



# Energy-saving permanent-magnet synchronous motors

Design version for  
Super Premium Efficiency IE4\*

SENSE EXPERIENCE  
EXPERIENCE VISION





# Energy-saving permanent-magnet synchronous motors

## Design version for Super Premium Efficiency IE4\*

High-efficiency drives for pumps and fans

### Economy and ecology

High-efficiency energy-saving motors from VEM

- › reduce power consumption
- › help cut energy costs
- › comply with the statutory regulations of the European Union
- › spare natural resources thanks to their high energy efficiency.

EC regulation 640/2009 currently requires three-phase motors in 2-, 4- and 6-pole designs for the output range 0.75 to 375 kW to attain the efficiency of asynchronous motors of efficiency class IE2 “High Efficiency”. From 2015, the requirements stipulated in EU law will be tightened to IE3 “Premium Efficiency” for the output range 7.5 to 375 kW.

IE3 will not be prescribed as the minimum efficiency for the whole output range until 01.01.2017.

Efficiency class IE4 “Super Premium Efficiency” is presently still at the draft stage. The limit values specified in IEC 2/1679/CDV (IEC 60034-30-1:2012-09) and the regulations on efficiency measurement (IEC 2/1696/DTS (IEC/TS 60034-2-3:2013-01)) are thus subject to change in the course of the standardisation process.

The series IE4-PE.R applies the requirements of this future efficiency class to permanent-magnet synchronous motors.

### Design concept

The new series IE4-PE.R establishes a drive system based on permanent-magnet synchronous motors, taking up the mechanical design of the proven series IE2-WE.R. In contrast to the previous low-voltage asynchronous machine, the rotor excitation is realised not by the current flowing through the rotor windings, but instead with permanent magnets attached to the surface of the rotor. This design achieves a significantly higher motor efficiency, as rotor losses are eliminated. The use of high-quality permanent magnets renders rotor windings and brush systems superfluous. The result is a robust, low-maintenance design. Different cooling systems from the modular VEM product range permit tailoring to the particular field of application.

### Speed and torque ranges

The motors are designed exclusively for converter-fed operation and for variable speeds up to 3000 rpm. The possible overload is defined by the fundamental terminal voltage inherent to the motor design, and by the maximum possible voltage rise of the frequency converter; it lies between 1.3 and 1.6.

\* Motors of the VEM series PE.R meet the requirements of efficiency class IE4\* in accordance with draft regulation IEC 2/1679/CDV (IEC 60034-30-1:2012-09).

In all branches in which high-efficiency pumps and fans are used, energy-saving permanent-magnet synchronous motors of the class Super Premium Efficiency IE4 are the ideal choice as drives. They are designed exclusively for operation with a frequency converter.

<b>Series</b>	<b>IE4-PE.R and IE4-PE.F (mounting dimensions acc. to DIN EN 50347)</b>
Sizes	63 to 315
Efficiency class	IE4*
	acc. to IEC 2/1679/CDV (IEC 60034-30-1:2012-09), IEC/TS 60034-31:2010 and IEC 2/1696/DTS (IEC/TS 60034-2-3:2013-01)
Degree of protection	IP 55 acc. to DIN EN 60034-5, optionally IP 56 and IP 65
Type of construction	IM B3, IM B35, IM B5 and derived types acc. to DIN EN 60034-7
Torque range	0.4 to 1592 Nm
Type of cooling	IC 411, version IE4-PE.R IC 416, version IE4-PE.F
Synchronous speeds	3000, 1500, 1000 and 750 rpm, 4-pole 50 Hz and 100 Hz, 6-pole and 8-pole

Please refer to our catalogues for technical details. The catalogues are available in printed or in digital version on CD-ROM. They are also available in the internet.



## Energy-saving permanent-magnet synchronous motors for converter-fed operation

efficiency class IE4\* acc. to IEC 2/1679/CDV (IEC 60034-30-1:2012-09),  
IEC/TS 60034-31:2010, and IEC 2/1696/DTS (IEC/TS 60034-2-3:2013-01),  
with surface cooling, type IC 411,  
thermal class 155[F/B], degree of protection IP 55

**Motor selection data**

Converter input voltage 400 V, 50 Hz

		Rated output	Torque	Max. torque (2 min)	Voltage	Limit value IE4*	Efficiency	Power factor	Rated current	Phase resistance at 20 °C	No-load voltage at speed 1000 rpm	Main inductance	Leakage inductance	Main reactance	Leakage reactance	Motor inertia	Motor mass	
		[kW]	[Nm]		[V]	[%]	100 %	[-]	[A]	R <sub>120</sub> [Ω]	U <sub>P020</sub> [V/1000 rpm]	L <sub>1H</sub> [mH]	L <sub>1σ</sub> [mH]	X <sub>1H</sub> [Ω]	X <sub>1σ</sub> [Ω]	J	m	
		[Nm]	[V]	[%]	100 %	[-]	[A]	[Ω]	[V/1000 rpm]	[mH]	[mH]	[Ω]	[Ω]	kgm <sup>2</sup>	kg			
<b>Speed 3000 rpm – Rated frequency 50 Hz</b>																		
IE4-PE2R	63	K4	0.12	0.4	2.5	330	66.5	80	0.99	0.3	32	100	60	28	37.7	17.59	0.00019	4.8
IE4-PE2R	63	K4	0.18	0.6	2.5	335	70.8	80	0.99	0.35	32	100	60	28	37.7	17.59	0.00019	4.8
IE4-PE2R	63	G4	0.25	0.8	3.5	320	74.3	81.5	0.99	0.5	18	105	42	18	26.39	11.31	0.00024	5.2
IE4-PE2R	71	K4	0.37	1.2	4	320	78.1	83.2	0.99	0.81	13.5	100	37	15	23.25	9.42	0.00040	6.8
IE4-PE2R	71	G4	0.55	1.8	7	330	81.5	81.5	0.99	1.23	8.7	105	30	10	18.85	6.28	0.00050	7.8
IE4-PE2R	80	K4	0.75	2.4	10	335	83.5	84.2	0.99	1.55	4.5	110	25	8	15.71	5.03	0.00087	10.6
IE4-PE2R	80	G4	1.1	3.5	14	330	85.2	86.4	0.99	2.25	2.8	105	18	5	11.31	3.14	0.00107	11.7
IE4-PE2R	90	S4	1.5	4.8	19	310	86.5	86.8	0.99	3.25	1.7	105	9.5	2.5	5.969	1.57	0.00207	15.5
IE4-PE2R	90	L4	2.2	7	28	280	88.0	88.1	0.99	5.20	0.8	90	5	1	3.142	0.63	0.00260	18.0
IE4-PE2R	100	L4	3.0	9.5	45	320	89.1	92.7	0.99	5.90	0.6	100	4.7	1.3	2.953	0.82	0.00400	23.5
IE4-PE2R	112	MY4	4.0	12.7	50	330	90.0	91.2	0.99	7.75	0.4	110	3.2	0.8	2.011	0.50	0.00725	30.0
IE4-PE2R	132	SY4T	5.5	17.5	85	310	90.9	92.3	1.00	11.10	0.25	110	2	0.5	1.257	0.31	0.009	37
IE4-PE2R	132	S4T	7.5	23.9	100	305	91.7	92.8	1.00	15.30	0.2	105	1.2	0.3	0.754	0.19	0.011	45
IE4-PE1R	132	M4	11.0	35	44	344	92.6	92.6	1.00	19.9	0.1170	121	2.280	0.960	1.432	0.603	0.022	72
IE4-PE1R	132	M4	15.0	48	60	347	93.3	93.4	1.00	26.7	0.1170	121	2.280	0.960	1.432	0.603	0.022	72
IE4-PE1R	160	M4	18.5	59	74	350	93.7	93.8	1.00	32.6	0.0690	116	1.660	0.630	1.042	0.396	0.031	92
IE4-PE1R	160	L4	18.5	59	74	372	93.7	93.9	0.99	31.0	0.0480	121	1.576	0.526	0.990	0.330	0.062	121
IE4-PE1R	180	M4	22.0	70	88	346	94.0	94.0	1.00	39.1	0.0410	123	1.350	0.460	0.848	0.289	0.079	135
IE4-PE1R	180	M4	30.0	96	120	347	94.5	94.5	0.99	53.4	0.0410	123	1.350	0.460	0.848	0.289	0.079	135
IE4-PE1R	180	L4	30.0	96	119	362	94.5	94.7	0.98	51.7	0.0270	116	1.150	0.360	0.722	0.226	0.116	170
IE4-PE1R	200	L4	37.0	118	147	365	94.8	95	0.98	63.0	0.0180	118	0.901	0.257	0.566	0.161	0.150	200
IE4-PE1R	225	S4	45.0	143	179	365	95.0	95.1	0.98	76.5	0.0110	118	0.725	0.198	0.455	0.124	0.251	270
IE4-PE1R	225	M4	55.0	175	219	355	95.3	95.4	0.98	95.8	0.0091	115	0.587	0.153	0.369	0.096	0.288	300
IE4-PE1R	250	M4	75.0	239	298	369	95.6	95.7	0.97	126.5	0.0073	118	0.543	0.144	0.341	0.090	0.457	375
IE4-PE1R	250	M4	90.0	287	358	374	95.8	96	0.96	151.1	0.0073	118	0.543	0.145	0.341	0.091	0.457	375
IE4-PE1R	280	S4	110.0	350	438	363	96.0	96.1	0.96	189.8	0.0045	115	0.420	0.111	0.264	0.070	0.864	520
IE4-PE1R	280	S4	132.0	420	525	370	96.2	96.4	0.94	227.8	0.0045	115	0.420	0.111	0.264	0.070	0.864	520
IE4-PE1R	280	M4	160.0	509	637	380	96.3	96.5	0.94	268.5	0.0037	118	0.373	0.085	0.234	0.053	1.011	580
IE4-PE1R	315	MX4	200.0	637	796	360	96.5	96.9	0.98	339.2	0.0019	117	0.152	0.038	0.095	0.024	1.556	980
IE4-PE1R	315	MY4	250.0	796	995	380	96.5	97.1	0.97	405.8	0.0018	123	0.161	0.036	0.101	0.023	2.499	1170
Upon request			>250				96.5											
<b>Speed 1500 rpm – Rated frequency 50 Hz</b>																		
IE4-PE2R	63	K4	0.12	0.8	2.5	310	69.8	76.0	0.98	0.3	95	170	160	80	50.3	25.13	0.00019	4.8
IE4-PE2R	63	G4	0.18	1.1	3.5	310	74.7	85.5	0.98	0.4	57	180	130	60	40.8	18.85	0.00024	5.2
IE4-PE2R	71	K4	0.25	1.6	10	290	77.9	78.6	0.99	0.64	14.5	190	76	24	23.9	7.54	0.00087	9.9
IE4-PE2R	71	G4	0.37	2.4	14	305	81.1	86.3	0.99	0.82	9.5	195	61	19	19.2	5.97	0.00107	11.0
IE4-PE2R	80	K4	0.55	3.5	14	315	83.9	84.9	0.99	1.20	9.5	195	61	19	19.2	5.97	0.00107	11.7
IE4-PE2R	80	G4	0.75	4.8	19	305	85.7	86.9	0.99	1.65	6	195	36	9	11.3	2.83	0.00207	14.5
IE4-PE2R	90	S4	1.1	7	28	300	87.2	88.0	0.99	2.43	3.4	190	24.5	5.5	7.7	1.73	0.00260	18.0
IE4-PE2R	90	L4	1.5	9.5	28	305	88.2	88.3	0.99	3.25	3.4	190	24.5	5.5	7.7	1.73	0.00260	18.0
IE4-PE2R	100	L4	2.2	14	45	315	89.5	90.5	0.99	4.5	2.1	195	15.5	4.5	4.9	1.41	0.00400	23.5
IE4-PE2R	100	LX4	3.0	19.1	50	335	90.4	91.6	0.99	5.7	1.5	215	16.0	4.0	5.0	1.26	0.00725	30.0
IE4-PE2R	112	M4	4.0	25.5	70	320	91.1	92.3	0.99	7.9	0.9	205	10.5	2.5	3.3	0.79	0.009	37.0
IE4-PE2R	112	MX4	5.5	35	100	325	91.9	93.1	0.99	10.6	0.65	210	8.2	1.8	2.6	0.57	0.011	45.0
IE4-PE1R	132	M4	7.5	48	60	362	92.6	93.5	0.99	13.0	0.4290	232	8.379	3.486	2.631	1.095	0.022	70
IE4-PE1R	160	M4	11.0	70	88	362	93.3	94.1	0.99	19.0	0.2510	235	5.847	2.227	1.836	0.699	0.031	92
IE4-PE1R	160	L4	15.0	96	119	357	93.9	94.3	0.98	26.4	0.1250	229	3.717	1.306	1.167	0.410	0.068	120
IE4-PE1R	180	M4	18.5	118	147	364	94.2	94.8	0.98	31.8	0.1340	233	5.101	1.613	1.602	0.506	0.073	136
IE4-PE1R	180	L4	22.0	140	175	354	94.5	95	0.98	38.7	0.0720	226	2.840	0.937	0.892	0.294	0.126	170
IE4-PE1R	200	L4	30.0	191	239	360	94.9	95.3	0.98	51.7	0.0510	230	2.210	0.675	0.694	0.212	0.162	220
IE4-PE1R	225	S4	37.0	236	294	355	95.2	95.5	0.97	65.2	0.0290	228	1.800	0.531	0.565	0.167	0.269	270
IE4-PE1R	225	M4	45.0	287	358	363	95.4	95.7	0.98	76.6	0.0240	233	1.603	0.450	0.503	0.141	0.308	300
IE4-PE1R	250	M4	55.0	350	438	355	95.7	95.8	0.97	96.4	0.0170	228	1.231	0.347	0.387	0.109	0.492	375
IE4-PE1R	250	M4	75.0	478	597	366	96.0	96.1	0.98	125.8	0.0170	237	1.319	0.369	0.414	0.116	0.492	375
IE4-PE1R	280	S4	90.0	573	716	369	96.1	96.3	0.98	149.5	0.0120	239	1.176	0.283	0.369	0.089	0.911	520
IE4-PE1R	280	M4	110.0	700	875	359	96.3	96.4	0.96	191.4	0.0088	229	0.897	0.207	0.282	0.065	1.065	580
IE4-PE1R	280	M4	132.0	840	1051	373	96.4	96.5	0.98	216.3	0.0099	243	0.848	0.250	0.266	0.079	1.089	580
IE4-PE1R	315	S4	160.0	1019	1273	356	96.6	96.8	0.95	282.8	0.0060	224	0.727	0.155	0.228	0.049	1.750	740
IE4-PE1R	315	MX4	200.0	1273	1592	366	96.7	96.9	0.98	332.9	0.0044	239	0.484	0.114	0.152	0.036	2.350	1000
IE4-PE1R	315	MY4	250.0	1592	1990	372	96.7	97	0.96	418.0	0.0035	236	0.389	0.078	0.122	0.024	4.224	1200
Upon request			>250				96.7											

The maximum speed is dependent on the converter link voltage, load and converter type.  
Parameters with index 1: Phase values  
Subject to change in the course of technical further development



## Energy-saving permanent-magnet synchronous motors for converter-fed operation

efficiency class IE4\* acc. to IEC 2/1679/CDV (IEC 60034-30-1:2012-09),  
IEC/TS 60034-31:2010, and IEC 2/1696/DTS (IEC/TS 60034-2-3:2013-01),  
with surface cooling, type IC 411,  
thermal class 155[F/B], degree of protection IP 55

**Motor selection data**

Converter input voltage 400 V, 50 Hz

		Rated output	Torque	Max. torque (2 min)	Voltage	Limit value IE4*	Efficiency	Power factor	Rated current	Phase resistance at 20 °C	No-load voltage at speed 1000 rpm	Main inductance	Leakage inductance	Main reactance	Leakage reactance	Motor inertia	Motor mass	
		[kW]	[Nm]		[V]	[%]	[%]	[-]	[A]	$R_{120}$	$U_{P020}$	$L_{1H}$	$L_{1\sigma}$	$X_{1H}$	$X_{1\sigma}$	J	m	
										[Ω]	[V/1000 rpm]	[mH]	[mH]	[Ω]	[Ω]	kgm <sup>2</sup>	kg	
<b>Speed 1000 rpm – Rated frequency 50 Hz</b>																		
IE4-PE2R	63	G6	0.12	1.3	4.8	285	64.9	81.9	0.99	0.30	63	260	90	90	28.3	28.27	0.00027	5.7
IE4-PE2R	71	K6	0.18	1.7	7	285	70.1	81.9	0.99	0.45	36	250	70	60	22.0	18.85	0.00045	7.4
IE4-PE2R	71	G6	0.25	2.4	10	285	74.1	85.3	0.99	0.60	25	270	55	45	17.3	14.14	0.00060	8.3
IE4-PE2R	80	K6	0.37	3.5	14	310	78.0	92.8	0.99	0.75	19	280	37	23	11.6	7.23	0.00130	11.0
IE4-PE2R	80	G6	0.55	5.3	21	310	80.9	90.0	0.99	1.15	10.7	295	25	15	7.9	4.71	0.00175	12.5
IE4-PE2R	90	S6	0.75	7.2	28	315	82.7	88.7	1.00	1.55	7.5	300	25	13	7.9	4.08	0.00325	16
IE4-PE2R	90	L6	1.1	10.5	42	305	84.5	90.5	1.00	2.3	4.7	295	19	9	6.0	2.83	0.00425	19
IE4-PE2R	100	L6	1.5	14.3	60	310	85.9	90.1	1.00	3.10	2.7	300	14	6	4.4	1.88	0.00625	24
IE4-PE2R	112	M6	2.2	21	75	305	87.4	94.7	1.00	4.4	1.6	300	10	3	3.1	0.94	0.01225	33.5
IE4-PE2R	132	S6T	3.0	29	100	310	88.6	93.1	1.00	6.0	1.3	305	9	3	2.8	0.94	0.0139	39
IE4-PE1R	132	M6	4.0	38	48	350	89.5	90.9	0.99	7.4	0.991	343	7.74	4.02	2.43	1.26	0.021	53
IE4-PE1R	132	MX6	5.5	53	66	362	90.5	91.5	0.99	9.8	0.5350	348	6.624	3.072	2.080	0.965	0.040	70
IE4-PE1R	160	M6	7.5	72	90	364	91.3	91.7	0.99	13.2	0.3580	351	5.160	2.300	1.620	0.722	0.052	86
IE4-PE1R	160	L6	11.0	105	131	361	92.3	92.5	0.98	19.4	0.2390	345	4.549	1.729	1.428	0.543	0.104	114
IE4-PE1R	180	L6	15.0	143	179	360	92.9	93.1	0.98	26.4	0.1590	345	3.385	1.217	1.063	0.382	0.135	136
IE4-PE1R	180	L6	18.5	177	221	358	93.4	93.6	0.99	32.3	0.1545	347	3.403	1.217	1.069	0.382	0.135	136
IE4-PE1R	200	L6	22.0	210	263	359	93.7	93.9	0.99	38.1	0.1140	355	3.332	1.136	1.046	0.357	0.219	175
IE4-PE1R	200	LX6	30.0	287	358	359	94.2	94.3	0.98	52.3	0.0790	343	2.538	0.835	0.797	0.262	0.270	200
IE4-PE1R	225	M6	37.0	353	442	362	94.5	94.6	0.981	63.7	0.0495	350	1.899	0.610	0.596	0.192	0.437	265
IE4-PE1R	250	M6	45.0	430	537	360	94.8	94.9	0.98	77.7	0.0375	349	1.604	0.529	0.504	0.166	0.711	360
IE4-PE1R	280	S6	55.0	525	657	360	95.1	95.3	0.95	97.6	0.0335	334	1.656	0.538	0.520	0.169	1.142	465
IE4-PE1R	280	M6	75.0	716	895	367	95.4	95.5	0.97	127.5	0.0260	348	1.414	0.436	0.444	0.137	1.423	520
IE4-PE1R	315	S6	90.0	860	1074	358	95.6	95.8	0.95	159.8	0.0163	334	1.123	0.348	0.353	0.109	2.275	690
IE4-PE1R	315	M6	110.0	1051	1313	360	95.8	96	0.96	191.8	0.0120	341	0.908	0.266	0.285	0.084	2.875	800
IE4-PE1R	315	MX6	132.0	1261	1576	371	96.0	96.2	0.97	220.6	0.0116	356	0.910	0.262	0.286	0.082	3.110	890
IE4-PE1R	315	MY6	160.0	1528	1910	368	96.2	96.3	0.97	269.0	0.0076	353	0.717	0.181	0.225	0.057	5.285	1050
IE4-PE1R	315	L6	200.0	1273	1592	365	96.3	96.4	0.96	342.2	0.0063	347	0.612	0.151	0.192	0.047	5.940	1250
IE4-PE1R	315	LX6	250.0	1592	1990	362	96.5	96.5	0.95	434.9	0.0043	340	0.451	0.106	0.142	0.033	7.644	1460
Upon request			>250				96.5											

**Speed 750 rpm – Rated frequency 50 Hz**

IE4-PE2R	71	G8	0.12	1.5	7	290	60.0	80.4	0.99	0.30	51.0	365	60	75	18.8	23.56	0.0006	8.1
IE4-PE2R	80	K8	0.18	2.3	9	300	66.0	87.5	0.99	0.40	40.0	365	65	55	20.4	17.28	0.0013	10.5
IE4-PE2R	80	G8	0.25	3.2	14	310	70.2	85.5	0.99	0.55	26.0	390	50	40	15.7	12.57	0.00175	12
IE4-PE2R	90	S8	0.37	4.7	20	300	74.5	89.9	0.99	0.80	12.0	400	22	21	6.9	6.60	0.003	15
IE4-PE2R	90	L8	0.55	7.0	28	310	77.9	94.1	0.99	1.10	7.3	410	18	16	5.7	5.03	0.003775	18
IE4-PE2R	100	L8	0.75	9.6	38	275	80.0	93.6	0.99	1.70	4.8	370	14	11	4.4	3.46	0.00625	23
IE4-PE2R	100	LX8	1.1	14.0	55	310	82.1	90.0	0.99	2.30	3.6	410	14	9	4.4	2.83	0.009	28
IE4-PE2R	112	M8	1.5	19.1	75	320	83.7	94.3	0.99	2.90	2.4	430	11	7	3.5	2.20	0.01225	33.5
IE4-PE2R	132	S8T	2.2	28.0	100	300	85.5	93.0	0.99	4.60	1.5	400	8	4	2.5	1.26	0.0139	39

The maximum speed is dependent on the converter link voltage, load and converter type.  
Parameters with index 1: Phase values  
Subject to change in the course of technical further development

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