

Data Sheet

EM-PMI375-T800

Electric machine, permanent magnet internal

FEATURES

- Synchronous Reluctance assisted Permanent Magnet (SRPM) technology
- Extremely compact and robust structure
- Highest efficiency throughout the operation range on the market (~96 %)
- Liquid cooled with plain water or water/glycol mixture
- Low coolant flow required
- Allowed coolant temperature up to +65°C
- IP65 enclosure class to maximize reliability, IP67 available as option
- Multiple mounting possibilities

**GENERATOR SPECIFIC FEATURES**

- Standard SAE flange mounting to match the diesel engine connection
- Wide selection of speed ratings allowing the generator to be selected to customer specific applications with various voltage requirements
- Can be also used as starter motor for the ICE

MOTOR SPECIFIC FEATURES

- Extended speed and torque capabilities compared to standard PM motors from Danfoss reluctance assisted permanent magnet motor technology
- Motor structure is designed to be able to produce high starting torques: EM-PMI motor can produce instantly full torque to a non-moving axle
- Optimized speed range to meet the most common gear ratios used in heavy mobile machinery

GENERAL

The machine is developed especially for demanding applications. It is smaller, lighter and more efficient than conventional products on the market.

TYPICAL APPLICATIONS

- Generator for diesel-electric/ serial hybrid applications
- Traction/propulsion motor
- Generator/Motor for parallel hybrid applications

SPECIFICATIONS

General electrical properties

Nominal voltage (line to line)	500 V _{AC}
Voltage stress	IEC 60034-25, Curve A: Without filters for motors up to 500 V _{AC}
Nominal efficiency	96 %
Pole pair number	6
Power supply	Inverter fed.
Minimum inverter switching frequency	8 kHz

Basic information

Machine type	Synchronous reluctance assisted permanent magnet
Mounting (IEC 60034-7)	IM 3001 (Flange)
Standard Flange D-end (SAE J617)	SAE 3, transmission housing
Standard axle spline D-end	DIN5480 W50x2x24x8f
Standard Flange N-end (SAE J617)	SAE 4, flywheel housing
Standard rotation direction	Clockwise (both directions possible)
Protection class	IP65 IP67 available as option +IP67 Tests: 0.3 bar under pressure held for 120 seconds. Pressure not allowed to drop under 0.25 bar
Duty type (IEC 60034-1)	S9

Mechanical

Total weight	210 kg (no options)
Moment of inertia	0.63 kgm ²
Rotating mass	70.2 kg
Maximum static torque on the shaft	3400 Nm
Maximum dynamic torque on the shaft	2500 Nm
Maximum deceleration (shaft braking)	4400 rad/s ²

Dimensions

Length (frame)	428 mm
Diameter (frame)	450 mm

Cooling

Cooling liquid	Plain water with appropriate corrosive inhibitor (max. 50 % corrosive inhibitor)
Cooling liquid corrosive inhibitor type	Ethylene glycol Glystantin G48 recommended
Cooling method (IEC 60034-6)	IC 9S7Y7 (Liquid cooled, external heat exchanger)
Minimum cooling liquid flow	20 l/min
Maximum operating pressure	2 bar
Pressure loss	0.4 bar with 20l/min (+25°C coolant)

Cooling liquid temperature max	+65°C (Derating required if exceeded)
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Temperature rating

Insulation class (IEC 60034-1)	H (180°C)
Temperature rise (IEC 60034-1)	85°C (F) / 115°C (H)
Maximum winding temperature	180°C
Nominal ambient temperature	65°C
Min. ambient temperature	-40°C
Nominal altitude (IEC 60034-1)	1000 m

Vibration & Shock tolerance

Mechanical vibration	5.9 G _{RMS} ISO 16750-3 Test VII – Commercial vehicle, sprung masses – Table 12 Notes: test duration 8h axis (two axes tested; radial and axial) total spectral acceleration 5,91 grms Test done with EM-PMI375-T800
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Mechanical shock	50 G ISO 16750-3 4.2.2 Test for devices on rigid points on the body and on the frame Notes: –acceleration: 500 m/s ² ; –duration: 6 ms; –number of shocks: 10 per test direction. Test done with EM-PMI375-T800
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Connections

Coolant connection	2 x G3/4 bore
HV cables	3 x 70 mm ² max. (SINGLE winding model)

HV cable glands	2 x 3 x 70 mm ² max. (DUAL winding model) Pflitsch blueglobe TRI bg 225ms tri	LV mating connector pin type	DEUTSCH 0462-201-1631 DEUTSCH 0462-005-2031 Plug: DEUTSCH 0413-204-2005 (size 20) Plug: DEUTSCH 0413-003-1605 (size 16)
HV cable	Recommended H+S Radox screened cable	LV connector pin configuration	See Table below
HV cable lug size	35-8, 50-8, 70-8	Anticondensing heater (optional)	50W 230VAC single phase heater resistor
HV connection boxes	1 x 3 phase box (SINGLE winding model) 2 x 3 phase box (DUAL winding model)	Heater connector (optional)	Hummel art. no. 7651 0 51 01 D
LV connector	47 pin DEUTSCH HD34-24-47PE for resolver and temperature measurement.	Heater mating connector	Hummel art. no. 7550 6 51 02 D
LV connector type	DEUTSCH HD34-24-47PE	Heater connector pin type	Hummel 7010 9 42 01 1
LV connector pin type	Gold plated	Heater connector pin configuration	See Table below
LV mating connector type	DEUTSCH HD36-24-47SE or DEUTSCH HD36-24-47SE-059		

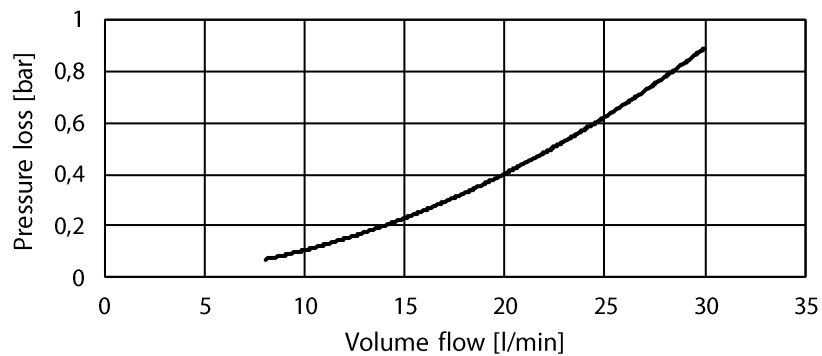
Table 1 Pin configuration of LV-connector

PIN	Description
47	Temperature 1, PT100 (P), windings
46	Temperature 1, PT100 (N), windings
33	Temperature 2, PT100 (P), windings
32	Temperature 2, PT100 (N), windings
45	Temperature 3, PT100 (P), windings
31	Temperature 3, PT100 (N), windings
30	Temperature 4, PT100 (P), windings option TEMP4
29	Temperature 4, PT100 (N), windings option TEMP4
44	Temperature 5, PT100 (P), windings option TEMP4
43	Temperature 5, PT100 (N), windings option TEMP4
28	Temperature 6, PT100 (P), windings option TEMP4
16	Temperature 6, PT100 (N), windings option TEMP4
35	Resolver, RES_COS_N, in-built non-contacting
20	Resolver, RES_COS_P, in-built non-contacting
36	Resolver, RES_SIN_N, in-built non-contacting
21	Resolver, RES_SIN_P, in-built non-contacting
22	Resolver, EXCN, in-built non-contacting
10	Resolver, EXCP, in-built non-contacting
34	Resolver, SHIELD/GROUND, in-built non-contacting

Table 2 Pin configuration of Heater

PIN	Description
1	Phase, 230VAC
2	Neutral
3	Reserve
4	Reserve
5	Reserve

PRESSURE LOSS VS COOLANT FLOW



Picture 1 Pressure loss vs coolant flow

MOTORS (temperature class F, 150 °C)

Type	Coolant temperature +65°C			Coolant temperature +40°C			Coolant temperature +40 / +65°C			
	Cont. Torque [Nm]	Cont. Power [kW]	Nom. Current [A]	Cont. Torque [Nm]	Cont. Power [kW]	Nom. Current [A]	Nom. speed [rpm]	Max. speed [rpm]	Peak torque Single (*)	Peak torque DUAL (**)
EM-PMI375-T800-900	823	78	108	910	86	116	900	1800	2280	-
EM-PMI375-T800-1300	828	113	165	895	122	161	1300	2600	1900	2100
EM-PMI375-T800-1600	828	139	203	902	151	202	1600	3200	1550	2100
EM-PMI375-T800-1900	771	153	226	854	170	224	1900	3800	1300	2100
EM-PMI375-T800-2300	723	174	251	797	192	251	2300	4000	1050	2040
EM-PMI375-T800-2800	665	195	283	733	215	283	2800	4000	850	1700
EM-PMI375-T800-3200	622	208	303	683	229	306	3200	4000	750	1450
EM-PMI375-T800-3800	570	227	323	628	250	325	3800	4000	630	1230

(* Peak torque achieved with a 350A inverter

(** Peak torque achieved with two 350A inverter

GENERATORS (temperature class F, 150 °C)

Type	Coolant temperature +65°C				Coolant temperature +40°C				Coolant temperature +40 / +65°C		
	Apparent power [kVA]	Cont. power [kW]	Nom. Current [A]	Power factor	Apparent power [kVA]	Cont. Power [kW]	Nom. Current [A]	Power factor	Nom. speed [rpm]	Nom. Freq. [Hz]	Volt/ speed ratio [V/rpm] (***)
EM-PMI375-T800-900	92	85	104	0.93	105	96	120	0.92	1000	100	0.509
EM-PMI375-T800-1300	128	121	145	0.95	141	131	152	0.93	1400	140	0.382
EM-PMI375-T800-1600	159	148	181	0.93	175	161	196	0.92	1700	170	0.297
EM-PMI375-T800-1900	172	160	197	0.93	193	178	235	0.92	2000	200	0.254
EM-PMI375-T800-2300	190	179	221	0.94	212	198	266	0.93	2500	250	0.212
EM-PMI375-T800-2800	215	200	249	0.93	242	223	326	0.92	3000	300	0.17
EM-PMI375-T800-3200	236	216	274	0.91	258	236	375	0.91	3400	340	0.149
EM-PMI375-T800-3800	247	233	288	0.94	273	256	428	0.94	3900	390	0.127

(*** Back EMF for cold (20°C) generator

MOTORS (temperature class H, 180°C)

Type	Coolant temperature +65°C			Coolant temperature +40°C			Coolant temperature +40 / +65°C			
	Cont. Torque [Nm]	Cont. Power [kW]	Nom. Current [A]	Cont. Torque [Nm]	Cont. Power [kW]	Nom. Current [A]	Nom. speed [rpm]	Max. speed [rpm]	Peak torque Single (*)	Peak torque DUAL (**)
EM-PMI375-T800-900	900	85	115	1000	94	128	900	1800	2280	-
EM-PMI375-T800-1300	917	125	165	984	134	182	1300	2600	1900	2100
EM-PMI375-T800-1600	921	154	203	997	167	226	1600	3200	1550	2100
EM-PMI375-T800-1900	860	171	226	938	187	252	1900	3800	1300	2100
EM-PMI375-T800-2300	796	191	251	880	212	282	2300	4000	1050	2040
EM-PMI375-T800-2800	740	217	283	813	238	313	2800	4000	850	1700
EM-PMI375-T800-3200	683	229	303	749	251	336	3200	4000	750	1450
EM-PMI375-T800-3800	630	251	323	697	277	359	3800	4000	630	1230

(* Peak torque achieved with a 350A inverter

(** Peak torque achieved with two 350A inverter

GENERATORS (temperature class H, 180°C)

Type	Coolant temperature +65°C				Coolant temperature +40°C				Coolant temperature +40 / +65°C		
	Apparent power [kVA]	Cont. power [kW]	Nom. Current [A]	Power factor	Apparent power [kVA]	Cont. Power [kW]	Nom. Current [A]	Power factor	Nom. speed [rpm]	Nom. Freq. [Hz]	Volt/ speed ratio [V/rpm] (***)
EM-PMI375-T800-900	101	93	115	0.92	114	106	128	0.93	1100	110	0.509
EM-PMI375-T800-1300	146	135	164	0.93	159	148	181	0.93	1400	140	0.382
EM-PMI375-T800-1600	175	164	202	0.94	197	182	224	0.92	1800	180	0.297
EM-PMI375-T800-1900	196	180	224	0.92	226	207	259	0.91	2100	200	0.254
EM-PMI375-T800-2300	217	201	248	0.93	243	223	279	0.92	2400	240	0.212
EM-PMI375-T800-2800	242	223	279	0.93	268	246	309	0.92	2900	290	0.17
EM-PMI375-T800-3200	258	236	298	0.91	284	258	331	0.91	3300	330	0.149
EM-PMI375-T800-3800	271	254	315	0.95	301	281	352	0.93	3900	390	0.127

(*** Back EMF for cold (20°C) generator

PRODUCT CODE AND OPTIONS

Use product code including all needed options for ordering. Standard options are not given with the code as they are selected by default if a non-standard option is not selected.

Product code	Description
EM-PMI375-T800-1900	Standard 1900 rpm unit with the standard options
EM-PMI375-T800-1900+BIN+RES1	Standard unit that has insulated bearing in N-end and resolver

Table 3 Product code examples

			EM-PMI375-T800	
			s = standard o = option	
Variant	Code	Description	Standard	
High voltage connections	*	One 3 phase system	s	One connection box containing one 3 phase system with one M25 cable gland per phase
	-DUAL	Two galvanically isolated 3 phase systems	o	2 connection boxes each containing one 3 phase system with one M25 cable gland per phase
Mounting direction	*	Can be used in any direction	s	Requires greased for life bearings
	+MH	Only horizontal assembly	o	With all bearing options
N-end attachment	+NE1	Flange	s	SAE 4 FH
	+NE2	Male shaft + Flange	o	DIN5480 W50x2x24x8f + SAE 4 FH
Bearing lubrication	*	Greased for life	s	Bearings: SKF 6211 2RS1 C3 WT
	+BHS	Grease lubricated	o	Bearings: SKF 6211 C3, Grease: SKF LGHP2 (requires MH)
Bearing insulation	*	Non-insulated bearings	s	Bearing types according to greased for life bearing
	+BIN	Insulated bearing in N-end	o	SKF 6211 insulated bearing in N-end
	+BIA	Insulated bearing in both ends	o	SKF 6211 insulated bearing in both ends
Shaft grounding	*	None	s	
	+SG1	D-end shaft grounding	o	In-built grounding ring
Protection class	*	Standard protection class	s	IP65 protection class
	+IP67	IP67 protection class	o	IP67 protection class, Not available with +BHS option
Cable direction	*	Cable direction fixed	s	Cable direction towards D-end
	+CNE	Cable direction towards N-end	o	
Rotation sensor	*	None	s	No resolver
	+RES1	Resolver	o	In-built non contacting resolver, 6-pole pair
Winding temperature sensors	*	Temperature surveillance	s	3 x PT100 (two wire) in windings
	+TEMP4	Redundant temperature surveillance	o	6 x PT100 (two wire) in windings
Bearing temperature sensors	*	None	s	
	+BTMP1	PT100 in bearings	o	plug in connector
Anticondensation heaters	*	None	s	
	+HEAT1	One anticondensation heater	o	230VAC/50W

Table 4 Option list

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