

# Series PMSM of synchronous motors with permanent magnets for industrial applications

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1. Introduction of PulnikovEC
2. Overview of the developed series of synchronous motors with permanent magnets (PMSM series)
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# 1. Introduction of PulnikovEC

PulnikovEC is a team of experts in:

- Design and development of electrical machines
- CFD, FEA and mathematical modelling
- Composite materials and containment technologies
- CAD
- Development of technical documentation

## 2. Overview of the developed PMSM series

Motors of the PMSM series are designed to comply with the same standards as conventional asynchronous motors



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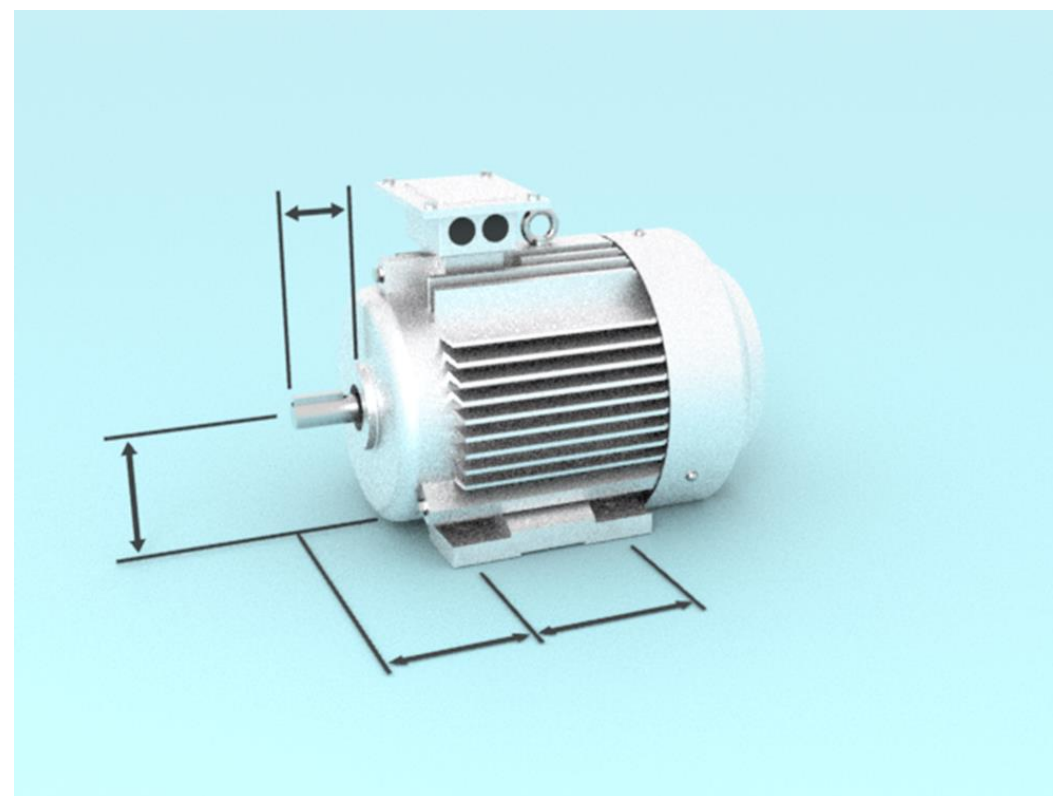
- 1) standard power supply;



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Motors of the PMSM series are designed to comply with the same standards as conventional asynchronous motors:

- 1) standard power supply;
- 2) standard axis height;



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- 4) standard rating (IP54);

Ingress  
Protection



**IP 54**



Dust    Splashing  
Protected    Water

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- 1) standard power supply;
- 2) standard axis height;
- 3) standard mounting;
- 4) standard rating (IP54);
- 5) standard output power;

Output power [kW]

0.04

0.06

0.09

0.12

0.18

0.25

0.37

0.55

0.75

1.1

1.5

2.2

3

4

5.5

7.5

11

15

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- 1) standard power supply;
- 2) standard axis height;
- 3) standard mounting;
- 4) standard rating (IP54);
- 5) standard output power;
- 6) standard rotation speed;

Rotation speed [rpm]

1500

3000

6000

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- 1) standard power supply;
- 2) standard axis height;
- 3) standard mounting;
- 4) standard rating (IP54);
- 5) standard output power;
- 6) standard rotation speed;
- 7) suitable for standard vector control (same as for synchronous or asynchronous motors).



## 2. Overview of the developed PMSM series

Main qualities of the motors of SM series:

1) RECORD HIGH EFFICIENCY;

SM series: IE6..IE9 efficiency class

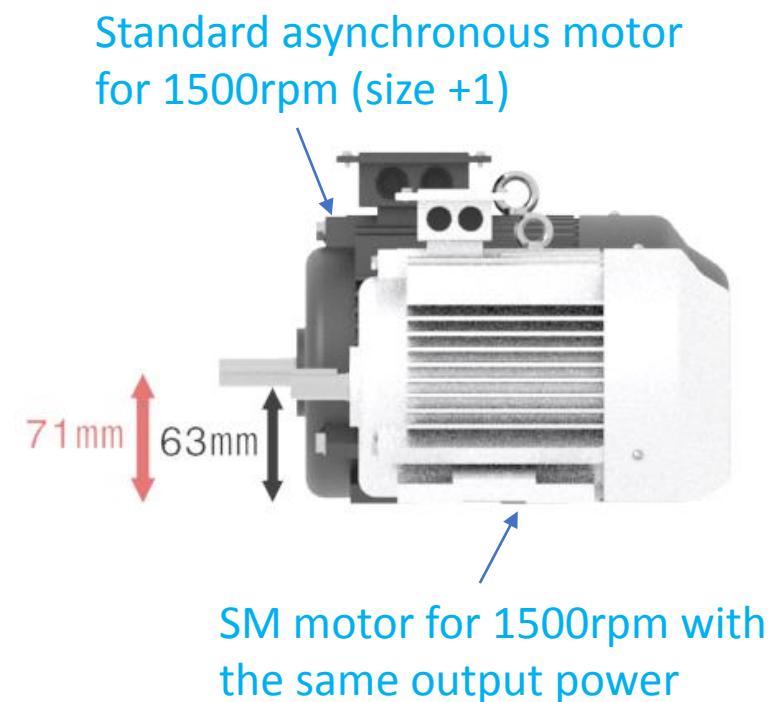
Competition: IE4..IE5 efficiency class



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Main qualities of the motors of PMSM series:

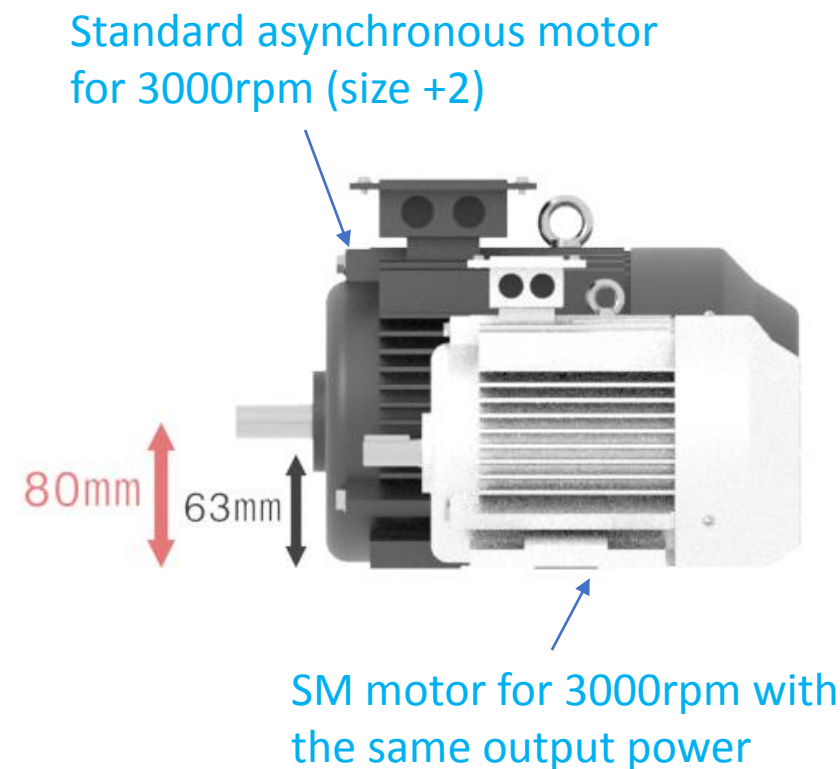
- 1) RECORD HIGH EFFICIENCY;
- 2) COMPACTNESS



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Main qualities of the motors of PMSM series:

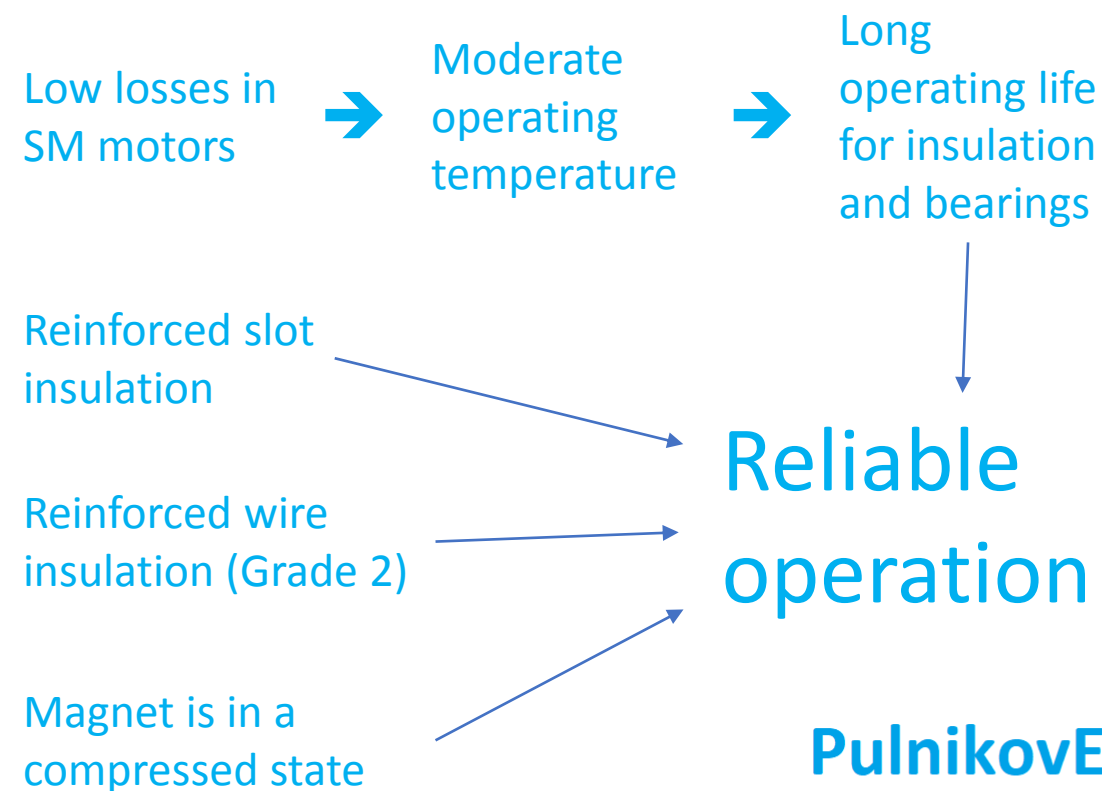
- 1) RECORD HIGH EFFICIENCY;
- 2) COMPACTNESS



## 2. Overview of the developed PMSM series

Main qualities of the motors of PMSM series:

- 1) RECORD HIGH EFFICIENCY;
- 2) COMPACTNESS;
- 3) RELIABILITY





## 2. Overview of the developed PMSM series

**n = 1500 rpm, U = 400 V, NdFeB, compressing molded**

hax, mm	P2, kW	Torque, Nm	Efficiency, r.u.	Kt, Nm/A	R phph, Ohm	Ua, V	Ia, A
<b>IE9</b>							
45	0.04	0.25	0.830	2.946	77.786	222	0.064
50	0.06	0.38	0.849	2.890	53.352	218	0.098
50	0.09	0.57	0.883	2.900	53.352	219	0.147
56	0.12	0.76	0.883	2.922	27.435	220	0.194
56	0.18	1.15	0.907	2.922	27.435	221	0.290
<b>IE8</b>							
63	0.25	1.59	0.908	2.925	15.557	222	0.40
63	0.37	2.36	0.923	2.925	15.557	223	0.60
71	0.55	3.50	0.930	2.894	6.914	220	0.90
71	0.75	4.77	0.937	2.894	6.914	221	1.22
<b>IE7</b>							
80	1.1	7.00	0.939	2.872	4.064	220	1.8
80	1.5	9.55	0.942	2.872	4.064	222	2.5
90	2.2	14.01	0.946	2.869	2.296	222	3.6
<b>IE6</b>							
90	3	19.10	0.944	2.869	2.296	224	4.9
100	4	25.46	0.951	2.829	1.239	218	6.7
112	5.5	35.01	0.956	2.813	0.688	217	9.2
112	7.5	47.75	0.954	2.813	0.688	219	12.6
132	11	70.03	0.963	2.867	0.286	220	18.1
132	15	95.49	0.961	2.867	0.286	223	24.7

## 2. Overview of the developed PMSM series

**n = 3000 rpm, U = 400 V, NdFeB, compressing molded**

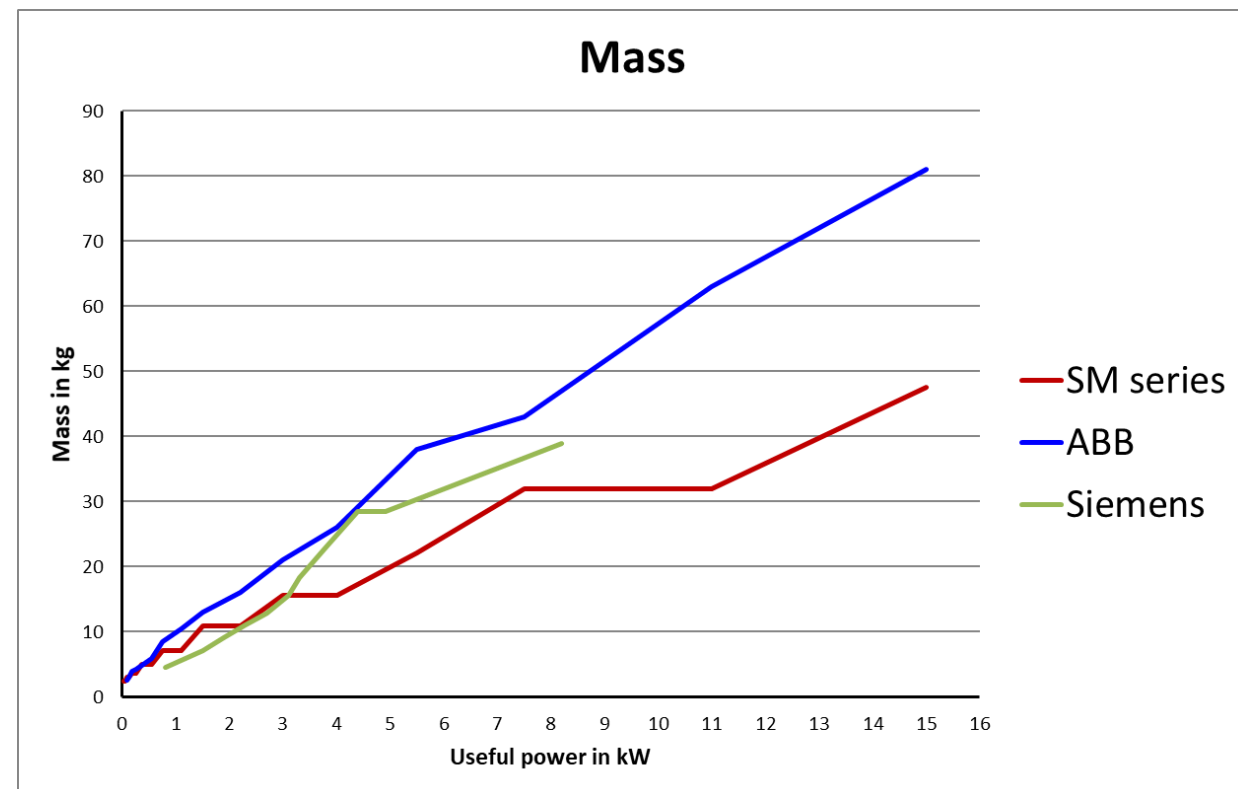
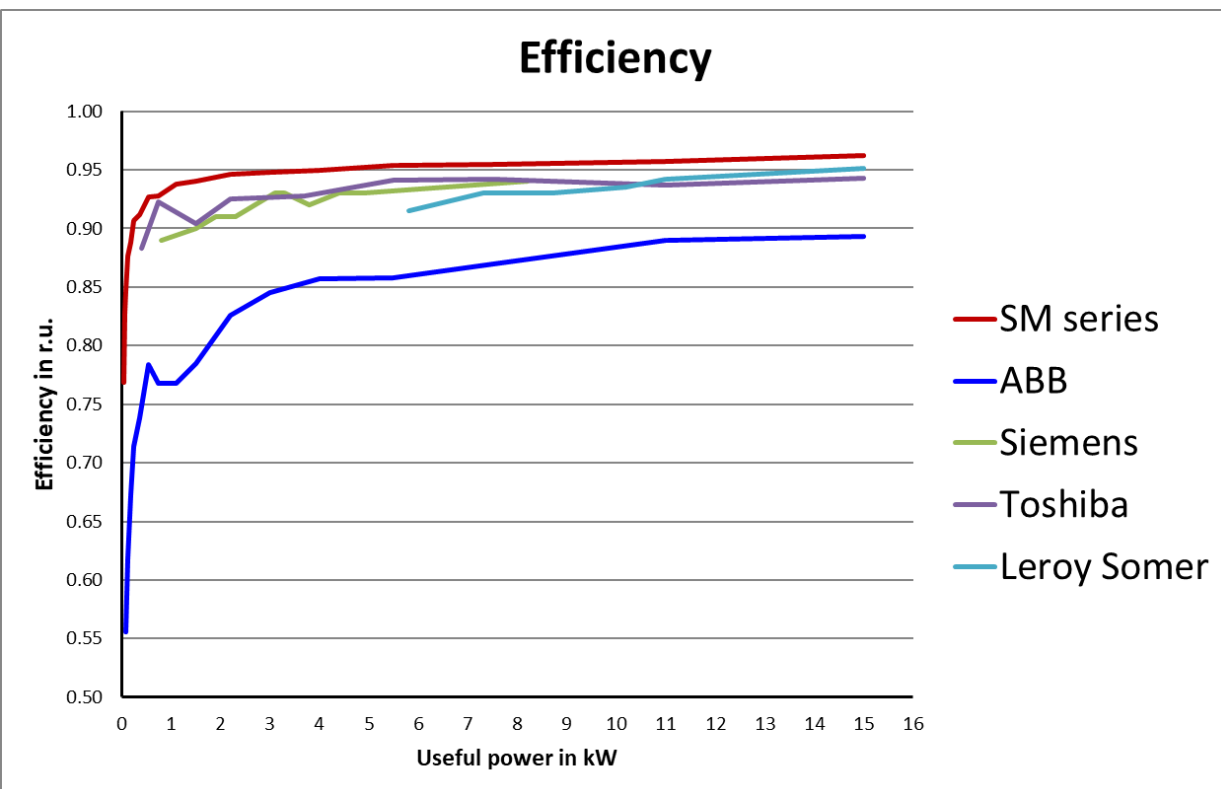
hax, mm	P2, kW	Torque, Nm	Efficiency, r.u.	Kt, Nm/A	R phph, Ohm	Ua, V	Ia, A
<b>IE8</b>							
40	0.04	0.13	0.769	1.209	29.71	181	0.078
40	0.06	0.19	0.828	1.209	29.71	181	0.117
<b>IE9</b>							
45	0.09	0.29	0.847	1.210	16.65	182	0.18
45	0.12	0.38	0.876	1.210	16.65	182	0.23
50	0.18	0.57	0.888	1.224	13.28	185	0.35
50	0.25	0.80	0.907	1.224	13.28	186	0.48
<b>IE8</b>							
56	0.37	1.18	0.912	1.219	6.72	185	0.72
56	0.55	1.75	0.927	1.219	6.72	187	1.06
63	0.75	2.39	0.928	1.244	3.32	190	1.42
63	1.1	3.50	0.938	1.244	3.32	193	2.08
71	1.5	4.77	0.940	1.256	1.67	194	2.82
<b>IE7</b>							
71	2.2	7.00	0.946	1.256	1.67	197	4.13
80	3	9.55	0.948	1.257	0.922	196	5.6
80	4	12.73	0.950	1.257	0.922	200	7.5
90	5.5	17.51	0.954	1.273	0.425	200	10.2
<b>IE6</b>							
100	7.5	23.87	0.955	1.322	0.308	210	13.4
100	11	35.01	0.957	1.322	0.308	216	19.6
112	15	47.75	0.962	1.332	0.161	211	26.5

## 2. Overview of the developed PMSM series

**n = 6000 rpm, U = 400 V, sintered Ferrite**

hax, mm	P2, kW	Torque, Nm	Efficiency, r.u.	Kt, Nm/A	R phph, Ohm	Ua, V	Ia, A
<b>IE6</b>							
40	0.09	0.14	0.723	0.689	23.83	206	0.154
40	0.12	0.19	0.773	0.689	23.83	207	0.205
<b>IE7</b>							
45	0.18	0.29	0.822	0.665	13.74	200	0.319
45	0.25	0.40	0.858	0.665	13.74	202	0.443
50	0.37	0.59	0.881	0.643	9.24	196	0.678
50	0.55	0.88	0.902	0.643	9.24	201	1.01
56	0.75	1.19	0.916	0.671	5.40	208	1.32
56	1.1	1.75	0.924	0.671	5.40	216	1.93
63	1.5	2.39	0.934	0.665	2.65	201	2.66
63	2.2	3.50	0.936	0.665	2.65	203	3.90
<b>IE6</b>							
71	3	4.77	0.947	6.350	1.22	216	5.61
71	4	6.37	0.945	6.350	1.22	227	7.48
80	5.5	8.75	0.954	0.630	0.598	222	10.3
80	7.5	11.94	0.950	0.630	0.598	237	14.0
90	11	17.51	0.958	0.651	0.349	231	19.6
100	15	23.87	0.962	0.674	0.195	234	26.2
100	18.5	29.44	0.960	0.674	0.195	249	32.3
112	22	35.01	0.966	0.675	0.104	228	38.4
112	30	47.75	0.964	0.675	0.104	249	52.4

# 3. Comparison of PMSM series with series present on the market



3000 rpm

## 3. Conclusion on PMSM series

1. Most efficient
2. Most compact
3. Unique solution
4. Proven technology
5. Documentation is available
6. This series could be extended to higher powers and other rotation speeds