

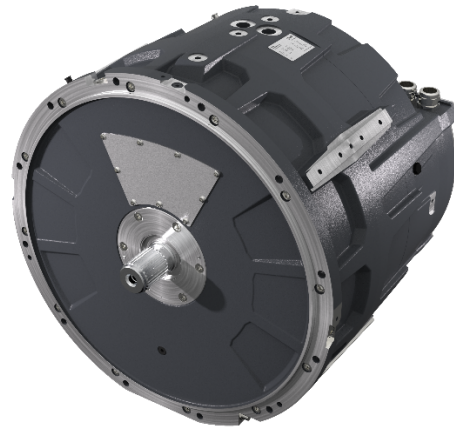


## EM-PMI540-T1500

Electric machine, permanent magnet internal

### FEATURES

- Synchronous Reluctance assisted Permanent Magnet (SRPM) technology
- Extremely compact and robust aluminum frame 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



### GENERAL

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

### 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

### TYPICAL APPLICATIONS

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

### 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 torque: EM-PMI motor can produce instantly full torque to a non-rotating shaft
- Optimized speed range to meet the most common gear ratios used in heavy mobile machinery

## SPECIFICATIONS

### General electrical properties

|                                      |   |
|--------------------------------------|---|
| Nominal voltage (line to line)       | 500 V <sub>AC</sub>   |
| Voltage stress                       | IEC 60034-25, Curve A: Without filters for motors up to 500 V <sub>AC</sub> |
| Nominal efficiency                   | 96 %  |
| Pole pair number                     | 8   |
| Power supply                         | Inverter fed.   |
| Nominal inverter switching frequency | 8 kHz   |
| Minimal inverter switching frequency | 4 kHz (with limited speed 1.4 times nominal speed)                          |

### Basic information

|                                  |  |
|----------------------------------|--|
| Machine type                     | Synchronous reluctance assisted permanent magnet   |
| Frame material                   | Aluminum   |
| Mounting direction               | Horizontal or vertical assembly (V1, D-end shaft down), see user guide for details   |
| Mounting (IEC 60034-7)           | IM 3009-B5 (Flange horizontal), IM 3019-V1 (Flange and D-end down)   |
| Standard Flange D-end (SAE J617) | SAE ½ mating transmission housing  |
| Standard axle spline D-end       | DIN5480 W55x2x26x8a  |
| Axle spline N-end                | See option list option +NE4<br>Note: Also D-end axle length changes from 80mm to 100mm with this option  |
| Bearing type                     | Standard: 6214/C3 (with LGHP2 grease)<br>+BIN option: D-end: 6214/C3 (with LGHP2 grease), N-end: 6214/HC5C3 (with LGHP2 grease)<br>+BIA option: 6214/HC5C3WT (with LGHP2 grease) |
| Standard rotation direction      | Clockwise (both directions possible)   |
| Protection class                 | IP65<br>Tests: 0.3 bar under pressure held for 120 seconds.<br>Pressure not allowed to drop under 0.1 bar  |
| Duty type (IEC 60034-1)          | S1/S9  |
| Standard color                   | Dark grey RAL7024 powder coating   |

### Mechanical

|  |   |
|--|---|
| Total weight   | 390 kg (no options)   |
| Moment of inertia  | 3.45 kgm <sup>2</sup>                                       |
| Torsional stiffness of shaft drive end                               | 6 Nm/rad (from middle of the d-end spline to rotor air gap) |
| Rotating mass  | 140 kg  |
| Maximum static torque range on the shaft, max. 25000 cycles, R=0 (*) | 6800 Nm   |
| Maximum dynamic torque range on the shaft, max. 1e6 cycles, R=0 (*)  | 4000 Nm   |
| Maximum allowed vibratory torque range, 1e9...1e10 cycles (*)        | 0,3 x Nominal torque of machine                             |
| Maximum deceleration (fault stop)                                    | 1050 rad/s <sup>2</sup>                                     |

### Dimensions

|                  |        |
|------------------|--------|
| Length (frame)   | 531 mm |
| Diameter (frame) | 648 mm |

### Cooling

|   |  |
|---|--|
| Cooling liquid                          | Plain water with appropriate corrosive inhibitor (max. 50 % corrosive inhibitor) |
| Cooling liquid corrosive inhibitor type | Ethylene glycol Glysantin G48 recommended  |
| Cooling method (IEC 60034-6)            | IC 71 W  |
| Minimum cooling liquid flow             | 20 l/min   |
| Coolant circuit capacity                | 3.9 l  |
| Maximum operating pressure              | 2 bar  |
| Pressure loss                           | 0.4 bar with 20l/min (+25°C coolant)   |
| Nominal cooling liquid temperature      | +40°C (derating required if exceeded)  |
| Minimum cooling liquid temperature      | -20°C  |
| Maximum cooling liquid temperature      | +70°C  |
| Condensation dew point                  | Please use anti-condensation heaters   |
| Temperature rating                      |  |
| Insulation class (IEC 60034-1)          | H (180°C)  |

|                                |   |   |  |
|--------------------------------|---|---|--|
| Temperature rise (IEC 60034-1) | 85°C  | Recommended cable lug                                 | 35 mm <sup>2</sup> : Druseidt with narrow flange 03901<br>50 mm <sup>2</sup> : Druseidt with narrow flange 03903<br>70 mm <sup>2</sup> : Druseidt with narrow flange 03906<br>95 mm <sup>2</sup> : Druseidt with narrow flange 03910 |
| Maximum winding temperature    | 150°C   |   |  |
| Nominal ambient temperature    | +65°C / +45°C with +CL option   |   |  |
| Min. ambient temperature       | -40°C   | HV connection boxes                                   | 2 x 3 phase box  |
| Nominal altitude (IEC 60034-1) | 1000 m  | LV connector  | 47 pin DEUTSCH HD34-24-47PE for resolver and temperature measurement.  |
| Vibration & Shock tolerance    |   |   |  |
| Mechanical vibration           | 5.9 G <sub>RMS</sub><br>ISO 16750-3<br>Test VII – Commercial vehicle, sprung masses – Table 12<br>Notes:<br>test duration 8h axis (two axes tested; radial and axial)<br>total spectral acceleration 5,91 grms<br>Test done with EM-PMI540-T1500 (with flange mounting) | 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   |
|                                |   | LV mating connector pin type                          | DEUTSCH 0462-201-1631<br>DEUTSCH 0462-005-2031<br>Plug: DEUTSCH 0413-204-2005 (size 20)<br>Plug: DEUTSCH 0413-003-1605 (size 16)   |
| Mechanical shock               | 50 G<br>ISO 16750-3<br>4.2.2 Test for devices on rigid points on the body and on the frame<br>Notes:<br>–acceleration: 500 m/s <sup>2</sup> ;<br>–duration: 6 ms;<br>–number of shocks: 10 per test direction.<br>Test done with EM-PMI540-T1500 (with flange mounting) | LV connector pin configuration                        | See Table below  |
|                                |   | Anti-condensation heater (+HEAT1 option)              | 130 W 230 V <sub>AC</sub> single phase heater resistor   |
|                                |   | Heater connection (+HEAT1 option)                     | Pflitsch blueglobe mstri212 (M12) and terminal strip inside connection box   |
|                                |   | Heater terminal strip pin configuration               | See Table below  |
| Connections                    |   |   |  |
| Coolant connection             | 2 x G3/4 bore   | Bearing temp. measurement connector type              | 4-pin M12 A coded male   |
| Cable direction                | Cable direction fixed   | Bearing temp. measurement mating type                 | 4-pin M12 A coded female   |
| HV cables                      | 2 x 3 x 95 mm <sup>2</sup> max.   | Bearing temp. measurement connector pin configuration | See Table below  |
| HV cable glands                | Pflitsch blueglobe TRI bg 232ms tri   |   |  |
| HV cable                       | Recommended H+S Radox screened cable  |   |  |
| HV cable lug size              | 35-8, 50-8, 70-8, 95-8  |   |  |

(\* The values are based on structural analysis and they are not applicable to any marine class rules or requirements.

| 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 (+TEMP4 option) |
| 29  | Temperature 4, PT100 (N), windings (+TEMP4 option) |
| 44  | Temperature 5, PT100 (P), windings (+TEMP4 option) |
| 43  | Temperature 5, PT100 (N), windings (+TEMP4 option) |
| 28  | Temperature 6, PT100 (P), windings (+TEMP4 option) |
| 16  | Temperature 6, PT100 (N), windings (+TEMP4 option) |
| 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 1 Pin configuration of LV-connector

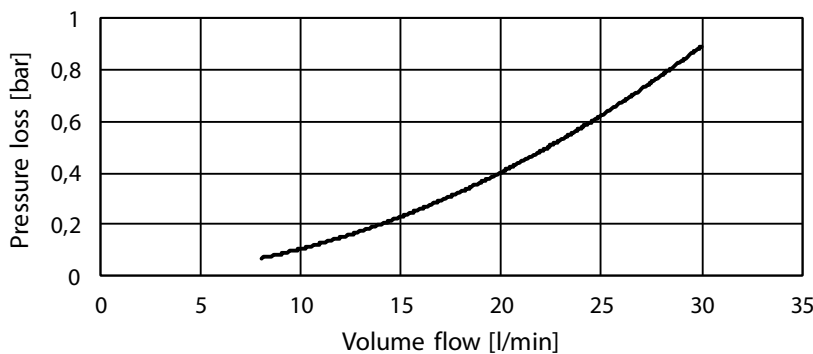
| PIN | Description  |
|-----|--|
| 1   | Phase, 230 V <sub>AC</sub> / Neutral                               |
| 2   | Phase, 230 V <sub>AC</sub> / Neutral                               |
| ⊥   | Ground/protective earth, M5 screw connection inside connection box |

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

| PIN | Description |
|-----|-------------|
| 1   | PT100       |
| 2   |             |
| 3   | PT100_GND   |
| 4   |             |

Table 3 Pin configuration of bearing temperature sensor connector (one sensor)

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 one (350A) inverter

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

The maximum allowed peak torque duration at stator winding starting temperature +90°C is 5.5 minutes. The given values indicate typical duration and are not verified. In case more accurate values are required, cyclic dimensions are needed.

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. Standard options are indicated by a star (\*).

| Product code                  | Description                                   |
|-------------------------------|---|
| EM-PMI540-T1500-1600-DUAL     | Standard 1600 rpm unit with standard options  |
| EM-PMI540-T1500-1600-DUAL+BIN | Standard unit with insulated bearing in N-end |

Table 4 Product code examples

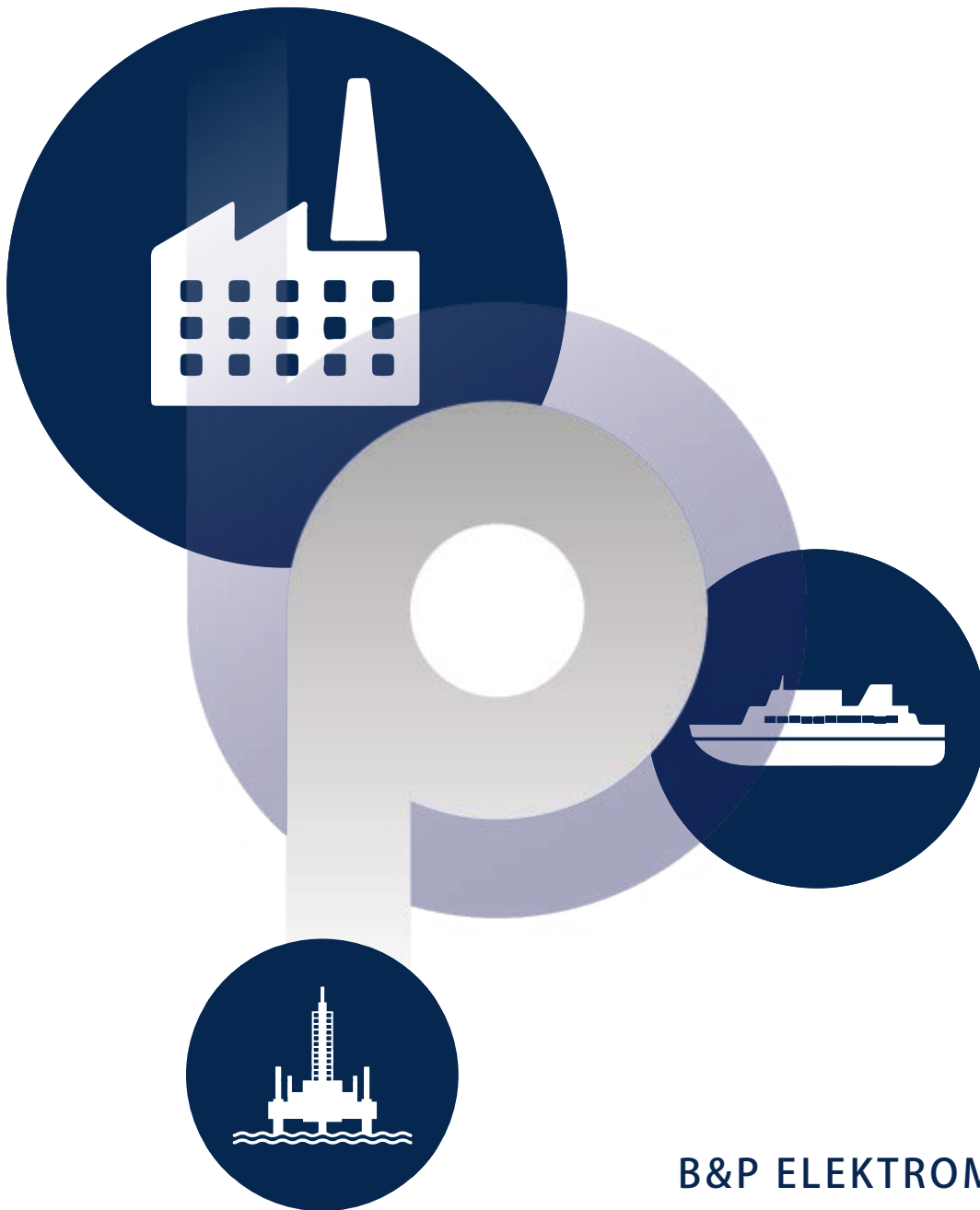
| Variant                          | Code   | Description                               | Additional information   |
|----------------------------------|--------|---|--|
| High voltage connections         | -DUAL  | Two galvanically isolated 3 phase systems | Two connection boxes each containing one 3 phase system with one M32 cable gland per phase |
| Connection extension             | *      | None                                      | Two connection boxes each containing one 3 phase system with one M32 cable gland per phase |
|                                  | +CE1   | Double phase connections                  | Extended connection boxes with two M32 cable glands per phase                              |
| N-end attachment                 | *      | None                                      |  |
|                                  | +NE4   | Male shaft, no flange                     | DIN5480 W55x2x26x8a, D-end axle length increases from 80mm to 100mm with +NE4 option       |
| Foot mounting                    | *      | None                                      |  |
|                                  | +FM1   | Foot                                      | Foot mounting, shaft height 315mm  |
| Bearing insulation               | *      | Non-insulated bearings                    | Non-insulated bearings   |
|                                  | +BIN   | Insulated bearing in N-end                | Insulated bearing in N-end   |
|                                  | +BIA   | Insulated bearing in both ends            | Insulated bearing in both ends   |
| Shaft grounding                  | *      | None                                      |  |
|                                  | +SG1   | D-end shaft grounding                     | In-built grounding ring  |
| Rotation sensor                  | *      | None                                      | No resolver  |
|                                  | +RES1  | Resolver                                  | In-built non contacting resolver, 8-pole pair  |
| Winding temperature sensors (**) | *      | Temperature surveillance                  | 3 x PT100 (two wire) in windings   |
|                                  | +TEMP4 | Redundant temperature surveillance        | 6 x PT100 (two wire) in windings   |
| Bearing temperature sensors      | *      | None                                      |  |
|                                  | +BTMP1 | PT100 in bearings                         | Plug-in connector  |
| Anti-condensation heaters        | *      | None                                      |  |
|                                  | +HEAT1 | One anti-condensation heater              | 230 V <sub>AC</sub> / 130 W  |
| Marine classification            | *      | No marine classification                  |  |
|                                  | +CL1   |   | ABS American Bureau of Shipping  |
|                                  | +CL2   |   | BV Bureau Veritas  |
|                                  | +CL3   |   | DNV GL DNV GL AS   |
|                                  | +CL4   |   | LR Lloyd's Register  |
|                                  | +CL5   |   | RINA   |

(\* Standard option

(\*\* Winding temperature sensors are for stator winding. The selection of high voltage connections does not have an influence on the quantity of PT100 elements.

Table 5 Option list

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without changes being necessary in specifications already agreed. All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.



## B&P ELEKTROMOTOREN BV

Ampèrestraat 8F  
4004 KB Tiel

[info@bnpelektromotoren.nl](mailto:info@bnpelektromotoren.nl)

+31 (0)344 616 267

BTW nr. NL819113918B01

KvK nr. 30237800

ING Bank NL60 INGB 0675 304 792



[www.bnpelektromotoren.nl](http://www.bnpelektromotoren.nl)