MERKES
SMALL MOTORS

IE4/IE5 Super Premium Standard Motors

SERIES MPM – MANUAL

2023

Legend

Version	Output reason
I/21	First edition
II/21	Addition of missing dimensions at page 11
I/22	Option 1.1 modified at page 6
I/23	Nominal current Size 132M changed at page 8
II/23	Addition IE5 at the cover + page 6 and 9, new phone number at the last page

We reserve the right to make technical changes for the purpose of improving the engines.

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1.1 Product description

Merkes MPM motors (**MPM** = **M**erkes **P**ermanentmagnet **M**otor) combine the technology of the permanently excited synchronous machine with the design of the classic asynchronous machine in standard motor construction. The magnets are not located on the surface of the rotor (**SPM** motor: **S**urface **P**ermanent **M**agnets) but in the rotor. This is also referred to as buried magnets (**IPM** motor: **I**ntegrated **P**ermanent **M**agnets).

1.2 Advantages compared to the standard asynchronous

- sustainable reduction of energy costs due to IE4 efficiency (and better, up to 98%)
- further efficiency advantages in the partial load range
- efficient use of material and resources
- reduced number of types possible
- more compact design (1 to 2 sizes smaller)
- lower motor weight
- constant torque over the entire speed range
- lower current consumption
- better dynamic properties (3 times nominal torque)
- no slip due to innovative encoderless speed control
- speed control by frequency inverter creates further possibilities regarding functionality and energy saving
- speeds up to n = 4,000 min-1 are possible as standard

1.3 Advantages compared to the PM (Permanent Magnet) servo motor

- the MPM motor is self-cooled and has an impeller, the housing has cooling fins
- higher efficiency
- lower purchase price due to the use of standardized components in production

1.4 Other advantages

- increased protection against demagnetization due to buried magnets
- innovative encoderless speed control enables operation as with an actual feedback motor
- free choice of frequency converter manufacturer

1.5 Smaller shaft

Due to the reduction in size, the shaft dimensions and the installed bearings are smaller than in comparable asynchronous motors and thus axial and radial load capacities are lower. This can be partly compensated by using larger end shields.

2.0 Economic advantages due to efficiency improvements

MPM motors have the advantage that standard components from standard motor production are used in their production (this makes them cheaper than comparable PM servo motors), but the production of the rotors is significantly more expensive than for pure asynchronous motors. This results in a significant additional purchase price. This additional price is usually amortized after a short time.

2.1 Efficiency advantage in the part-load range

The difference in efficiency is particularly large in the part-load range. There, the machine is operated below the rated speed. Since in the asynchronous machine the opposing field must first be generated in the rotor, the losses of the motor in the lower speed range are significantly higher than in the PM machine. Although the power of the motor decreases proportionally with the speed of the motor, the efficiency difference increases disproportionately. In order to accurately calculate the advantage of the MPM motor over the asynchronous machine, the load cycle of the motor must be known. If this is not known, it is advisable to carry out a power measurement directly upstream of the frequency converter used and then compare the results.

2.2 Amortization calculation at nominal

In order to perform an amortization calculation, the following values must be known:

- Efficiency of the comparison machine: η1
- Efficiency of the MPM machine: η2
- Running time of the machine per year in hours: t
- Nominal power of the machine: P
- Energy price of the energy supplier: K

For the calculation it is necessary to include a frequency converter, which is required for the operation of the MPM motor! Two efficiency specifications are made for MPM motors. The information for the pure sine refers to the operating case of the machine at the sinusoidal voltage curve directly at the mains. Since the motors as synchronous machines are not able to start independently, this case will not occur. The value with frequency converter is lower because additional losses occur in the motor due to the PWM (pulse width modulation). For the following calculation it is assumed that the asynchronous machine also has a frequency converter. Frequency inverters from different manufacturers provide different results for the efficiency of the machine, since the methods used differ significantly in some cases. A sensorless vector control is required as a minimum.

Savings in year = P * t * K * (η2- η1)

If no frequency converter is used to operate the asynchronous machine, the purchase price of the frequency converter and its efficiency must be included. The efficiency advantage of the MPM machine is then reduced by approx. 2%.

3.0 Safety instructions for the operation of MPM motors

- All work for connection, commissioning and installation may only be carried out by trained and qualified personnel. They must be familiar with and observe the following standards and guidelines: **DIN VDE 0105, IEC 364, accident prevention regulations**, improper behavior can cause serious personal injury and property damage.
- Before installation and commissioning, read this documentation as well as the commissioning and maintenance instructions. Observe the information on the connection conditions (nameplate and documentation) and the technical data.
- Before installation and commissioning, read this documentation as well as the commissioning and maintenance instructions. Observe the information on the connection conditions (nameplate and documentation) and the technical data.
- Surface temperatures of over 100°C can occur on the motors. Make sure that no temperature-sensitive parts are in contact with or attached to them. Protective measures against contact may have to be provided.

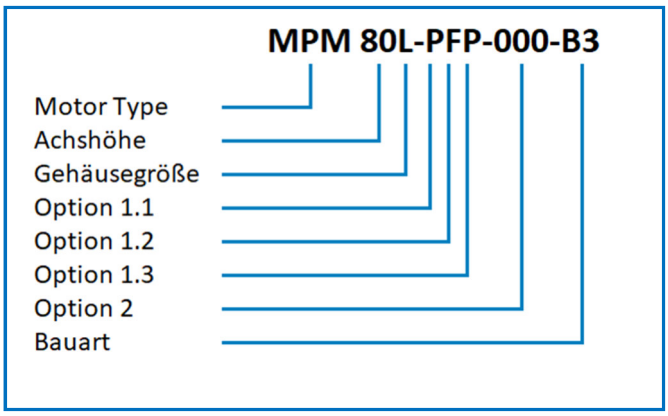
- Even if no voltage has been applied, voltages can occur at the motor terminals of rotating machines with permanent magnets. Check and ensure that the machine is at a standstill before working on it.

- Strong magnetic fields can destroy or influence electronic devices. Strong magnetic fields in the rotor and their forces can attract magnetic parts and cause damage or injury.

4.0 General technical characteristics

- The motors are manufactured in accordance with standard IEC/EN 60034-1: Rotating electrical machines Part 1: Design and operating characteristics.
- The motors are self-cooling. Cooling is provided by the surface and by the attached fan wheel.
- The motors have an aluminum housing. This includes both end shields, also in the variants B14 and B5. Only exception: MPM 160L build B14, the drive side bearing shield is made by cast iron.
- The shaft is made of steel, material: 39NiCrMo3, cylindrical end with threaded hole.
- Without shaft seal, but this can be retrofitted in both end shields.
- The winding insulation class is F.
- Color: RAL 7030

5.0 Order code



Motor type: MPM = Merkes permanent magnet motor
Size (axis height): (80, 90, 112, 132, 160) Specification in mm
Housing size: M, L, LL

Option 1.1:
0 = without thermal protection
1 = PT100
2 = PT1000
S = 3x BI NC 130 (bimetal switch)
T = 3x BI NO 130 (bimetal switch)
P = PTC 130
N = NTC 130

Option 1.2:
0 = no fan
F = fan wheel
E = external fan

Option 1.3:
P = feather key
G = smooth shaft

Option 2, special version:
000 = no special version

Build:
B3 = foot
B5 = flange
B14 = flange
B35 = foot & B5 flange
B34 = foot & B14 flange

5.1 Customised design

Customised versions are created after technical and commercial clarification. The following list provides an overview of possible variants:

- seal ring
- bearing for vertical installation
- hole for condensation water
- heating against condensation
- winding with insulation class H
- windings for other speeds
- additional winding impregnation
- IP65 version
- IP66 version
- UL version
- rain cover
- other RAL colour (standard is RAL 7030)
- special painting for corrosion protection classes according to EN ISO 12944: C1, C2, C3, C4, C5L, C5M
- brake
- manual brake actuation
- additional protection for brake at
- IP55
- IE5 on customer request
- ATEX in accordance with ATEX Directive 2014/34/EU Group II Class 3D/3G Zone 22/2

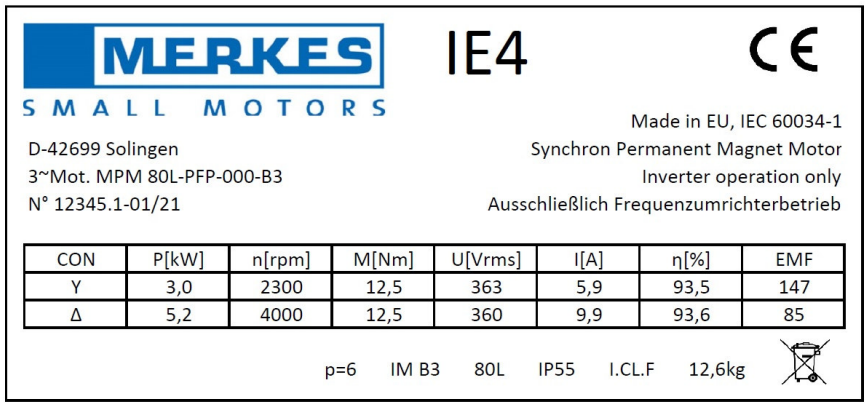
6.0 Electrical data Y-circuit

	Symbol	Unit	Size				
			80L	90LL	112M	132M	160L
Rated power (S1)	P	kW	3,0	6,5	10,9	18,4	31,2
Rated speed	n	rpm	2300				
Rated frequency	f	Hz	115				
Rated torque	M	Nm	12,5	27,0	45,3	76,4	129,5
Rated voltage	U	V	363	356	345	398	397
Rated current	I	A	5,8	11,6	20,0	32,7	58,6
Supply voltage (frequency converter)	U_{AC}	V	400				
Number of poles	p		6				
Switching frequency	f	kHz	4				
Voltage constant (effective value)	K_E	V/1000rpm	147	142	132,5	157	147
Torque constant	K_T	Nm/A	2,44	2,35	2,19	2,6	2,43
RMS value pure sine	η	%	94,5	96,2	95,7	96,1	96,7
RMS value with frequency converter	η	%	93,5	93,8	95,1	95,5	96,0
maximum speed	nmax	Rpm	2600	2800	2600	2500	2600
maximum torque	Mmax	Nm	25,0	54,0	90,6	152,8	259,0
maximum current at Mmax	Imax	A	11,5	23,7	45,5	65,0	117,2
winding resistance phase-phase	R_{pp}	Ω	3,30	1,32	0,63	0,29	0,112
winding inductance phase-phase	L_{ipp}	mH	43,50	23,90	15,30	7,18	4,80
winding inductance Ld phase-phase	L_d	mH	25,50	13,00	8,90	5,93	3,70
winding inductance Lq phase-phase	L_q	mH	61,40	34,80	21,60	8,43	5,90

7.0 Electrical data Δ-circuit

	Symbol	Unit	Size				
			80L	90LL	112M	132M	160L
Rated power (S1)	P	kW	5,2	11,3	18,9	32,0	54,0
Rated speed	n	rpm	4000				
Rated frequency	f	Hz	200				
Rated torque	M	Nm	12,5	27,0	45,3	76,4	129,5
Rated voltage	U	V	360	343	342	387	386
Rated current	I	A	9,9	19,8	34,6	58,8	101,0
Supply voltage (frequency converter)	U_{AC}	V	400				
Number of poles	p		6				
Switching frequency	f	kHz	4				
Voltage constant (effective value)	K_E	V/1000rpm	85	82,5	76,5	91	85
Torque constant	K_T	Nm/A	1,41	1,37	1,27	1,51	1,41
RMS value pure sine	η	%	97,2	97,3	98,2	98,1	95,1
RMS value with frequency converter	η	%	93,6	94,0	95,2	95,1	94,4
maximum speed	nmax	Rpm	4500	4800	5000	4300	4500
maximum torque	Mmax	Nm	25,0	54,0	90,6	152,8	259,0
maximum current at Mmax	Imax	A	19,5	41,0	78,5	111,3	203,0
winding resistance phase-phase	R_{pp}	Ω	1,10	0,46	0,19	0,12	0,038
winding inductance phase-phase	L_{ipp}	mH	15,00	7,90	5,00	2,21	1,50
winding inductance Ld phase-phase	L_d	mH	8,00	4,07	2,90	1,72	1,10
winding inductance Lq phase-phase	L_q	mH	21,90	11,90	7,00	2,71	1,80

8.0 Nameplate



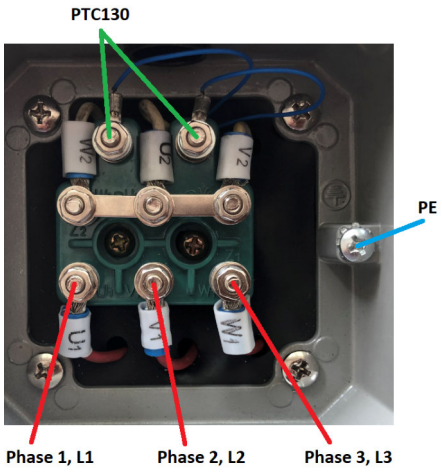
CON	P[kW]	n[rpm]	M[Nm]	U[Vrms]	I[A]	η[%]	EMF
Y	3,0	2300	12,5	363	5,9	93,5	147
Δ	5,2	4000	12,5	360	9,9	93,6	85

- **IE4/IE5** — IE4 Efficiency according to IEC/EN 60034-30-2, standard for variable speed motors fed by frequency inverters
  IE5 Efficiency according to VDE 0530-30-2 at the nameplate is possible on customer request for motor size 80, 90 and 112
- **CE** — Proof of conformity
- **IEC 60034-1** — Standard: Rotating electrical machines Part 1, Design and operational behavior
- **3~Mot.** — Machine with three motor phases
- **MPM 80L-PFP-000-B35** — Type designation
- **N° 12345.1** — Serial number
- **-01/21** — Production week and year
- **CON** — Type of motor connection
- **Y** — this line contains the values for the motor connection in star connection
- **Δ** — this line contains the values for the motor connection in delta connection
- **P[kW]** — Output shaft power at rated speed in kilowatts
- **n[rpm]** — Rated speed in revolutions per minute
- **M[Nm]** — Nominal torque in newton meters
- **U[Vrms]** — Rated voltage at rated speed in volts (rms = root main square, effective value)
- **I[A]** — Rated current in amps
- **η[%]** — Efficiency in percent
- **EMF** — EMF (electromagnetic force) in volts, effective value per 1000 revolutions per minute
- **P=6** — Number of poles
- **IM B3** — Design
- **80L** — Housing size (axis height) and length
- **IP55** — Protection class
- **I.CL.F** — Insulation class F
- **12,6kg** — Weight
-  — Disposal note, do not dispose of in household waste

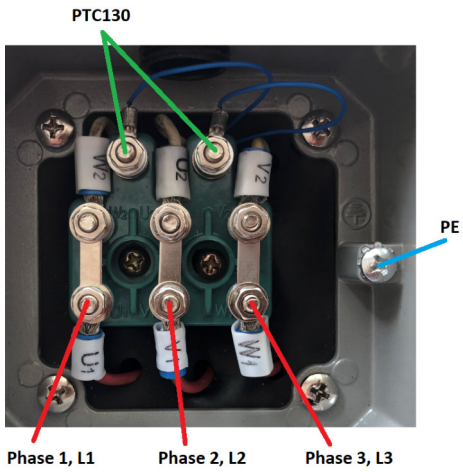
9.0 Electrical connection

- Even if no voltage has been applied, voltages can occur at the motor terminals of rotating machines with permanent magnets. Check and ensure that the machine is at a standstill before working on it.
- Motors of the MPM series are not intended for direct connection to the three-phase supply system, they must be operated via a frequency inverter with the "sensorless vector control" functionality. Failure to observe this may result in destruction of the machine.
- For the parameters required for operation, refer to the nameplate data in the manual or the data sheet.
- Check the assignment of frequency inverter and motor. Compare rated voltage and rated current of the devices, this should match each other and fit the application.
- The terminal box can be rotated 90°/180°/270°, according to the requirements.
- The machine is grounded via the PE connection provided for this purpose in the terminal box.
- The shielding of the machine must be carried out according to the frequency inverter operating instructions. If necessary, use low-capacitance, shielded cables and EMC cable glands.
- The connecting cable must be intercepted via the strain relief of the cable gland.
- Make sure that no contamination (remains of insulation, shielding, wire, etc.) remains in the terminal box.
- Connect the motor in Y-connection or Δ-delta connection according to the requirements.

Y-connection



Δ-delta connection

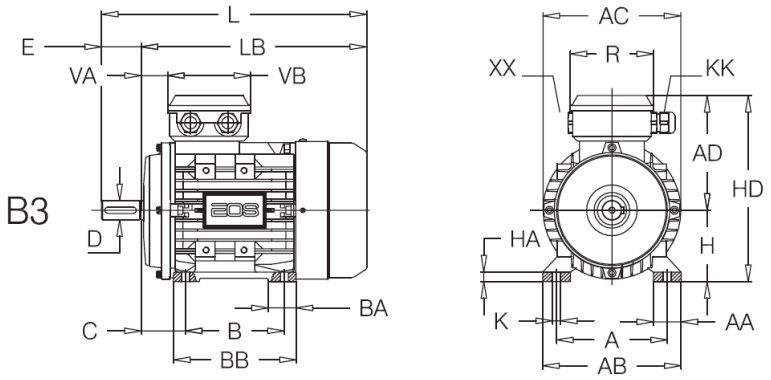


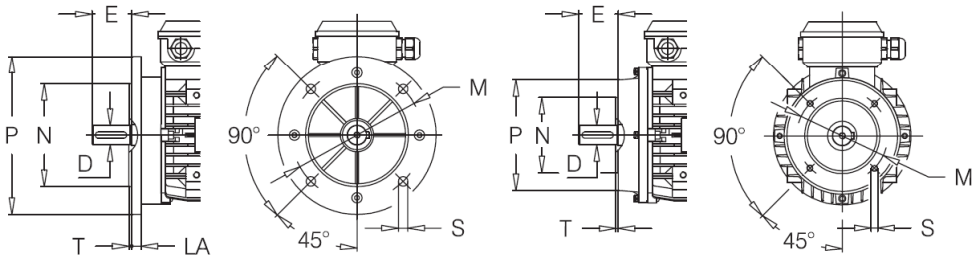
10.0 Thermal protection

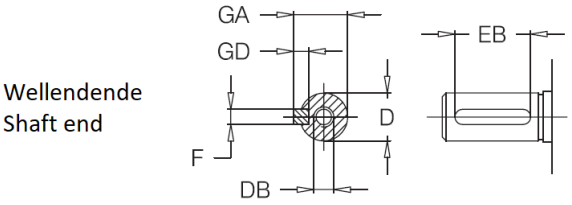
A PTC130 is provided as standard for the motor as a temperature protection. This must be connected to the terminals provided for this purpose. No polarity is to be observed. Alternatively, other temperature sensors can also be used. In this case, please observe the enclosed connection documents.

11.0 Dimensions

Motor size	Terminal box				
	VA	VB	R	XX	KK
80L	27,5	105	105	M20	M20
90LL	32	105	105	M25	M25
112M	32	112	119	M25	M25
132M	37	112	119	M32	M32
160L	65	143	146	M40	M40 +M16



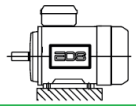
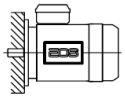
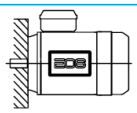
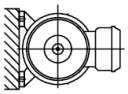
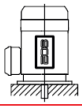
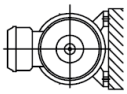
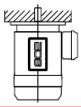
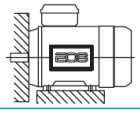
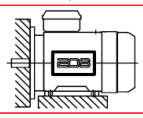
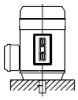
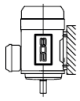
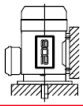
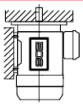




Motor size	Dimensions						Feet								
	AC	AD	H	HD	LB	L	A	B	C	AB	BB	AA	BA	HA	K
80L	157	135	80	215	254	294	125	100	50	160	130	35	35	11	10x13
90LL	174	143	90	233	283	333	140	125	56	175	155	35	33	12	10x13
112M	221	174	112	286	334	394	190	140	70	220	180	55	42	15	12x15
132M	258	193	132	325	390	470	216	178	89	252	212	58	40	15	13x16
160L	314	235	160	395	530	640	254	254	108	291	293	54	90	17	16x20

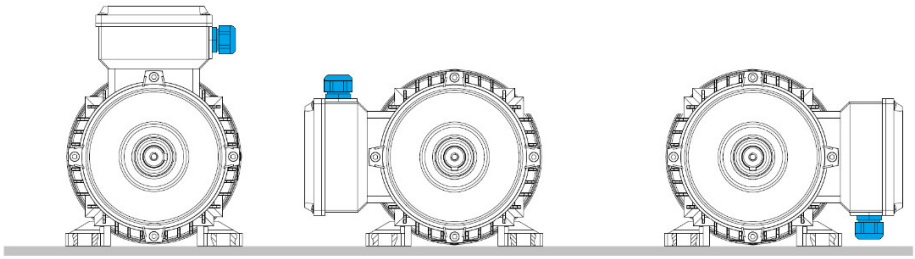
Motor size	Flange							Shaft						
	IM	M	Nj6	p	LA	T	S	D	DB	E	GA	F	GD	EB
80L	B5 B14	165 100	130 80	200 120	10 -	3,5 3	12 M6	19 j6	M6	40	21,5	6	6	32
90LL	B5 B14	165 115	130 95	200 140	12 -	3,5 3	12 M8	24 j6	M8	50	27	8	7	40
112M	B5 B14	215 130	180 110	250 160	14 -	4 3,5	15 M8	28 j6	M10	60	31	8	7	50
132M	B5 B14	265 165	230 130	300 200	14 -	4 3,5	15 M10	38 k6	M12	80	41	10	8	70
160L	B5 B14	300 215	250 180	350 250	15 -	5 4	15 M12	42 k6	M16	100	45	12	8	90

12.0 Mounting positions

IM B3 IM 1001		IM B5 IM 3001		IM B14 IM 3601	
IM B6 IM 1051		IM V1 IM 3011		IM V19 IM 3631	
IM B7 IM1061		IM V3 IM 3031		IM B34 IM 2101	
IM B8 IM 1071		IM B35 IM 2001		IM V18 IM 3611	
IM V5 IM 1011		IM V15 IM 2011			
IM V6 IM 1031		IM V36 IM 2031			

12.1 Position of the terminal box with a view of the shaft

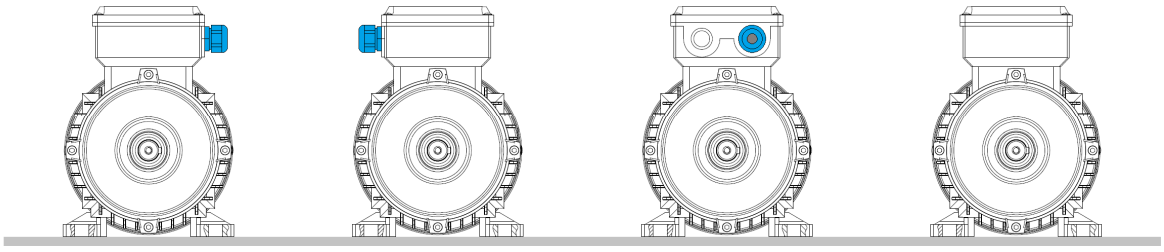
(standard) L (left) R (right)



If the terminal box position is not specified, the motor is supplied with the terminal box on top (standard).

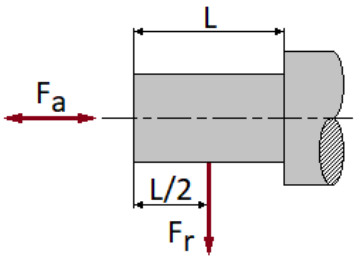
12.2 Cable outlet with view of the shaft

R (right) L (left) A (to the shaft) B (to the fan cover)



If the cable outlet is not specified, the motor is supplied with R (right).

13.0 Permissible bearing forces



F_r max [N] (L/2)

Motor size	F_r max [N] (L/2) n [rpm]			
	1500	2300	3000	4000
80L	1120	970	880	800
90LL	1210	1040	960	870
112M	2280	1970	1810	1640
132M	2600	2220	2060	1870
160L	3540	3070	2810	2550

F_a max [N] for horizontal motor installation

Motor size	n [rpm]					
	750	1000	1500	3000	4000	5000
80L	980	867	732	553	---	525
90LL	1048	927	788	593	---	561
112M	1780	1547	1265	880	975	
132M	2240	1993	1677	1273		
160L	2450	2090	2100	1910		

F_a max [N] for vertical motor installation

Motor size	n [rpm]					
	750	1000	1500	3000	4000	5000
80L	985	878	743	562	---	532
90LL	1060	943	800	605	---	571
112M	1795	1563	1276	890	985	
132M	2274	2022	1720	1293		
160L	2500	2127	2130	1920		

13.1 Built-in bearings

All bearings are lubricated for life. The bearings of the A and B sides are identical. The service life is at least 20.000 hours. For longer service lives, the maximum permissible bearing forces must be reduced.

By a factor of 0.87 for a service life of 30.000 hours.
By a factor of 0.79 for a service life of 40.000 hours.
By a factor of 0.74 for a service life of 50.000 hours.

The permissible operating temperature is -15°C ... 110°C.

Motor size	Bearing A- and B-side	dimensions [mm]	Oil seal (optional) [mm]
80L	6204-ZZ-C3	47 x 20 x 14	35 x 20 x 7
90LL	6205-ZZ-C3	52 x 25 x 15	37 x 25 x 7
112M	6206-ZZ-C3	72 x 30 x 19	44 x 30 x 7
132M	6208-ZZ-C3	90 x 40 x 23	58 x 40 x 8
160L	6209-ZZ-C3	100 x 45 x 25	65 x 45 x 8

14.0 Balancing method

The MPM motors are dynamically balanced with half key according to DIN EN 600034-14 (VDE 0530-14) and achieve vibration magnitude level B.

15.0 Weight [kg]

Motor size	B3	B14	B5	B34	B35
80L	12,6	12,4	12,7	12,6	13
90LL	18,6	18,3	18,7	18,6	18,9
112M	34,7	34,5	35,1	35,1	35,5
132M	55	54,9	56	55	56,1
160L	98	102,6	99,5	102,8	99,6

16.0 Mass inertia [kgcm²]

Motor size	J
80L	40,5
90LL	75
112M	248,6
132M	449
160L	1160

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