent magnets inside the rotor. It is directed to expert staff with knowledge of electrical and mechanical engineering. The operation of the MPM motor is possible only with frequency inverters. Therefor follow the documentation and instructions of the inverter manufacturer very exact.

6.2 Conventional use

MPM motors are only for use with frequency inverter. This inverter need the possibility of „sensor less - vector – control“, inside the control unit. Reliable information about that you will receive from your inverter manufacturer. Nonobservance can or will destroy or damage the motor. In that case the warranty will be terminated.

6.3 Structure of the motors

The stator winding is comparable with asynchronous motors. The lamination and the winding are optimized to the back EMF. The rotor magnets are inside (burrowed). At the non-drive side of the shaft a blower wheel is mounted. The airflow depends on the motor speed and is directed to the load side of the motor. The remaining small losses are leaded away over the surface.

6.3.1 Shaft end load side (drive side)

The power transmission occurs by the cylindrical shaft end at drive side of the motor. Notice, that there is the possibility of high radial forces during the use of belt, toothed belt or gear-wheel for moving the load. The allowed values are depending on the motor speed. The maximum values for 4.000 rpm you find at table 1.

If the force tackles in the middle of the free shaft end, F_R is allowed to increase by 10%.

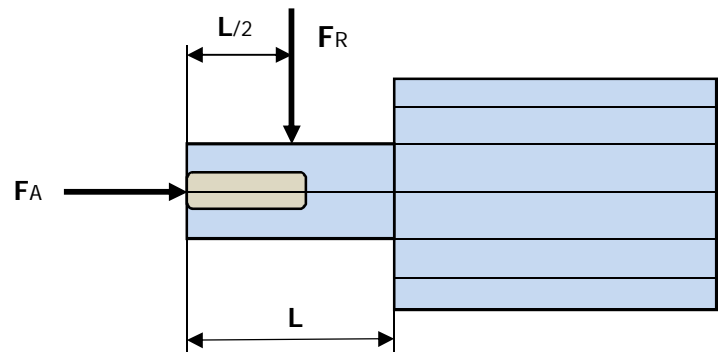
Ideal coupling elements are double conic collet chucks eventually in combination with metal bellow couplings. We advise form closed coupling elements free from backlash for a speed over 1.000 rpm.

The following specifications (radial- and axial- bearing load) are done for the strongest case, static load (standstill).

table 1: permissible bearing forces, shaft drive side

motortype	F_{Rmax} [N]	F_{Amax} [N]	F_{Rmax} [N] + F_{Amax} [N]
MPM 4,4	655	327	327
MPM 8,8	700	390	390
MPM 16	1120	560	560
MPM 30	1800	900	900

motortype	bearing type drive side	bearing type non drive side	note:
MPM 4,4	6204 2Z C3	6204 2Z C3	design: B3/B5/B14/B35/B34 A- and B-side are the same
MPM 8,8	6205 2Z C3	6205 2Z C3	
MPM 16	6206 2Z C3	6206 2Z C3	
MPM 30	6208 2Z C3	6208 2Z C3	



6.3.1.1. Special feature: increased speed

The special construction of the MPM motors enables constant torque over the whole speed range up to 4000 rpm. The higher energy concentration of the MPM motors compared with standard asynchronous standard motors enables during comparably power lower motor sizes. That gives new possibilities to electrical and mechanical construction.

Finally: The Merkes GmbH is transmitting the improved performance directly into the customer advantage.

6.3.2 Degree of protection (without rotary shaft seal)

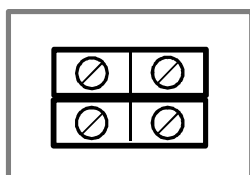
Standard for all MPM types is:

MPM 4,4	IP 55
MPM 8,8	
MPM 16	
MPM 30	

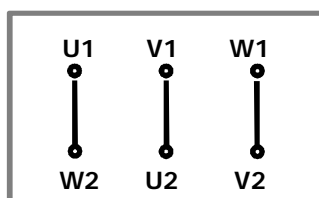
6.3.3 Connection technology

The conception is for use in Y/ Δ - connection at a frequency inverter with an 400V AC power supply and the possibility of „sensor less - vector – control“ inside the control unit.

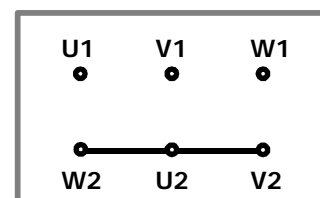
thermal sensor



Δ - connection



Y – connection



6.4 Selection criteria

To select the optimal motor for a given application we recommend to use the three most necessary motor parameters: the power, the torque and the speed. For the Acceleration you are able to use the double of nominal torque for 1 minute. That enables acceleration possibilities which the asynchronous motor has not.

S1 operation: The nominal torque is available at 1.000 rpm.

- nominal torque M_n [Nm]
- nominal speed n_n [rpm]
- nominal power P_n [kW]

$$M \text{ [Nm]} = \frac{9550 \cdot P \text{ [kW]}}{n \text{ [rpm]}} \quad (2)$$

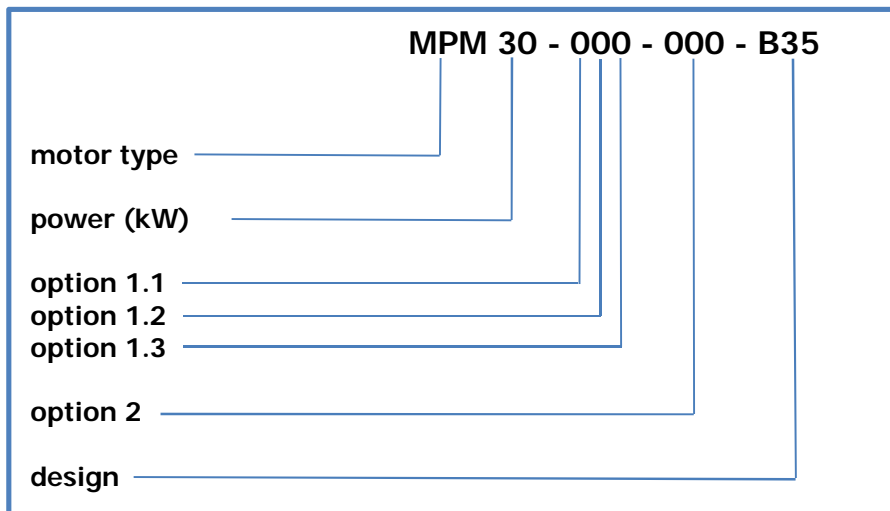
If you want to use the double torque take care that the inverter is able to drive the necessary current.

Customary inverters allow the operation in all 4 quadrants. Forward acceleration, forward deceleration, reward acceleration, reward deceleration.

If you use the MPM as a generator: Take care that the current does not rise the maximum current from the type shield. That will demagnetize the magnets and destroy the motor.

The MPM as generator provides a sinus voltage which has only 1,5% difference to the ideal sinus.

6.5 Order key for MPM standard motors with permanent magnets



- motortype: MPM
- power:
 - 4,4 = 4,4kW
 - 8,8 = 8,8kW
 - 16 = 16,0kW
 - 30 = 30,0kW
- option 1.1:
 - 0 = without thermal sensor
 - T = temperature switch
 - P = PTC
 - N = NTC
- option 1.2:
 - 0 = no fan
 - F = fan wheel
 - E = external fan
- option 1.3:
 - P = feather key
 - G = plain shaft
- option 2: special edition
- design:
 - B3 = foot
 - B5 = flange
 - B14 = flange
 - B35 = foot & B5 flange
 - B34 = foot & B14 flange

7.0 Mounting / start up

7.1 Essential to note:



- Check the assignment of inverter and motor. Are the nominal voltage and current of inverter and motor fit together?
- Execute the wiring as described in the inverter installation manual with sufficient cross-sections for the connections.
- Take care about faultless execution of the grounding.
- Take care about faultless execution of the shielding. Connect the shield with the greatest possible surface (low impedance), EMC-compatible.
- Do not exceed the allowed radial- and axial-load F_R and F_A . If you are using a toothed belt, then you can calculate the permissible diameter of the disc with the following formula: $d_{\min} \geq M_0/F_R \times 2$
- Take care about enough distance to the ND-Side (fan wheel) during the mounting of the motors. The distance must not be less than 20 cm. By disregarding the minimum distance, over temperature and destruction of the motors are possible.
- Do not exceed the maximum current and voltage, otherwise you take a chance of destruct the motor.
- If the motor does not start under inverter control, contact the support of the inverter supplier.
- Maintenance of the bearings (D_ and ND-side) is not necessary. The bearings are lubed-for-life and do not need to be lubricated.
- **In any case: Dismounting the motor is not allowed! The magnetic force is very strong and improper handling will increase the possibility of accidents.** To reduce damage and danger the safer way is to consult a Merkes certified workshop. Customers and operators are able to return motors for inspection to the Merkes GmbH located at Solingen. We indicate you, that we have motors in standard design on stock. That gives you the possibility of replacement during a few days.

Caution!



Never undo the electrical connections to the motor while it is energized.

The residual charge in the capacitors of the inverter can produce dangerous voltages up to 300 seconds after the mains supply has been switched off. Even when the motor is not running, power and control cables can still be live.

7.2. General

Before operating the motor check the general function by turning it by hand. Any bearing damage or corrosion damages to shaft or flange should be reported to Merkes GmbH immediately.

7.3 Environmental conditions

Conditions for the place of installation:

- The maximum installation altitude of 1000 m above sea level must not be exceeded.
- The Motors are suitable for use within a temperature range between -20°C and 40°C.
- The permissible relative air humidity (no condensation) is between 15% and 85%.
- The motors are not made for outdoor use, or to be used in aggressive or contaminated air.

Any divergences from the described environmental conditions cause a need of performance reduction.

7.4 Drive elements

At manufacturing, the rotor of the motor is balanced electronically. Before mounting the drive elements at the shaft end remove the corrosion protection.

Use suitable tools for mounting and unmounting the drive elements. To avoid damages, pay also attention to the manufacturer's instructions regarding the mounting and usage of the drive elements.

Our recommendation: Use a double conical clamping set.



During the mounting procedure avoid hard impacts at the motor flange and shaft. That can cause damage at shaft or bearings.

7.5. Electrical connections

The electrical wiring work should be carried out by a qualified electrician.

All installation work may only be carried out when no voltage is applied.

Wire diameters used are depending on the nominal motor current.

Locally applicable installation regulations for electrical equipment must be observed, for example in the federal republic of Germany DIN VDE 0105.

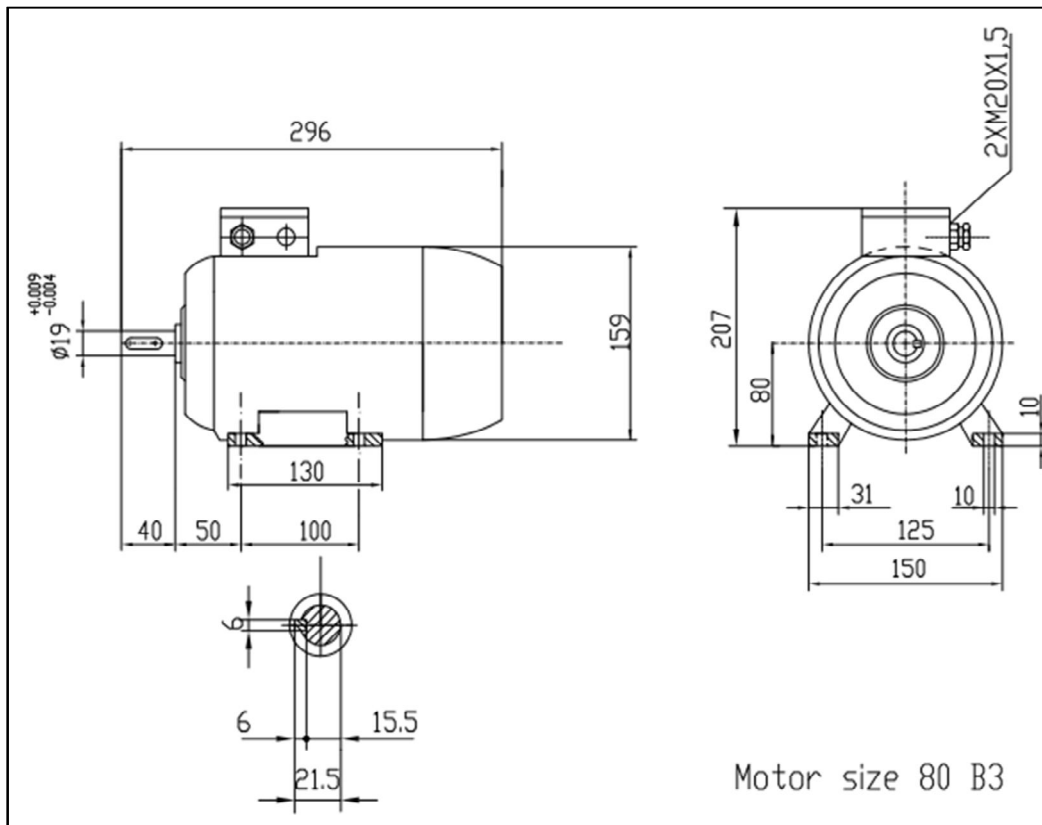
Please be sure to refer to the notes about Electromagnetic Compatibility (EMC) from the inverter manufacturer.

When connecting shielded cables, make sure that the shield is mounted with the greatest possible surface (low impedance) at both sides of the cable.

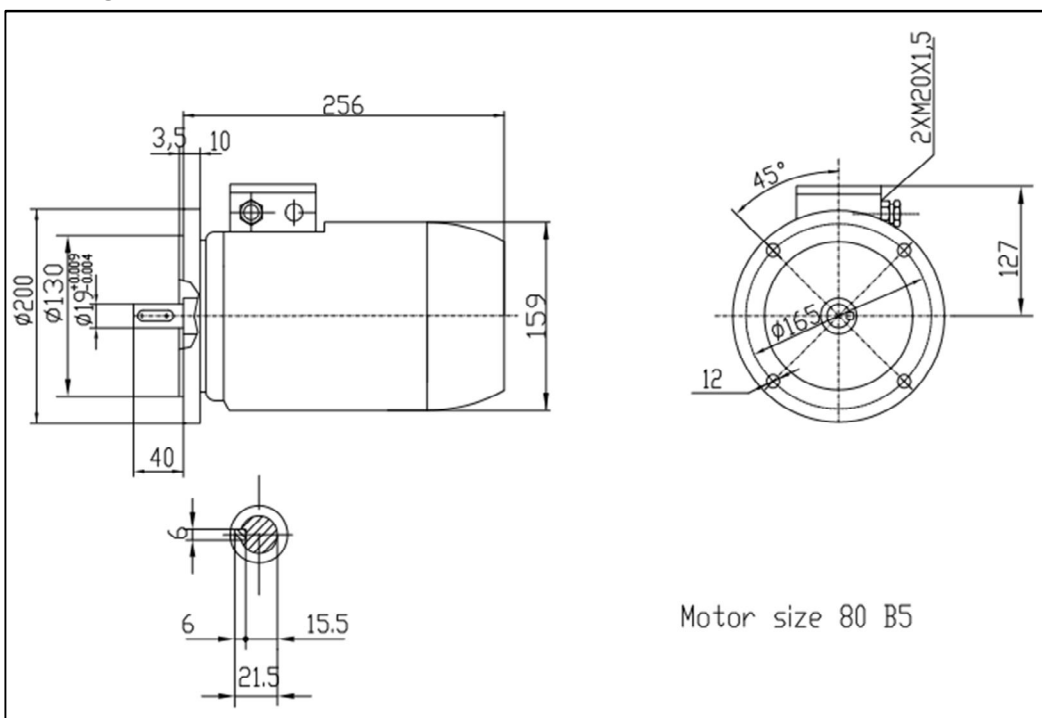
8.0 Technical data

8.1 Dimensions

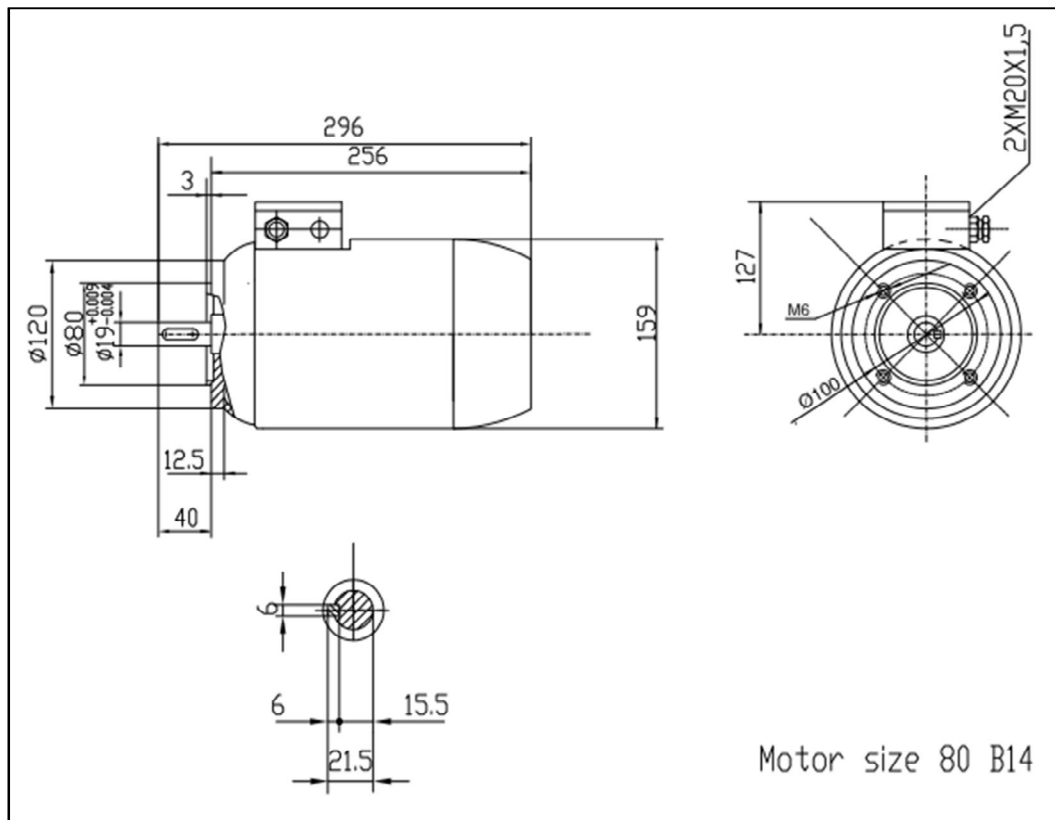
MPM 4,4-x-x-B3



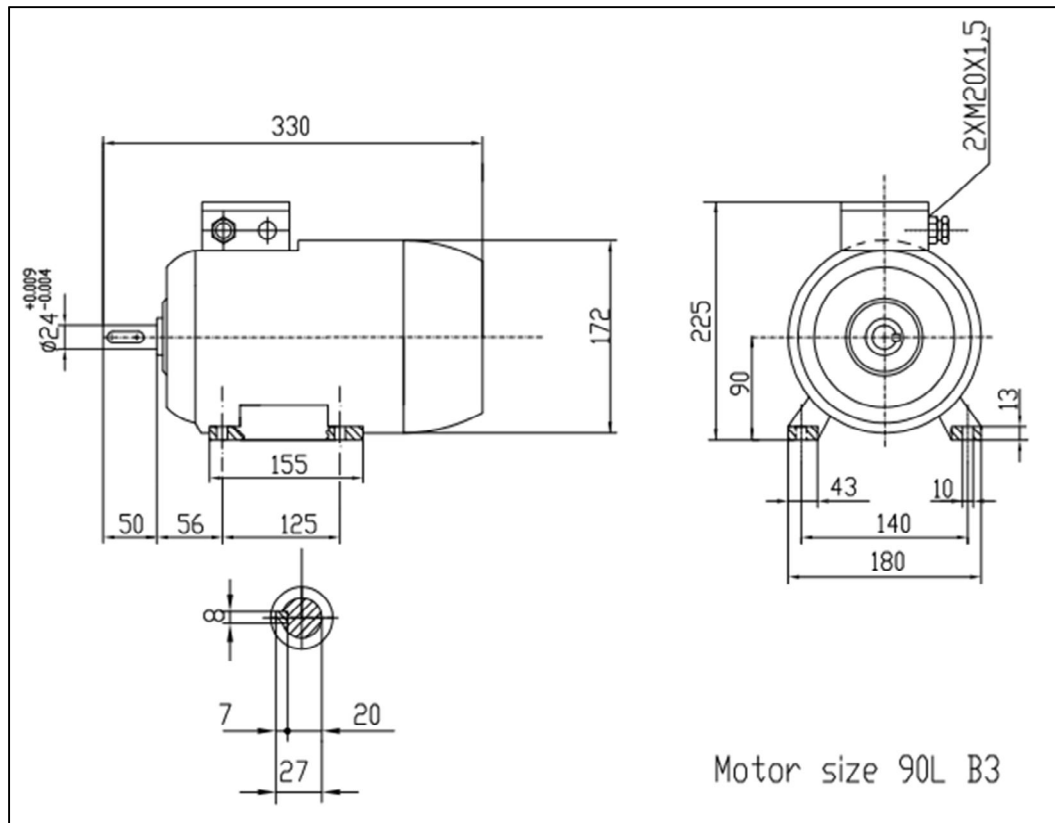
MPM 4,4-x-x-B5



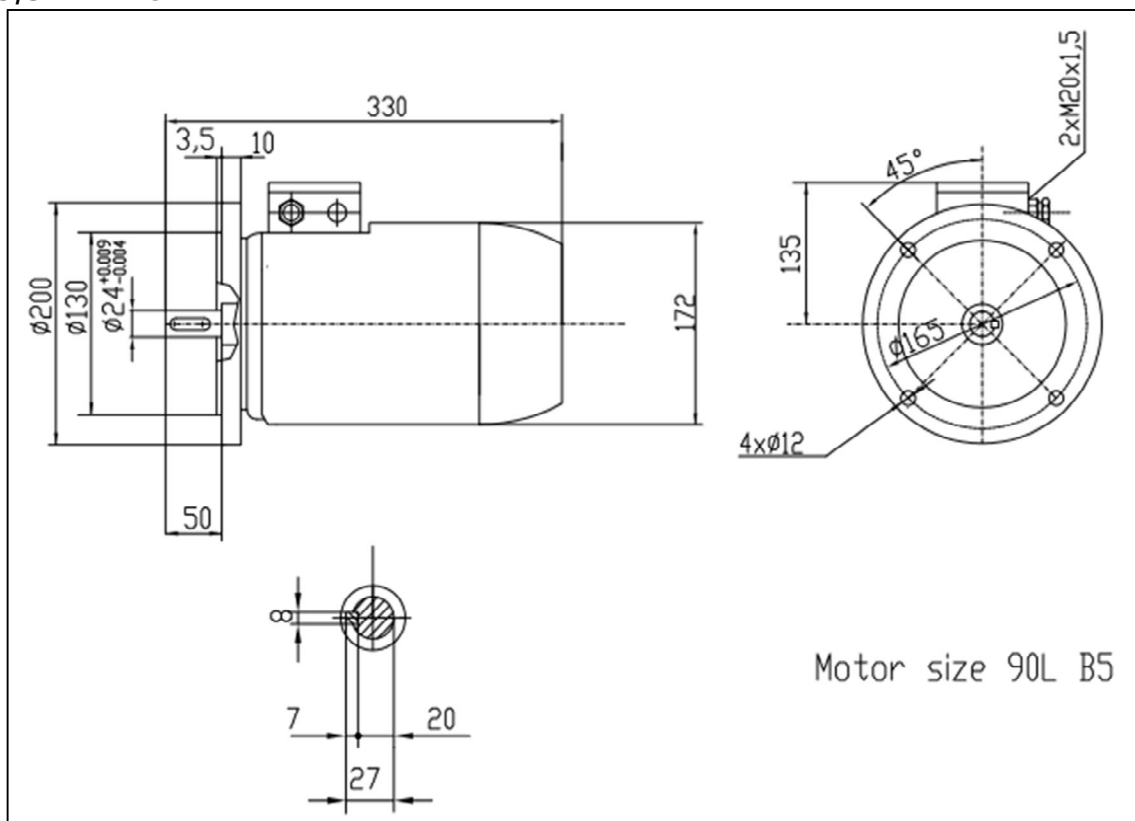
MPM 4,4-x-x-B14



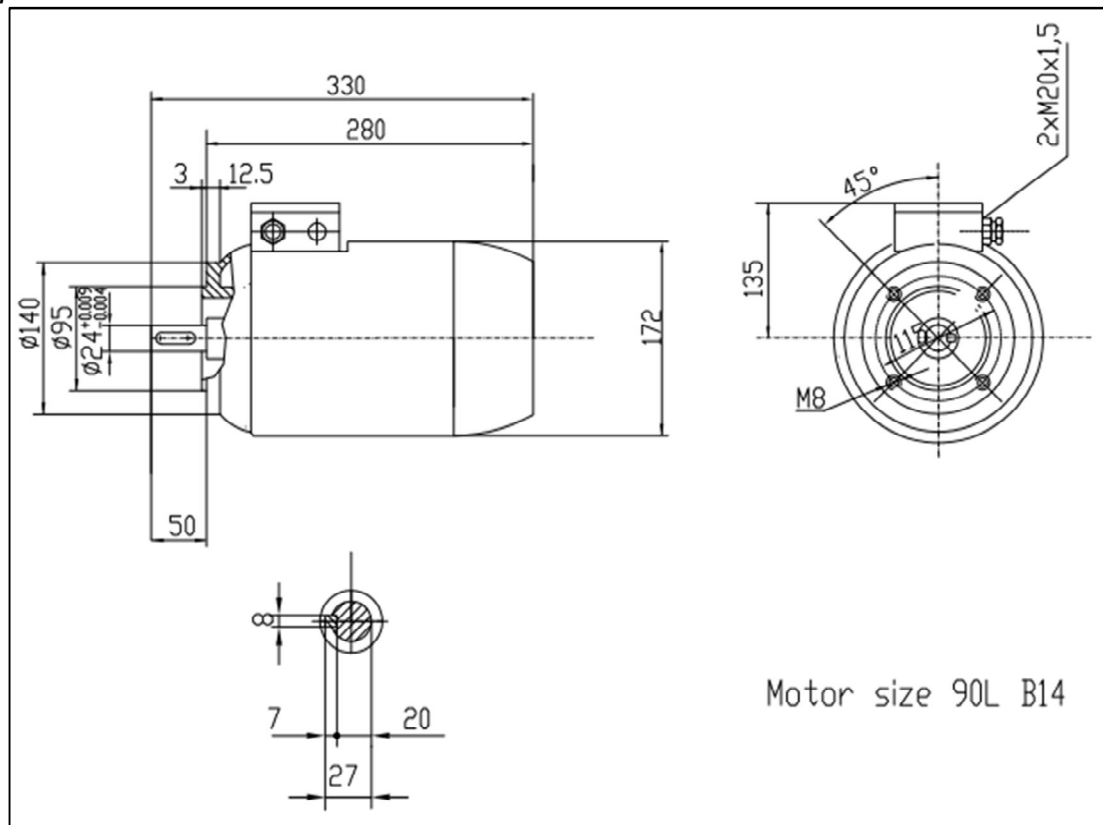
MPM 8,8-x-x-B3



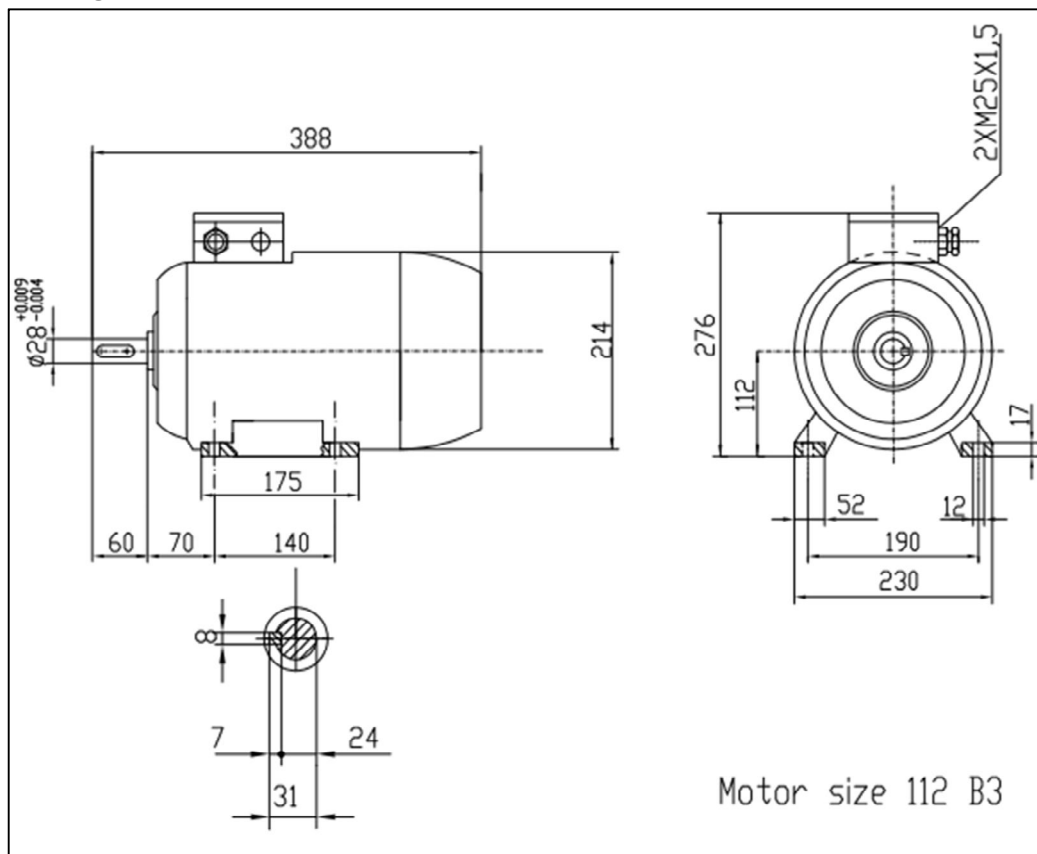
MPM 8,8-x-x-B5



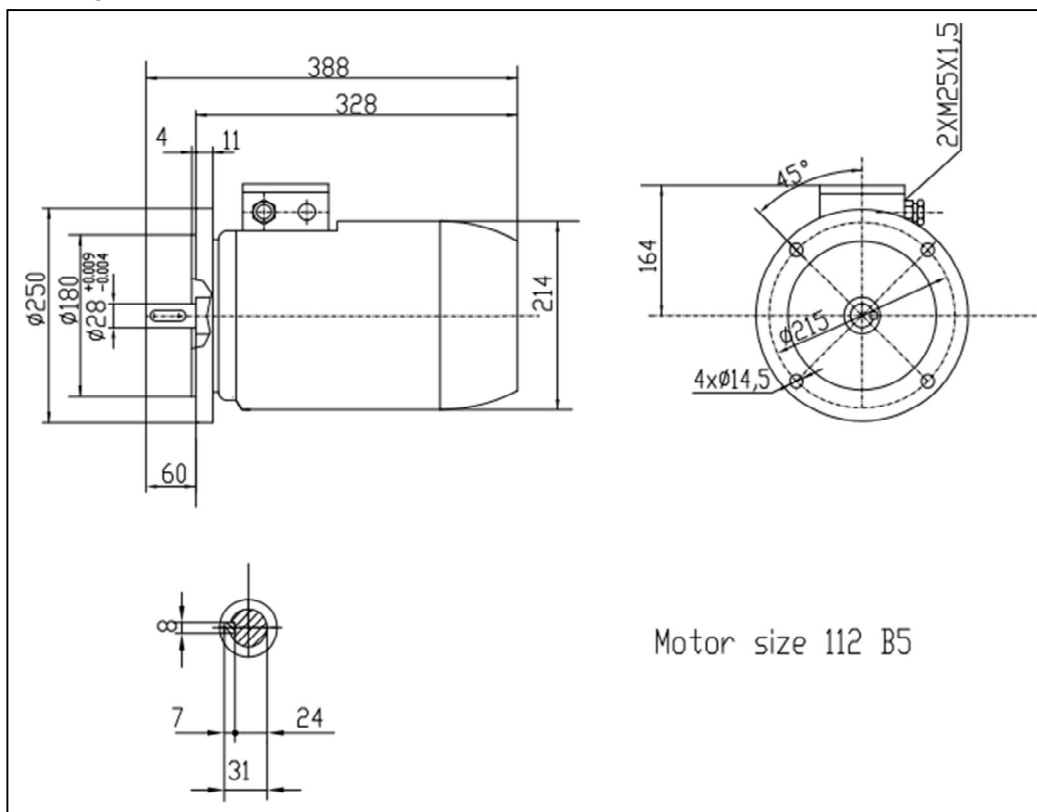
MPM 8,8-x-x-B14



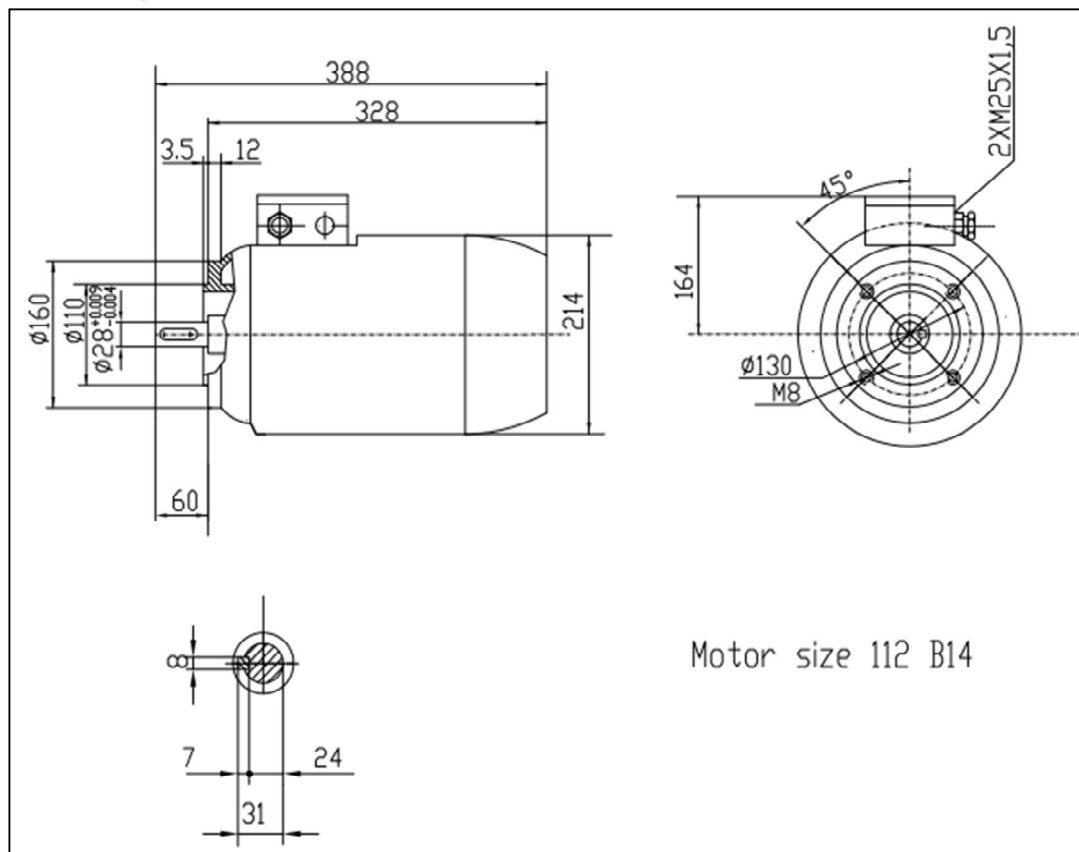
MPM 16-x-x-B3



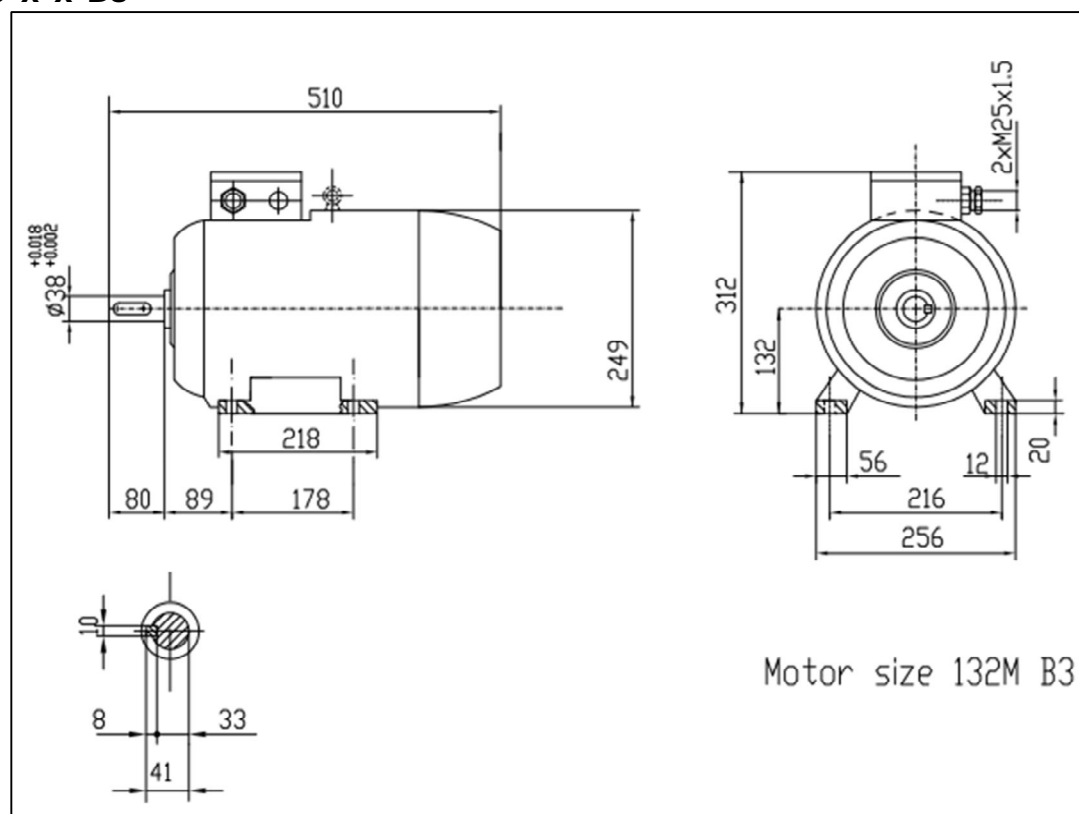
MPM 16-x-x-B5



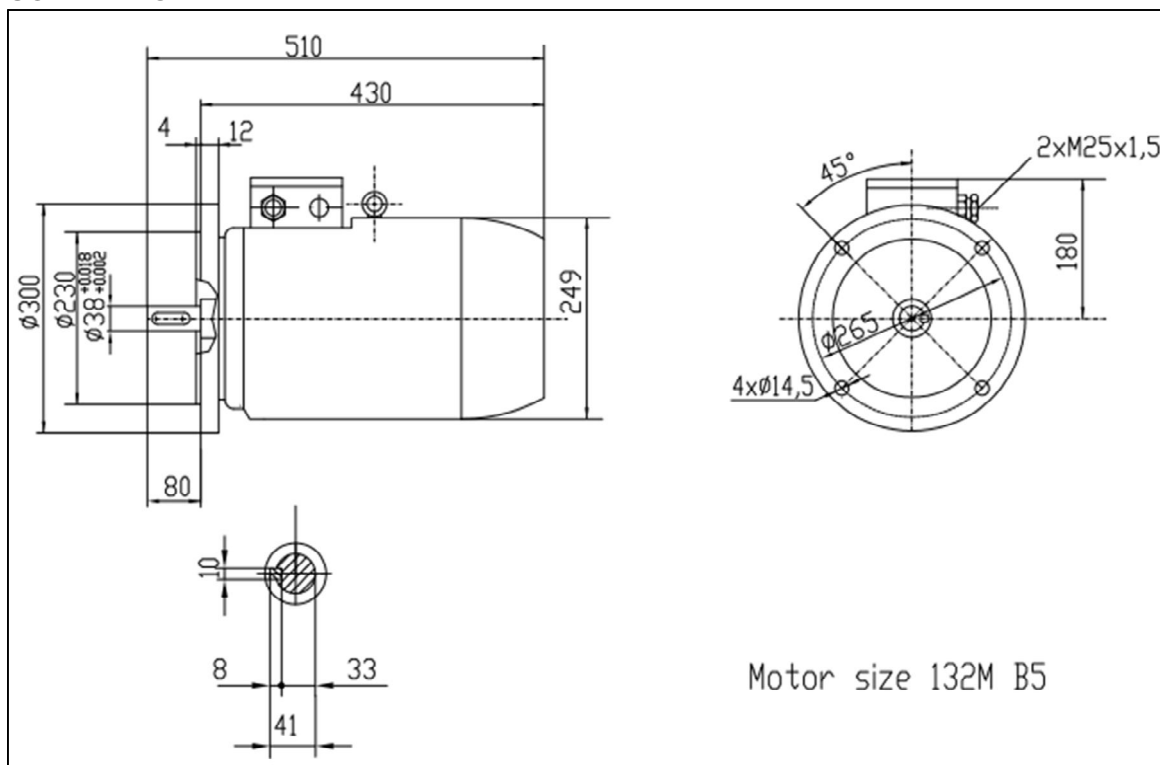
MPM 16-x-x-B14



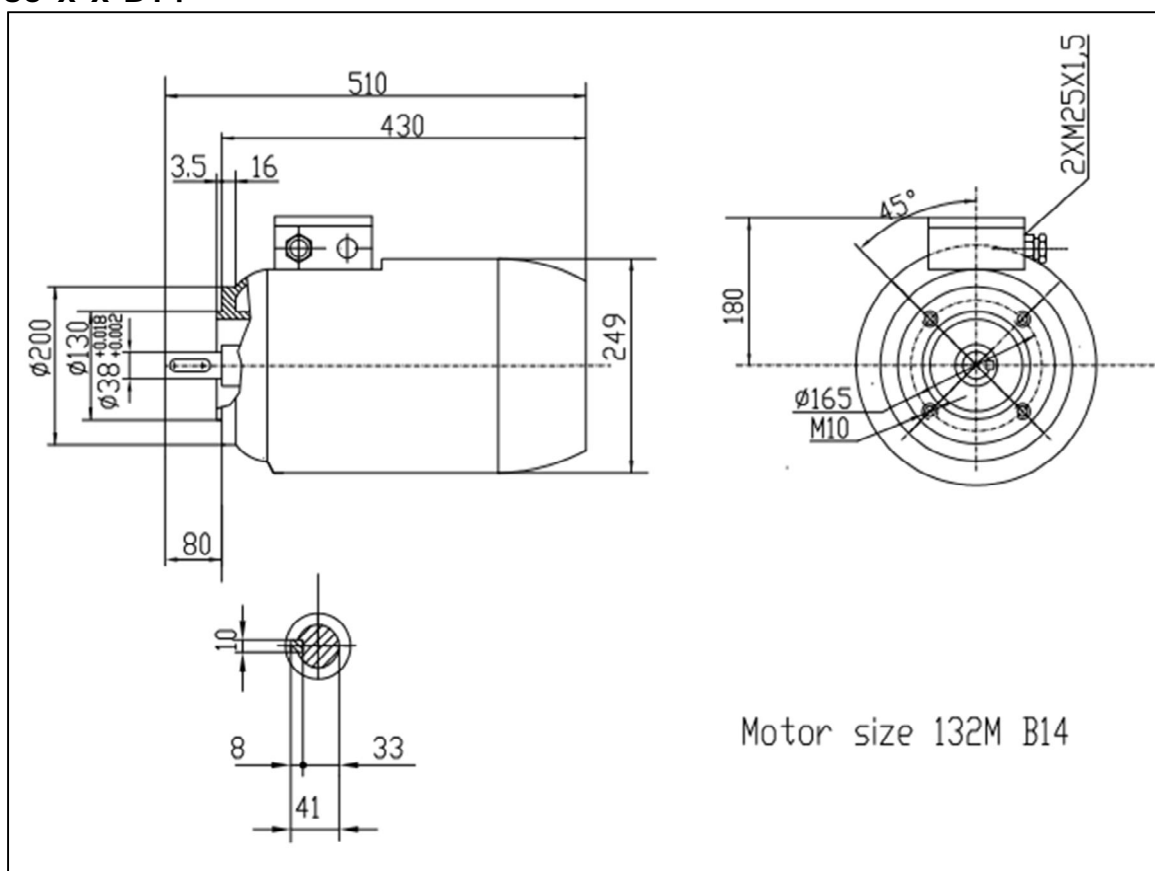
MPM 30-x-x-B3



MPM 30-x-x-B5



MPM 30-x-x-B14



8.2 Motor weight and inertia

Motor type	MPM 4,4 (80)	MPM 8,8 (90L)	MPM 16 (112)	MPM 30 (132M)
B3	12,5	18,9	33,1	64,9
B14	12,5	18,6	32,6	66,6
B5	12,9	19	33,3	65
B35	13	19,4	33,9	66
B34	12,7	19	33,2	67,6

	symbol	unit	MPM 4,4	MPM 8,8	MPM 16	MPM 30
rotor inertia	J_m	kgcm ²	34	66	203	580

8.3 Electrical motor data

8.3.1 Data Δ connection

	symbol	unit	MPM 4,4	MPM 8,8	MPM 16	MPM 30
Polzahl	p		6			
connection voltage (inverter)	U_{AC}	V	400			
nominal power (S1)	P	kW	4,4	8,8	16	30
nominal speed	n	min ⁻¹	4.000			
nominal torque	M	Nm	10,5	21	38,2	72
nominal frequency	f	Hz	200			
nominal voltage	U	V	383	392	412	373
nominal current	I	A	7,44	14,5	25,1	51
reactive factor	$\cos\phi$		0,97	0,97	0,95	0,97
winding resistance phase-phase	R_{pp}	Ω	0,98	0,49	0,24	0,04
winding inductivity phase-phase	L_{pp}	mH	7,2	3,4	2,6	0,6
winding inductivity L_q phase-phase	L_q	mH	23	10	8	4,6
winding inductivity L_d phase-phase	L_d	mH	8	3,5	2,4	1,5
standstill torque	M_0	Nm	8,4	16,8	30,6	57,6
standstill current	I_0	A	6,0	11,6	20,1	40,8
maximum speed	n_{max}	min ⁻¹	4.000			
maximum torque	M_{max}	Nm	21	42	76,4	144
maximum current	I_{max}	A	14,88	29	50,2	102
voltage constant	k_E	V/1000min ⁻¹	87	89	89	84
torque constant	k_T	Nm/A	1,41	1,45	1,52	1,41
electrical time constant	T_{el}	ms	7,3	6,9	10,8	16

+/-3% tolerance at M_0 , M_n

8.3.2 Data Y connection

	symbol	unit	MPM 4,4	MPM 8,8	MPM 16	MPM 30
Polzahl	p		6			
connection voltage (inverter)	U_{AC}	V	400			
nominal power (S1)	P	kW	2,5	5,1	9,2	17,3
nominal speed	n	min ⁻¹	2.300			
nominal torque	M	Nm	10,5	21	38,2	72
nominal frequency	f	Hz	115			
nominal voltage	U	V	376	383	402	371
nominal current	I	A	4,19	8,3	14,4	28,8
reactive factor	$\cos\phi$		0,99	0,98	0,98	0,99
winding resistance phase-phase	R_{pp}	Ω	2,95	1,46	0,74	0,19
winding inductivity phase-phase	L_{pp}	mH	19	10,2	7,8	2
winding inductivity Lq phase-phase	L_q	mH	60	30	24	13,8
winding inductivity Ld phase-phase	L_d	mH	21	10,5	8,5	4,5
standstil torque	M_0	Nm	8,4	16,8	30,6	57,6
standstil current	I_0	A	3,4	6,6	11,5	23,0
maximum speed	n_{max}	min ⁻¹	2.300			
maximum torque	M_{max}	Nm	21	42	76,4	144
maximum current	I_{max}	A	8,38	16,6	28,8	57,6
voltage constant	k_E	V/1000min ⁻¹	150	154	154	145
torque constant	k_T	Nm/A	2,51	2,53	2,65	2,50
electrical time constant	T_{el}	ms	6,5	7	10,5	16,6

+/-3% tolerance at M_0 , M_n

9.0 Definitions

standstill torque M_0 [Nm]

Thermal torque limitation, torque that can be delivered endlessly during nominal external conditions and a blocked motor with $n = 0$ rpm.

nominal torque M_n [Nm]

The nominal torque can be delivered endlessly during the nominal current is received and the motor drives with nominal speed, S1 operation .

standstill current I_0 [A]

This current is received during the motor delivers the standstill torque. This information refers to the sinusoidal current values.

nominal current [A]

This current is received during the motor delivers the nominal torque. This information refers to the sinusoidal current values.

maximum current I_{max} [A]

The maximum permissible current for 1 minute. More than the double of the nominal current is not allowed. Even a short overcurrent can cause an irreversible damage of the motor by demagnetizing.

torque constant K_T [Nm/A]

This constant specifies the volume of torque [Nm] which the motor is delivering, during an effective current of 1A is received. ($M = I * K_T$)

voltage constant K_E [V/1000 rpm]

This constant specifies the volume of voltage caused by the back-emf with regard to 1.000 rpm motor revolutions and refers to the effective voltage values between two motor phases.

moment of inertia J_m [kgcm²]

This refers to the rotor only. Extensions (like coupling, brake, toothed belt dis, etc.) will change the written values. For the calculation of the dynamic parameters you have to take the moment of inertia as a whole.

nominal power P_n [kW]

The nominal power is delivered during the motor is running with nominal speed and delivers the nominal torque. Following the standard of standard motors, the nominal power for a 6-pole machine has to be declared for a speed of 1.000 rpm. MPM motors are able to run with the quadruple of this speed. That increases the nominal power by 4 times!

basic target of the motor concept

Stator and rotor are designed in a way that allows all standard inverters to drive the MPM. In addition to that they can deliver the optimum of power and control performance.

For all of them the software structure „**sensorless-vector-control**“ has to be available and applicable. If there are any questions with new software applications, please contact us directly.

two different rotor designs

1. The magnets are mounted at the surface of the rotor. The inductances $L_q = L_d$ are the same.
2. The magnets are mounted inside the rotor. The inductances $L_q \neq L_d$ are following two asymmetrically sinusoidal curves and are not the same. For the calculation they can be combined to one inductance.

different control procedures

To capture the rotor position (estimation) there are different kinds of procedures possible. Often they are combined to deliver optimized results at high and low motor speed. Measured is the current- and the voltage-ripple. Used techniques are the HF-detection and the HF-injection. HF-detection is capturing the rotor and the system position during the start procedure. HF-injection is doing that during the rotating machine. Modern frequency inverters do enable the control of position during the standstill of the rotor.

winding parameters R, L

During the detection of the motor parameter the inverter manufacturer follow different ways. String values or phase-phase values during Y- or Δ - connection are determined or measured. The measurements are going to be done during standstill or turning rotor or in combination of both procedures. We recommend to use inverter with auto tuning for determination of parameters. By manual parameter input take our values as starting point. During the optimizing process get closer to the optimum through gradual approach by variation of the inductivity. This process has proven successful in practice.

tolerances of the magnetic material

Stator windings and the lamination of the rotor, which is transporting the magnetic flow, are producible with high reproducibility. This precision is not reachable with the magnet materials. The difference between the magnets has been reduced to a minimum. A maximum deviation of $\pm 2\%$ was determined.



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