

Data Sheet

# EM-PMI540-T1500

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
- 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		Diameter (frame)	648 mm
Nominal voltage (line to line)	500 V <sub>AC</sub>	Cooling	
Voltage stress	IEC 60034-25, Curve A: Without filters for motors up to 500 V <sub>AC</sub>	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	8	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	Coolant circuit capacity	3.9 l
Basic information		Maximum operating pressure	2 bar
Machine type	Synchronous reluctance assisted permanent magnet	Pressure loss	0.4 bar with 20l/min (+25°C coolant)
Mounting (IEC 60034-7)	IM 3001 (Flange)	Cooling liquid temperature	+65°C (Derating required if max. temp exceeded)
Standard Flange D-end (SAE J617)	SAE ½, transmission housing	Temperature rating	
Standard axle spline D-end	DIN5480 W55x2x30x26x8a	Insulation class (IEC 60034-1)	H (180°C)
Axle spline N-end	See option list option +NE4 Note: Also D-end axle length changes from 80mm to 100mm with this option	Temperature rise (IEC 60034-1)	85°C
Standard bearings	SKF 6214 C3, Grease LGHP2	Maximum winding temperature	150°C
Standard rotation direction	Clockwise (both directions possible)	Nominal ambient temperature	65°C
Protection class	IP65 Tests: 0.3 bar under pressure held for 120 seconds. Pressure not allowed to drop under 0.1 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 <sub>RMS</sub> 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-PMI540-T1500
Total weight	390 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 <sup>2</sup> ; –duration: 6 ms; –number of shocks: 10 per test direction.
Moment of inertia	3.45 kgm <sup>2</sup>		
Rotating mass	140 kg		
Maximum static torque on the shaft	6800 Nm		
Maximum dynamic torque on the shaft	4000 Nm		
Maximum deceleration (shaft braking)	1000 rad/s <sup>2</sup>		
Dimensions			
Length (frame)	531 mm		

Connections	Test done with EM-PMI540-T1500	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)
Coolant connection	2 x G3/4 bore	LV connector pin configuration	See Table below
HV cables	2 x 3 x 95 mm <sup>2</sup> max.	Anticondensing heater (optional)	50W 230VAC single phase heater resistor
HV cable glands	Pflitsch blueglobe TRI bg 232ms tri	Heater connection (optional)	Pflitsch blueglobe mstri212 (M12) and terminal strip inside connection box
HV cable	Recommended H+S Radox screened cable	Heater terminal strip pin configuration	See Table below
HV cable lug size	35-8, 50-8, 70-8	Bearing temp. measurement connector type	4-pin M12 A coded male
HV connection boxes	2 x 3 phase box	Bearing temp. measurement mating type	4-pin M12 A coded female
LV connector	47 pin DEUTSCH HD34-24-47PE for resolver and temperature measurement.	Bearing temp. measurement connector pin configuration	See Table below
LV connector type	DEUTSCH HD34-24-47PE		
LV connector pin type	Gold plated		
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

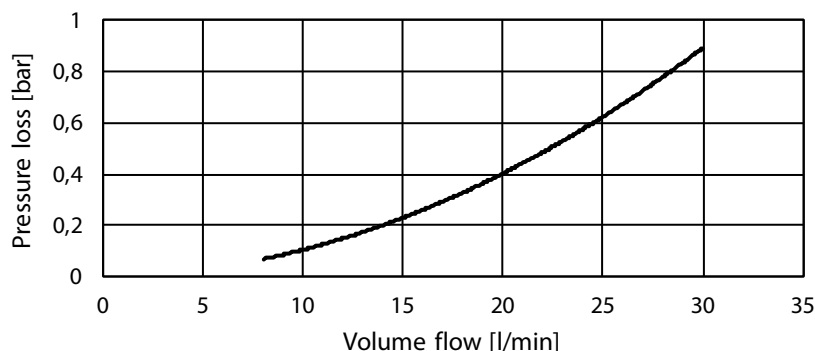
Table 2 Pin configuration of heater (pin configuration does not matter)

PIN	Description
1	Phase, 230VAC / Neutral
2	Phase, 230VAC / Neutral

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

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-PMI540-T1500-700	1619	119	154	1810	133	176	700	1400	2600	-
EM-PMI540-T1500-1200	1580	199	269	1716	216	293	1200	2400	2110	2600
EM-PMI540-T1500-1400	1553	228	325	1723	253	358	1400	2800	1695	2600
EM-PMI540-T1500-1600	1452	243	342	1662	278	391	1600	3200	1500	2600
EM-PMI540-T1500-1800	1455	274	376	1606	303	413	1800	3600	1359	2600
EM-PMI540-T1500-2100	1381	304	411	1542	339	454	2100	4000	1118	2500
EM-PMI540-T1500-2400	1322	332	458	1510	380	522	2400	4000	1012	2135

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

(\*\* Peak torque achieved with 2 (350A) inverters

GENERATORS

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-PMI540-T1500-700	137	131	153	0.96	155	147	175	0.95	800	106.7	0.713
EM-PMI540-T1500-1200	232	221	268	0.95	254	241	291	0.95	1400	187	0.389
EM-PMI540-T1500-1400	277	255	321	0.92	308	282	356	0.92	1600	213	0.324
EM-PMI540-T1500-1600	292	267	338	0.91	336	302	358	0.90	1800	240	0.291
EM-PMI540-T1500-1800	321	300	372	0.94	354	330	409	0.93	2000	267	0.259
EM-PMI540-T1500-2100	349	329	405	0.94	388	364	450	0.94	2300	307	0.238
EM-PMI540-T1500-2400	378	349	441	0.92	443	409	516	0.92	2600	347	0.194

(\*\*\* 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-PMI 540-T1500-2400-DUAL	Standard 2400 rpm unit with standard options
EM-PMI540-T1500-2400-DUAL+BIN	Standard unit with insulated bearing in N-end

Table 3 Product code examples

Variant	code	Description	s = standard o = option	
			Standard	
High voltage connections	-DUAL	Two galvanically isolated 3 phase syst	s	2 connection boxes each containing one 3 phase system with one M32 cable gland per phase
Connection extension	*	None	s	2 connection boxes each containing one 3 phase system with one M32 cable gland per phase
	+CE1	Double phase connections	o	2 connection boxes each containing one 3 phase system with two M32 cable glands per phase
N-end attachment	*	None	s	
	+NE4	Male shaft, no flange	o	DIN5480 W55x2x30x26x8a
Bearing insulation	*	Non-insulated bearings	s	Bearing types according to BHS
	+BIN	Insulated bearing in N-end	o	SKF 6214 insulated bearing in N-end
	+BIA	Insulated bearing in both ends	o	SKF 6214 insulated bearing in both ends
Shaft grounding	*	None	s	
	+SG1	D-end shaft grounding	o	In-built grounding ring
Rotation sensor	*	None	s	No resolver
	+RES1	Resolver	o	In-built non contacting resolver, 8-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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