

Data Sheet

EM-PMI375-T500

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 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. The design of these machines makes them 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		Diameter (frame)	450 mm
Nominal voltage (line to line)	500 VAC	Cooling	
Voltage stress	IEC 60034-25, Curve A: Without filters for motors up to 500 V _{AC}	Cooling liquid	Plain water with appropriate corrosive inhibitor (max. 50 % corrosive inhibitor)
Nominal efficiency	96 %	Cooling liquid corrosive inhibitor type	Ethylene glycol Glysantin G48 recommended
Pole pair number	6	Cooling method (IEC 60034-6)	IC 9S7Y7 (Liquid cooled, external heat exchanger)
Power supply	Inverter fed.	Minimum cooling liquid flow	20 l/min
Nominal inverter switching frequency	8 kHz	Maximum operating pressure	2 bar
Basic information		Coolant circuit capacity	1.4 l
Machine type	Synchronous reluctance assisted permanent magnet	Pressure loss	0.4 bar with 20 l/min (+25°C coolant)
Mounting (IEC 60034-7)	IM 3001 (Flange)	Cooling liquid temperature max	+65°C (Derating required if exceeded)
Standard Flange D-end (SAE J617)	SAE 3, transmission housing	Temperature rating	
Standard bearings	SKF 6211 2RS1 C3 WT	Insulation class (IEC 60034-1)	H (180°C)
Standard axle spline D-end	DIN5480 W50x2x24x8f	Temperature rise (IEC 60034-1)	85°C (F) / 110°C (H)
Standard Flange N-end (SAE J617)	SAE 4, flywheel housing	Maximum winding temperature	175°C
Standard rotation direction	Clockwise (both directions possible)	Nominal ambient temperature	65°C
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	Min. ambient temperature	-40°C
Duty type (IEC 60034-1)	S9	Nominal altitude (IEC 60034-1)	1000 m
Standard color	Dark grey RAL7024 powder coating	Vibration & Shock tolerance	
Mechanical		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
Total weight	172 kg (no options)	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
Moment of inertia	0.46 kgm ²		
Rotating mass	52.5 kg		
Maximum static torque on the shaft	3400 Nm		
Maximum dynamic torque on the shaft	2500 Nm		
Maximum deceleration (shaft braking)	6000 rad/s ²		
Dimensions			
Length (frame)	368 mm		

Connections		Plug: DEUTSCH 0413-204-2005 (size 20)
Coolant connection	2 x G3/4 bore	Plug: DEUTSCH 0413-003-1605 (size 16)
HV cables	3 x 70 mm ² max. (SINGLE winding model) 2 x 3 x 70 mm ² max. (DUAL winding model)	LV connector pin configuration: See Table below
HV cable glands	Pflitsch blueglobe TRI bg 225ms tri	Anticondensing heater (optional): 50W 230VAC single phase heater resistor
HV cable	Recommended H+S Radox screened cable	Heater connector (optional): Hummel art. no. 7651 0 51 01 D
HV cable lug size	35-8, 50-8, 70-8	Heater mating connector: Hummel art. no. 7550 6 51 02 D
HV connection boxes	1 x 3 phase box (SINGLE winding model) 2 x 3 phase box (DUAL winding model)	Heater connector pin type: Hummel 7010 9 42 01 1
LV connector	47 pin DEUTSCH HD34-24-47PE for resolver and temperature measurement.	Heater connector pin configuration: See Table below
LV connector type	DEUTSCH HD34-24-47PE	Bearing temp. measurement connector type: 4-pin M12 A coded male
LV connector pin type	Gold plated	Bearing temp. measurement mating type: 4-pin M12 A coded female
LV mating connector type	DEUTSCH HD36-24-47SE or DEUTSCH HD36-24-47SE-059	Bearing temp. measurement connector pin configuration: See Table below
LV mating connector pin type	DEUTSCH 0462-201-1631 DEUTSCH 0462-005-2031	

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

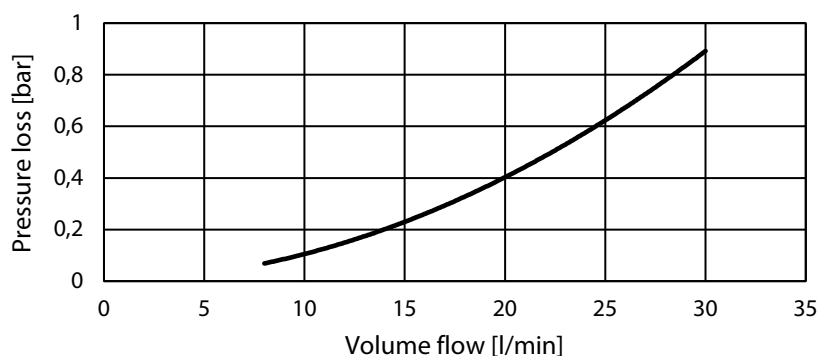
Table 2 Pin configuration of heater

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

Table 3 Pin configuration of bearing temperature sensor connector

PIN	Description
1	PT-100
2	PT-100
3	PT-100_GND
4	PT-100_GND

PRESSURE LOSS VS COOLANT FLOW



Picture 1 Pressure loss vs coolant flow

MOTORS (temperature class F, maximum winding temperature 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-T500-1100	526	61	77	573	66	86	1100	2200	1490	-
EM-PMI375-T500-1300	520	71	95	575	78	110	1300	2600	1480	-
EM-PMI375-T500-1600	515	86	111	575	96	127	1600	3200	1450	-
EM-PMI375-T500-1800	511	96	121	560	106	132	1800	3600	1400	-
EM-PMI375-T500-2000	502	105	136	550	115	149	2000	4000	1200	-
EM-PMI375-T500-2300	497	120	156	543	125	168	2300	4000	1170	1450
EM-PMI375-T500-2700	472	133	170	530	150	192	2700	4000	895	1194
EM-PMI375-T500-3200	442	148	192	484	162	208	3200	4000	736	1038

(* Peak torque achieved with 1 (350A) inverter

(** Peak torque achieved with 2 (350A) inverter

GENERATORS (temperature class F, maximum winding temperature 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-T500-1100	67	57	77	0.95	76	72	86	0.95	1200	120	0.442
EM-PMI375-T500-1300	82	77	94	0.90	95	83	109	0.87	1400	140	0.379
EM-PMI375-T500-1600	96	88	110	0.94	110	100	126	0.91	1700	170	0.316
EM-PMI375-T500-1800	104	97	120	0.97	113	110	131	0.97	1900	190	0.284
EM-PMI375-T500-2000	116	105	135	0.93	129	120	148	0.93	2100	210	0.252
EM-PMI375-T500-2300	133	120	153	0.93	144	131	165	0.91	2400	240	0.217
EM-PMI375-T500-2700	145	145	169	0.94	164	155	191	0.94	2800	280	0.190
EM-PMI375-T500-3200	164	148	190	0.94	177	166	205	0.94	3300	330	0.158

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

MOTORS (temperature class H, maximum winding temperature 175 °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-T500-1100	572	66	86	617	71	94	1100	2200	1490	-
EM-PMI375-T500-1300	560	76	103	607	83	114	1300	2600	1480	-
EM-PMI375-T500-1600	558	93	122	615	103	136	1600	3200	1450	-
EM-PMI375-T500-1800	552	104	131	616	116	146	1800	3600	1400	-
EM-PMI375-T500-2000	550	115	150	596	125	164	2000	4000	1200	-
EM-PMI375-T500-2300	538	130	169	578	139	184	2300	4000	1170	1450
EM-PMI375-T500-2700	524	148	190	585	165	215	2700	4000	895	1194
EM-PMI375-T500-3200	473	158	207	539	181	233	3200	4000	736	1038

(* Peak torque achieved with 1 (350A) inverter

(** Peak torque achieved with 2 (350A) inverter

GENERATORS (temperature class H, maximum winding temperature 175 °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-T500-1100	76	72	85	0.93	84	78	94	0.94	1200	120	0.442
EM-PMI375-T500-1300	90	83	102	0.93	100	90	113	0.89	1500	150	0.379
EM-PMI375-T500-1600	107	102	121	0.95	107	102	121	0.95	1800	180	0.316
EM-PMI375-T500-1800	113	110	130	0.97	126	124	145	0.98	2000	200	0.284
EM-PMI375-T500-2000	129	123	148	0.95	141	131	163	0.93	2100	210	0.252
EM-PMI375-T500-2300	144	134	166	0.93	158	146	181	0.93	2400	240	0.217
EM-PMI375-T500-2700	163	153	189	0.94	186	173	213	0.93	2800	280	0.190
EM-PMI375-T500-3200	177	166	204	0.94	199	185	230	0.93	3300	330	0.158

(*** 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 name	Description
EM-PMI375-T500-1100	Standard 1100 rpm unit with standard options
EM-PMI375-T500-1100+BIN+RES1	Standard unit otherwise but with insulated bearing in N-end and resolver

Table 3 Product code examples

Variant	code	Description	Legend	
			Standard	
s = standard o = option				
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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