

## Data Sheet

**EM-PMI540B-T4000**

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 water-glycol mixture
- Low coolant flow required
- Allowed coolant temperature up to +65°C
- IP67 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

## 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.

## 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

## 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 <sub>AC</sub>                                                              |
| Voltage stress                                            | IEC 60034-25:2009, 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 10 % derated performance)                                            |
| Maximum phase-to-phase peak-to-peak voltage without du/dt | 1.5 kV                                                                           |
| Maximum voltage rise time without du/dt                   | 8 kV/μs                                                                          |

| Basic information                |                                                                                                                                                                                                  |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machine type                     | Synchronous reluctance assisted permanent magnet                                                                                                                                                 |
| Frame material                   | Frame including coolant circuit: Aluminum 6063<br>Endshields: AISi7Mg                                                                                                                            |
| Mounting direction               | Only horizontal assembly (see user guide for details)                                                                                                                                            |
| Mounting (IEC 60034-7)           | See Table 7                                                                                                                                                                                      |
| Standard flange D-end (SAE J617) | SAE ½ mating transmission housing                                                                                                                                                                |
| D-end shaft                      | Male cylindrical shaft, diameter 70 mm h7                                                                                                                                                        |
| Bearing type                     | Standard:<br>6216/C3 (with LGHP2 grease)<br>+BIN option:<br>D-end: 6216/C3 (with LGHP2 grease)<br>N-end: 6216/ C3VL0241 (with LGHP2 grease)<br>+BIA option:<br>6216/C3VL0241 (with LGHP2 grease) |
| Standard rotation direction      | Clockwise (both directions possible)                                                                                                                                                             |
| Protection class                 | IP67                                                                                                                                                                                             |
| Duty type (IEC 60034-1)          | S1/S9                                                                                                                                                                                            |
| Machine coating                  | Coating is optional                                                                                                                                                                              |
| Nominal altitude (IEC 60034-1)   | Up to 4000 m (see Picture 1 for details)                                                                                                                                                         |

| Mechanical                                                           |                                                                |
|----------------------------------------------------------------------|----------------------------------------------------------------|
| Total weight                                                         | 987.9 kg (+/- 2 %, no options)                                 |
| Moment of inertia                                                    | 10.9 kgm <sup>2</sup>                                          |
| Torsional stiffness of shaft drive end                               | 18*10 <sup>5</sup> Nm/rad (130 mm from the end of D-end shaft) |
| Rotating mass                                                        | 451 kg                                                         |
| Maximum static torque range on the shaft, max. 25000 cycles, R=0 (*) | 7500 Nm                                                        |
| Maximum dynamic torque range on the shaft, max. 1e6 cycles, R=0 (*)  | 6000 Nm                                                        |
| Maximum allowed vibratory torque range, 1e9...1e10 cycles (*)        | 0.3 x nominal torque of machine                                |
| Maximum deceleration (fault stop)                                    | 1000 rad/s <sup>2</sup>                                        |

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

| Dimensions       |         |
|------------------|---------|
| Length (frame)   | 1014 mm |
| Diameter (frame) | 600 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             | 40 l/min                                                                         |
| Coolant circuit capacity                | 5.4 l                                                                            |
| Maximum operating pressure              | 2 bar                                                                            |
| Pressure loss                           | 0.5 bar with 40 l/min (+25°C coolant) (see Picture 2 for details)                |
| Nominal cooling liquid temperature      | +65°C (derating required if exceeded)                                            |
| Minimum cooling liquid temperature      | -20°C                                                                            |
| Maximum cooling liquid temperature      | +70°C                                                                            |

| Temperature rating             |            |
|--------------------------------|------------|
| Insulation class (IEC 60034-1) | H (+180°C) |
| Temperature rise (IEC 60034-1) | +85°C      |
| Maximum winding temperature    | +150°C     |
| Nominal ambient temperature    | +65°C      |
| Min. ambient temperature       | -40°C      |

| Vibration & Shock tolerance |                                                                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mechanical vibration        | 3.19 G <sub>RMS</sub><br>ISO 16750-3:2023<br>Test XVI - Hybrid-electric/fully electric commercial vehicle, sprung mass (vehicle body), large and heavy DUT |
| Mechanical shock            | 50 G<br>ISO 16750-3:2023<br>4.2.2 Test for devices on rigid points on the body and on the frame                                                            |

| Connections               |                                                                                                                                                                          |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coolant connection        | 2 x G3/4 bore (see dimension drawing for details)                                                                                                                        |
| Cable direction           | Cable direction fixed upwards                                                                                                                                            |
| HV cables                 | 2 x 3 x 95 mm <sup>2</sup> max.<br>4 x 3 x 95 mm <sup>2</sup> max.                                                                                                       |
| HV cable glands           | Pflitsch blueglobe TRI bg 232ms tri                                                                                                                                      |
| HV cable recommended type | HUBER+SUHNER Radox Elastomer S, screened, single core, automotive cable (FHLR4GC13X)<br><a href="http://www.hubersuhner.com">www.hubersuhner.com</a>                     |
| HV cable lug size         | 70-8, 95-8                                                                                                                                                               |
| Recommended cable lug     | 70 mm <sup>2</sup> : Druseidt with narrow flange 03906<br>95 mm <sup>2</sup> : Druseidt with narrow flange 03910<br><a href="http://www.druseidt.de">www.druseidt.de</a> |
| HV connection boxes       | 2 x 3 phase box<br>4 x 3 phase box                                                                                                                                       |

|                                                       |                                                                                                                                                                                                         |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LV connector                                          | 47 pin DEUTSCH HD34-24-47PE for resolver and temperature measurement<br><a href="https://www.te.com">https://www.te.com</a>                                                                             |
| LV connector type                                     | DEUTSCH HD34-24-47PE                                                                                                                                                                                    |
| LV connector pin type                                 | Gold plated                                                                                                                                                                                             |
| LV mating connector type                              | DEUTSCH HD36-24-47SE or<br>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)                                                                        |
| LV connector pin configuration                        | See Table 1 and Table 2                                                                                                                                                                                 |
| Angle/Speed sensor                                    | Type: Externally excited SIN/COS resolver<br>Pole pair number 8<br>Input 7 V<br>Frequency 10 kHz<br>Output 2 V +/- 0.2 V<br>Input impedance 80 +/- 16 Ohm<br>Output impedance 380 +/- 76 Ohm            |
| Anti-condensation heater (+HEAT2 option)              | 2 x 130 W 230 V <sub>AC</sub> single-phase heater resistors                                                                                                                                             |
| Heater connector (+HEAT2 option)                      | Hummel art no. 7651 0 51 01 D (combination of housing 7651 0 00 00 0, insert 7084 9 51 10 1 / 7084 9 51 12 1, crimp pins 7010 9 42 01 1)<br><a href="https://www.hummel.com">https://www.hummel.com</a> |
| Heater mating connector                               | Hummel art no. 7550 6 51 02 D (combination of housing 7550 6 00 00 0, insert 7084 9 51 10 2 / 7084 9 51 12 2, crimp socket 7010 9 42 00 2)                                                              |
| Heater connector pin type                             | Hummel art. no. 7010 9 42 01 1                                                                                                                                                                          |
| Heater connector pin configuration                    | See Table 5                                                                                                                                                                                             |
| Bearing temp. measurement connector type              | D-end: 4-pin M12 A coded male<br>N-end: DEUTSCH HD34-24-47PE                                                                                                                                            |
| Bearing temp. measurement mating type                 | D-end: 4-pin M12 A coded female<br>N-end: DEUTSCH HD36-24-47SE or DEUTSCH HD36-24-47SE-059                                                                                                              |
| Bearing temp. measurement connector pin configuration | See Table 1, Table 2 and Table 6                                                                                                                                                                        |

(\*\* Connector IP-rating of IP67 is reached only when connector mating part is installed and all unused pin holes are plugged in the connector mating part with the following plugs, depending on the hole size: DEUTSCH 0413-003-1605 (size 16) or DEUTSCH 0413-204-2005 (size 20). For further information, contact the connector manufacturer TE connectivity directly.

| Description                   |                                                   | PIN | Option |
|-------------------------------|---------------------------------------------------|-----|--------|
| Temperature 1                 | phase U1, main sensor, PT100 (P)                  | 47  |        |
|                               | phase U1, main sensor, PT100 (N)                  | 46  |        |
| Temperature 2                 | phase V1, main sensor, PT100 (P)                  | 33  |        |
|                               | phase V1, main sensor, PT100 (N)                  | 32  |        |
| Temperature 3                 | phase W1, main sensor, PT100 (P)                  | 45  |        |
|                               | phase W1, main sensor, PT100 (N)                  | 31  |        |
| Temperature 4                 | phase U2, main sensor, PT100 (P)                  | 30  |        |
|                               | phase U2, main sensor, PT100 (N)                  | 29  |        |
| Temperature 5                 | phase V2, main sensor, PT100 (P)                  | 44  |        |
|                               | phase V2, main sensor, PT100 (N)                  | 43  |        |
| Temperature 6                 | phase W2, main sensor, PT100 (P)                  | 28  |        |
|                               | phase W2, main sensor, PT100 (N)                  | 16  |        |
| Temperature 7                 | phase U1, spare sensor, PT100 (P)                 | 42  | +TEMP5 |
|                               | phase U1, spare sensor, PT100 (N)                 | 27  |        |
| Temperature 8                 | phase V1, spare sensor, PT100 (P)                 | 15  | +TEMP5 |
|                               | phase V1, spare sensor, PT100 (N)                 | 14  |        |
| Temperature 9                 | phase W1, spare sensor, PT100 (P)                 | 40  | +TEMP5 |
|                               | phase W1, spare sensor, PT100 (N)                 | 26  |        |
| Temperature 10                | phase U2, spare sensor, PT100 (P)                 | 41  | +TEMP5 |
|                               | phase U2, spare sensor, PT100 (N)                 | 13  |        |
| Temperature 11                | phase V2, spare sensor, PT100 (P)                 | 39  | +TEMP5 |
|                               | phase V2, spare sensor, PT100 (N)                 | 38  |        |
| Temperature 12                | phase W2, spare sensor, PT100 (P)                 | 25  | +TEMP5 |
|                               | phase W2, spare sensor, PT100 (N)                 | 12  |        |
| Resolver COS                  | Resolver, RES_COS_N, Inbuilt non-contacting       | 35  |        |
| Resolver COS                  | Resolver, RES_COS_P, Inbuilt non-contacting       | 20  |        |
| Resolver SIN                  | Resolver, RES_SIN_N, Inbuilt non-contacting       | 36  |        |
| Resolver SIN                  | Resolver, RES_SIN_P, Inbuilt non-contacting       | 21  |        |
| Resolver EXCN                 | Resolver, EXCN, Inbuilt non-contacting            | 22  |        |
| Resolver EXCP                 | Resolver, EXCP, Inbuilt non-contacting            | 10  |        |
| Resolver shield               | Resolver, SHIELD/GROUND, Inbuilt non-contacting   | 34  |        |
| Resolver2 COS                 | Resolver 2, RES_COS_N, Inbuilt non-contacting     | 37  | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_P, Inbuilt non-contacting     | 24  | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_N, Inbuilt non-contacting     | 23  | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_P, Inbuilt non-contacting     | 11  | +RES2  |
| Resolver2 EXCN                | Resolver 2, EXCN, Inbuilt non-contacting          | 9   | +RES2  |
| Resolver2 EXCP                | Resolver 2, EXCP, Inbuilt non-contacting          | 8   | +RES2  |
| Resolver2 shield              | Resolver 2, SHIELD/GROUND, Inbuilt non-contacting | 4   | +RES2  |
| Bearing temperature, sensor 1 | PT100                                             | 2   |        |
| Bearing temperature, sensor 1 | PT100_GND                                         | 18  |        |
| Bearing temperature, sensor 2 | PT100                                             | 3   |        |
| Bearing temperature, sensor 2 | PT100_GND                                         | 19  |        |

Table 1 Pin configuration of LV-connector (+DUAL)

| LV-connector 1                |                                                   |     |        |
|-------------------------------|---------------------------------------------------|-----|--------|
| Description                   |                                                   | PIN | Option |
| Temperature 1                 | phase U1, main sensor, PT100 (P)                  | 47  |        |
|                               | phase U1, main sensor, PT100 (N)                  | 46  |        |
| Temperature 2                 | phase V1, main sensor, PT100 (P)                  | 33  |        |
|                               | phase V1, main sensor, PT100 (N)                  | 32  |        |
| Temperature 3                 | phase W1, main sensor, PT100 (P)                  | 45  |        |
|                               | phase W1, main sensor, PT100 (N)                  | 31  |        |
| Temperature 4                 | phase U2, main sensor, PT100 (P)                  | 30  |        |
|                               | phase U2, main sensor, PT100 (N)                  | 29  |        |
| Temperature 5                 | phase V2, main sensor, PT100 (P)                  | 44  |        |
|                               | phase V2, main sensor, PT100 (N)                  | 43  |        |
| Temperature 6                 | phase W2, main sensor, PT100 (P)                  | 28  |        |
|                               | phase W2, main sensor, PT100 (N)                  | 16  |        |
| Temperature 7                 | phase U3, main sensor, PT100 (P)                  | 42  |        |
|                               | phase U3, main sensor, PT100 (N)                  | 27  |        |
| Temperature 8                 | phase V3, main sensor, PT100 (P)                  | 15  |        |
|                               | phase V3, main sensor, PT100 (N)                  | 14  |        |
| Temperature 9                 | phase W3, main sensor, PT100 (P)                  | 40  |        |
|                               | phase W3, main sensor, PT100 (N)                  | 26  |        |
| Temperature 10                | phase U4, main sensor, PT100 (P)                  | 41  |        |
|                               | phase U4, main sensor, PT100 (N)                  | 13  |        |
| Temperature 11                | phase V4, main sensor, PT100 (P)                  | 39  |        |
|                               | phase V4, main sensor, PT100 (N)                  | 38  |        |
| Temperature 12                | phase W4, main sensor, PT100 (P)                  | 25  |        |
|                               | phase W4, main sensor, PT100 (N)                  | 12  |        |
| Resolver COS                  | Resolver, RES_COS_N, Inbuilt non-contacting       | 35  |        |
| Resolver COS                  | Resolver, RES_COS_P, Inbuilt non-contacting       | 20  |        |
| Resolver SIN                  | Resolver, RES_SIN_N, Inbuilt non-contacting       | 36  |        |
| Resolver SIN                  | Resolver, RES_SIN_P, Inbuilt non-contacting       | 21  |        |
| Resolver EXCN                 | Resolver, EXCN, Inbuilt non-contacting            | 22  |        |
| Resolver EXCP                 | Resolver, EXCP, Inbuilt non-contacting            | 10  |        |
| Resolver shield               | Resolver, SHIELD/GROUND, Inbuilt non-contacting   | 34  |        |
| Resolver2 COS                 | Resolver 2, RES_COS_N, Inbuilt non-contacting     | 37  | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_P, Inbuilt non-contacting     | 24  | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_N, Inbuilt non-contacting     | 23  | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_P, Inbuilt non-contacting     | 11  | +RES2  |
| Resolver2 EXCN                | Resolver 2, EXCN, Inbuilt non-contacting          | 9   | +RES2  |
| Resolver2 EXCP                | Resolver 2, EXCP, Inbuilt non-contacting          | 8   | +RES2  |
| Resolver2 shield              | Resolver 2, SHIELD/GROUND, Inbuilt non-contacting | 4   | +RES2  |
| Bearing temperature, sensor 1 | PT100                                             | 2   |        |
| Bearing temperature, sensor 1 | PT100_GND                                         | 18  |        |
| Bearing temperature, sensor 2 | PT100                                             | 3   |        |
| Bearing temperature, sensor 2 | PT100_GND                                         | 19  |        |
| LV-connector 2                |                                                   |     |        |
| Description                   |                                                   | PIN | Option |
| Temperature 13                | phase U1, spare sensor, PT100 (P)                 | 47  | +TEMP5 |
|                               | phase U1, spare sensor, PT100 (N)                 | 46  |        |
| Temperature 14                | phase V1, spare sensor, PT100 (P)                 | 33  | +TEMP5 |
|                               | phase V1, spare sensor, PT100 (N)                 | 32  |        |

|                |                                   |    |        |
|----------------|-----------------------------------|----|--------|
| Temperature 15 | phase W1, spare sensor, PT100 (P) | 45 | +TEMP5 |
|                | phase W1, spare sensor, PT100 (N) | 31 |        |
| Temperature 16 | phase U2, spare sensor, PT100 (P) | 30 | +TEMP5 |
|                | phase U2, spare sensor, PT100 (N) | 29 |        |
| Temperature 17 | phase V2, spare sensor, PT100 (P) | 44 | +TEMP5 |
|                | phase V2, spare sensor, PT100 (N) | 43 |        |
| Temperature 18 | phase W2, spare sensor, PT100 (P) | 28 | +TEMP5 |
|                | phase W2, spare sensor, PT100 (N) | 16 |        |
| Temperature 19 | phase U3, spare sensor, PT100 (P) | 42 | +TEMP5 |
|                | phase U3, spare sensor, PT100 (N) | 27 |        |
| Temperature 20 | phase V3, spare sensor, PT100 (P) | 15 | +TEMP5 |
|                | phase V3, spare sensor, PT100 (N) | 14 |        |
| Temperature 21 | phase W3, spare sensor, PT100 (P) | 40 | +TEMP5 |
|                | phase W3, spare sensor, PT100 (N) | 26 |        |
| Temperature 22 | phase U4, spare sensor, PT100 (P) | 41 | +TEMP5 |
|                | phase U4, spare sensor, PT100 (N) | 13 |        |
| Temperature 23 | phase V4, spare sensor, PT100 (P) | 39 | +TEMP5 |
|                | phase V4, spare sensor, PT100 (N) | 38 |        |
| Temperature 24 | phase W4, spare sensor, PT100 (P) | 25 | +TEMP5 |
|                | phase W4, spare sensor, PT100 (N) | 12 |        |

Table 2 Pin configuration of LV-connectors (+QUAD)

| Measurement     | Description                                     | PIN       | Option |
|-----------------|-------------------------------------------------|-----------|--------|
| <b>N-END</b>    |                                                 |           |        |
| HEAT            | Heater, ground / protective earth               | 1 $\perp$ | +HEAT  |
| HEAT            | Heater, neutral                                 | 2         | +HEAT  |
| HEAT            | Heater, phase, 230 V <sub>AC</sub>              | 3         | +HEAT  |
| Resolver shield | Resolver, SHIELD/GROUND, Inbuilt non-contacting | 4 $\perp$ | +RES1  |
| Resolver COS    | Resolver, RES_COS_N, Inbuilt non-contacting     | 5         | +RES1  |
| Resolver COS    | Resolver, RES_COS_P, Inbuilt non-contacting     | 6         | +RES1  |
| Resolver SIN    | Resolver, RES_SIN_N, Inbuilt non-contacting     | 7         | +RES1  |
| Resolver SIN    | Resolver, RES_SIN_P, Inbuilt non-contacting     | 8         | +RES1  |
| Resolver EXCN   | Resolver, EXCN, Inbuilt non-contacting          | 9         | +RES1  |
| Resolver EXCP   | Resolver, EXCP, Inbuilt non-contacting          | 10        | +RES1  |
| Temperature 1   | phase U1, main sensor, PT100 (P)                | 11        |        |
|                 | phase U1, main sensor, PT100 (N)                | 12        |        |
| Temperature 2   | phase V1, main sensor, PT100 (P)                | 13        |        |
|                 | phase V1, main sensor, PT100 (N)                | 14        |        |
| Temperature 3   | phase W1, main sensor, PT100 (P)                | 15        |        |
|                 | phase W1, main sensor, PT100 (N)                | 16        |        |
| Temperature 4   | phase U2, main sensor, PT100 (P)                | 17        |        |
|                 | phase U2, main sensor, PT100 (N)                | 18        |        |
| Temperature 5   | phase V2, main sensor, PT100 (P)                | 19        |        |
|                 | phase V2, main sensor, PT100 (N)                | 20        |        |
| Temperature 6   | phase W2, main sensor, PT100 (P)                | 21        |        |
|                 | phase W2, main sensor, PT100 (N)                | 22        |        |
| Temperature 7   | phase U1, spare sensor, PT100 (P)               | 23        | +TEMP5 |
|                 | phase U1, spare sensor, PT100 (N)               | 24        |        |
| Temperature 8   | phase V1, spare sensor, PT100 (P)               | 25        | +TEMP5 |

|                               |                                   |    |        |
|-------------------------------|-----------------------------------|----|--------|
|                               | phase V1, spare sensor, PT100 (N) | 26 |        |
| Temperature 9                 | phase W1, spare sensor, PT100 (P) | 27 | +TEMP5 |
|                               | phase W1, spare sensor, PT100 (N) | 28 |        |
| Temperature 10                | phase U2, spare sensor, PT100 (P) | 29 | +TEMP5 |
|                               | phase U2, spare sensor, PT100 (N) | 30 |        |
| Temperature 11                | phase V2, spare sensor, PT100 (P) | 31 | +TEMP5 |
|                               | phase V2, spare sensor, PT100 (N) | 32 |        |
| Temperature 12                | phase W2, spare sensor, PT100 (P) | 33 | +TEMP5 |
|                               | phase W2, spare sensor, PT100 (N) | 34 |        |
| TEMP                          | N/A                               | 27 |        |
| TEMP                          | N/A                               | 28 |        |
| TEMP                          | N/A                               | 29 |        |
| TEMP                          | N/A                               | 30 |        |
| TEMP                          | N/A                               | 31 |        |
| TEMP                          | N/A                               | 32 |        |
| TEMP                          | N/A                               | 33 |        |
| TEMP                          | N/A                               | 34 |        |
| TEMP                          | N/A                               | 35 |        |
| TEMP                          | N/A                               | 36 |        |
| TEMP                          | N/A                               | 37 |        |
| TEMP                          | N/A                               | 38 |        |
| TEMP                          | N/A                               | 39 |        |
| TEMP                          | N/A                               | 40 |        |
| TEMP                          | N/A                               | 41 |        |
| TEMP                          | N/A                               | 42 |        |
| TEMP                          | N/A                               | 43 |        |
| TEMP                          | N/A                               | 44 |        |
| TEMP                          | N/A                               | 45 |        |
| TEMP                          | N/A                               | 46 |        |
| TEMP                          | N/A                               | 47 |        |
| TEMP                          | N/A                               | 48 |        |
| TEMP                          | N/A                               | 49 |        |
| TEMP                          | N/A                               | 50 |        |
| TEMP                          | N/A                               | 51 |        |
| TEMP                          | N/A                               | 52 |        |
| TEMP                          | N/A                               | 53 |        |
| TEMP                          | N/A                               | 54 |        |
| TEMP                          | N/A                               | 55 |        |
| TEMP                          | N/A                               | 56 |        |
| TEMP                          | N/A                               | 57 |        |
| TEMP                          | N/A                               | 58 |        |
| Bearing temperature, sensor 1 | PT100                             | 59 | +BTMP  |
| Bearing temperature, sensor 1 | PT100_GND                         | 60 | +BTMP  |
| Bearing temperature, sensor 2 | PT100                             | 61 | +BTMP  |
| Bearing temperature, sensor 2 | PT100_GND                         | 62 | +BTMP  |
| Reserve                       |                                   | 63 |        |
| Reserve                       |                                   | 64 |        |
| Reserve                       |                                   | 65 |        |

|                               |                                                   |    |        |
|-------------------------------|---------------------------------------------------|----|--------|
| Reserve                       |                                                   | 66 |        |
| Resolver2 shield              | Resolver 2, SHIELD/GROUND, Inbuilt non-contacting | 67 | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_N, Inbuilt non-contacting     | 68 | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_P, Inbuilt non-contacting     | 69 | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_N, Inbuilt non-contacting     | 70 | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_P, Inbuilt non-contacting     | 71 | +RES2  |
| Resolver2 EXCN                | Resolver 2, EXCN, Inbuilt non-contacting          | 72 | +RES2  |
| Resolver2 EXCP                | Resolver 2, EXCP, Inbuilt non-contacting          | 73 | +RES2  |
| <b>D-END 1/2</b>              |                                                   |    |        |
| Bearing temperature, sensor 1 | PT100                                             | 74 | +BTMP  |
| Bearing temperature, sensor 1 | PT100_GND                                         | 75 | +BTMP  |
| Bearing temperature, sensor 2 | PT100                                             | 76 | +BTMP  |
| Bearing temperature, sensor 2 | PT100_GND                                         | 77 | +BTMP  |
| <b>D-END 2/2</b>              |                                                   |    |        |
| HEAT2                         | Heater 2, ground / protective earth               | 78 | +HEAT2 |
| HEAT2                         | Heater 2, neutral                                 | 79 | +HEAT2 |
| HEAT2                         | Heater 2, phase, 230 V <sub>AC</sub>              | 80 | +HEAT2 |

Table 3 Pin configuration of +LVB connection (+DUAL)

| Measurement     | Description                                     | PIN                                                                                   | Option |
|-----------------|-------------------------------------------------|---------------------------------------------------------------------------------------|--------|
| <b>N-END</b>    |                                                 |                                                                                       |        |
| HEAT            | Heater, ground / protective earth               | 1  | +HEAT  |
| HEAT            | Heater, neutral                                 | 2                                                                                     | +HEAT  |
| HEAT            | Heater, phase, 230 V <sub>AC</sub>              | 3                                                                                     | +HEAT  |
| Resolver shield | Resolver, SHIELD/GROUND, Inbuilt non-contacting | 4  | +RES1  |
| Resolver COS    | Resolver, RES_COS_N, Inbuilt non-contacting     | 5                                                                                     | +RES1  |
| Resolver COS    | Resolver, RES_COS_P, Inbuilt non-contacting     | 6                                                                                     | +RES1  |
| Resolver SIN    | Resolver, RES_SIN_N, Inbuilt non-contacting     | 7                                                                                     | +RES1  |
| Resolver SIN    | Resolver, RES_SIN_P, Inbuilt non-contacting     | 8                                                                                     | +RES1  |
| Resolver EXCN   | Resolver, EXCN, Inbuilt non-contacting          | 9                                                                                     | +RES1  |
| Resolver EXCP   | Resolver, EXCP, Inbuilt non-contacting          | 10                                                                                    | +RES1  |
| Temperature 1   | phase U1, main sensor, PT100 (P)                | 11                                                                                    |        |
|                 | phase U1, main sensor, PT100 (N)                | 12                                                                                    |        |
| Temperature 2   | phase V1, main sensor, PT100 (P)                | 13                                                                                    |        |
|                 | phase V1, main sensor, PT100 (N)                | 14                                                                                    |        |
| Temperature 3   | phase W1, main sensor, PT100 (P)                | 15                                                                                    |        |
|                 | phase W1, main sensor, PT100 (N)                | 16                                                                                    |        |
| Temperature 4   | phase U2, main sensor, PT100 (P)                | 17                                                                                    |        |
|                 | phase U2, main sensor, PT100 (N)                | 18                                                                                    |        |
| Temperature 5   | phase V2, main sensor, PT100 (P)                | 19                                                                                    |        |
|                 | phase V2, main sensor, PT100 (N)                | 20                                                                                    |        |
| Temperature 6   | phase W2, main sensor, PT100 (P)                | 21                                                                                    |        |
|                 | phase W2, main sensor, PT100 (N)                | 22                                                                                    |        |
| Temperature 7   | phase U3, spare sensor, PT100 (P)               | 23                                                                                    |        |
|                 | phase U3, spare sensor, PT100 (N)               | 24                                                                                    |        |
| Temperature 8   | phase V3, spare sensor, PT100 (P)               | 25                                                                                    |        |
|                 | phase V3, spare sensor, PT100 (N)               | 26                                                                                    |        |

|                               |                                                   |    |        |
|-------------------------------|---------------------------------------------------|----|--------|
| Temperature 9                 | phase W3, spare sensor, PT100 (P)                 | 27 |        |
|                               | phase W3, spare sensor, PT100 (N)                 | 28 |        |
| Temperature 10                | phase U4, spare sensor, PT100 (P)                 | 29 |        |
|                               | phase U4, spare sensor, PT100 (N)                 | 30 |        |
| Temperature 11                | phase V4, spare sensor, PT100 (P)                 | 31 |        |
|                               | phase V4, spare sensor, PT100 (N)                 | 32 |        |
| Temperature 12                | phase W4, spare sensor, PT100 (P)                 | 33 |        |
|                               | phase W4, spare sensor, PT100 (N)                 | 34 |        |
| Temperature 13                | phase U1, spare sensor, PT100 (P)                 | 35 | +TEMP5 |
|                               | phase U1, spare sensor, PT100 (N)                 | 36 |        |
| Temperature 14                | phase V1, spare sensor, PT100 (P)                 | 37 | +TEMP5 |
|                               | phase V1, spare sensor, PT100 (N)                 | 38 |        |
| Temperature 15                | phase W1, spare sensor, PT100 (P)                 | 39 | +TEMP5 |
|                               | phase W1, spare sensor, PT100 (N)                 | 40 |        |
| Temperature 16                | phase U2, spare sensor, PT100 (P)                 | 41 | +TEMP5 |
|                               | phase U2, spare sensor, PT100 (N)                 | 42 |        |
| Temperature 17                | phase V2, spare sensor, PT100 (P)                 | 43 | +TEMP5 |
|                               | phase V2, spare sensor, PT100 (N)                 | 44 |        |
| Temperature 18                | phase W2, spare sensor, PT100 (P)                 | 45 | +TEMP5 |
|                               | phase W2, spare sensor, PT100 (N)                 | 46 |        |
| Temperature 19                | phase U3, spare sensor, PT100 (P)                 | 47 | +TEMP5 |
|                               | phase U3, spare sensor, PT100 (N)                 | 48 |        |
| Temperature 20                | phase V3, spare sensor, PT100 (P)                 | 49 | +TEMP5 |
|                               | phase V3, spare sensor, PT100 (N)                 | 50 |        |
| Temperature 21                | phase W3, spare sensor, PT100 (P)                 | 51 | +TEMP5 |
|                               | phase W3, spare sensor, PT100 (N)                 | 52 |        |
| Temperature 22                | phase U4, spare sensor, PT100 (P)                 | 53 | +TEMP5 |
|                               | phase U4, spare sensor, PT100 (N)                 | 54 |        |
| Temperature 23                | phase V4, spare sensor, PT100 (P)                 | 55 | +TEMP5 |
|                               | phase V4, spare sensor, PT100 (N)                 | 56 |        |
| Temperature 24                | phase W4, spare sensor, PT100 (P)                 | 57 | +TEMP5 |
|                               | phase W4, spare sensor, PT100 (N)                 | 58 |        |
| Bearing temperature, sensor 1 | PT100                                             | 59 | +BTMP  |
| Bearing temperature, sensor 1 | PT100_GND                                         | 60 | +BTMP  |
| Bearing temperature, sensor 2 | PT100                                             | 61 | +BTMP  |
| Bearing temperature, sensor 2 | PT100_GND                                         | 62 | +BTMP  |
| Reserve                       |                                                   | 63 |        |
| Reserve                       |                                                   | 64 |        |
| Reserve                       |                                                   | 65 |        |
| Reserve                       |                                                   | 66 |        |
| Resolver2 shield              | Resolver 2, SHIELD/GROUND, Inbuilt non-contacting | 67 | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_N, Inbuilt non-contacting     | 68 | +RES2  |
| Resolver2 COS                 | Resolver 2, RES_COS_P, Inbuilt non-contacting     | 69 | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_N, Inbuilt non-contacting     | 70 | +RES2  |
| Resolver2 SIN                 | Resolver 2, RES_SIN_P, Inbuilt non-contacting     | 71 | +RES2  |
| Resolver2 EXCN                | Resolver 2, EXCN, Inbuilt non-contacting          | 72 | +RES2  |
| Resolver2 EXCP                | Resolver 2, EXCP, Inbuilt non-contacting          | 73 | +RES2  |

D-END 1/2

|                               |                                      |    |        |
|-------------------------------|--------------------------------------|----|--------|
| Bearing temperature, sensor 1 | PT100                                | 74 | +BTMP  |
| Bearing temperature, sensor 1 | PT100_GND                            | 75 | +BTMP  |
| Bearing temperature, sensor 2 | PT100                                | 76 | +BTMP  |
| Bearing temperature, sensor 2 | PT100_GND                            | 77 | +BTMP  |
| <b>D-END 2/2</b>              |                                      |    |        |
| HEAT2                         | Heater 2, ground / protective earth  | 78 | +HEAT2 |
| HEAT2                         | Heater 2, neutral                    | 79 | +HEAT2 |
| HEAT2                         | Heater 2, phase, 230 V <sub>AC</sub> | 80 | +HEAT2 |

Table 4 Pin configuration of +LVB connection (+QUAD)

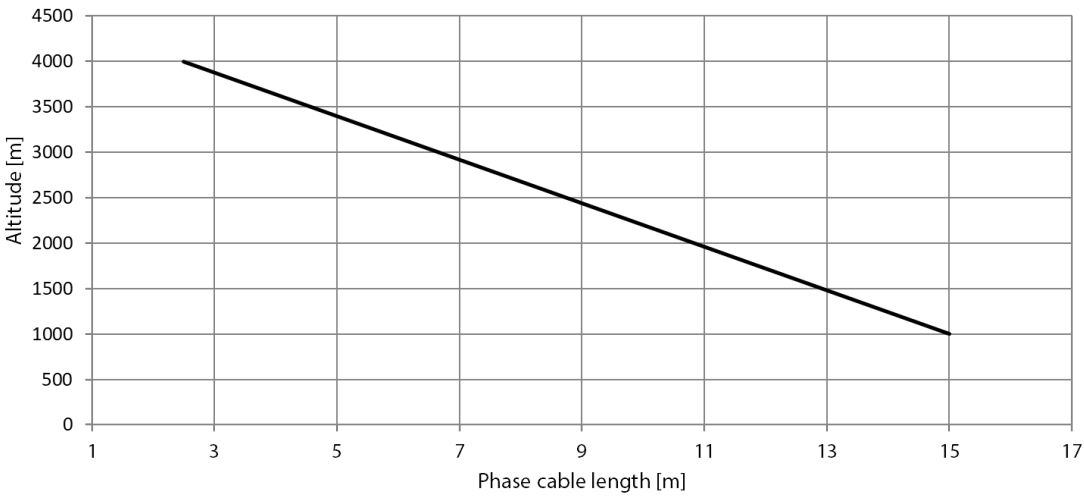
| PIN                                                                               | Description                |
|-----------------------------------------------------------------------------------|----------------------------|
| 1                                                                                 | Phase, 230 V <sub>AC</sub> |
| 2                                                                                 | Neutral                    |
|  | Ground/protective earth    |
| 4                                                                                 | Reserve                    |
| 5                                                                                 | Reserve                    |

Table 5 Pin configuration of heater

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

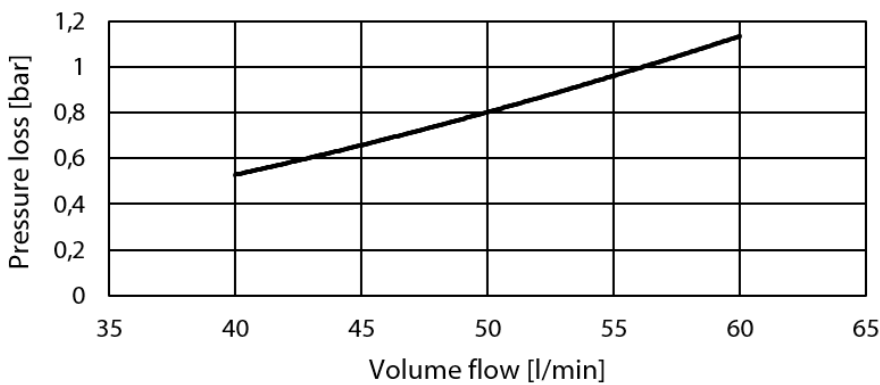
Table 6 Pin configuration of bearing temperature sensor connector (one two-wire PT100 sensor) in D-end

ALLOWED ALTITUDES VS PHASE CABLE LENGTH



Picture 1 Allowed altitudes vs phase cable length

PRESSURE LOSS VS COOLANT FLOW



Picture 2 Pressure loss vs coolant flow

| Mounting   |                                     |                                     |                                     | Shaft                               |          |        |                                     | IEC60034-7 |         |
|------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|----------|--------|-------------------------------------|------------|---------|
| Horizontal | Foot                                | Side                                | Flange                              | D-end                               | Dual-end | Spline | Cylindrical                         | Code I     | Code II |
|            | <input checked="" type="checkbox"/> |                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |          |        |                                     | B35        | IM2001  |
|            |                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |          |        |                                     | B25        | IM2401  |
|            | <input checked="" type="checkbox"/> |                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |          |        | <input checked="" type="checkbox"/> | B35        | IM2001  |
|            |                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |          |        | <input checked="" type="checkbox"/> | B25        | IM2401  |
|            |                                     | <input checked="" type="checkbox"/> |                                     | <input checked="" type="checkbox"/> |          |        |                                     | B20        | IM1101  |
|            | <input checked="" type="checkbox"/> |                                     |                                     | <input checked="" type="checkbox"/> |          |        |                                     | B3         | IM1001  |
|            |                                     | <input checked="" type="checkbox"/> |                                     | <input checked="" type="checkbox"/> |          |        | <input checked="" type="checkbox"/> | B20        | IM1101  |
|            | <input checked="" type="checkbox"/> |                                     |                                     | <input checked="" type="checkbox"/> |          |        | <input checked="" type="checkbox"/> | B3         | IM1001  |

Table 7 Mounting method

## 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 DUAL (a) | Peak torque QUAD (b) |
| EM-PMI540B-T4000-600  | 4522                      | 284              | 387              | 5454                      | 342              | 463              | 600                             | 1200             | 5930                 | 5930                 |
| EM-PMI540B-T4000-1200 | 4229                      | 531              | 716              | 4692                      | 590              | 790              | 1200                            | 2400             | 4158                 | 5930                 |
| EM-PMI540B-T4000-1600 | 4183                      | 701              | 954              | 4639                      | 777              | 1058             | 1600                            | 3200             | 3062                 | 5930                 |
| EM-PMI540B-T4000-2400 | 3565                      | 896              | 1232             | 4067                      | 1022             | 1422             | 2400                            | 4000 (c)         | -                    | 4000                 |

(a) Peak torque achieved with two 350A inverters

(b) Peak torque achieved with four 350A inverters

(c) Mechanical maximum speed

The maximum allowed peak torque duration at stator winding starting temperature +90°C is 10.5 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 <sub>AC</sub> /rpm] (d) |
| EM-PMI540B-T4000-600  | 340                       | 336              | 388              | 0.99         | 408                       | 397              | 464              | 0.97         | 800                             | 107             | 0.816                                        |
| EM-PMI540B-T4000-1200 | 609                       | 589              | 705              | 0.97         | 674                       | 648              | 779              | 0.96         | 1400                            | 187             | 0.416                                        |
| EM-PMI540B-T4000-1600 | 809                       | 759              | 942              | 0.94         | 896                       | 831              | 1040             | 0.93         | 1800                            | 240             | 0.290                                        |
| EM-PMI540B-T4000-2400 | 984                       | 911              | 1185             | 0.92         | 1074                      | 1024             | 1308             | 0.95         | 2500                            | 333             | 0.193                                        |

(d) 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-PMI540B-T4000-1600-DUAL          | Standard 1600 rpm unit with standard options                    |
| EM-PMI540B-T4000-1600-DUAL+BIA+RES1 | Standard unit otherwise but with isolated bearings and resolver |

Table 8 Product code examples

| Variant                                          | Code        | Description                                                         | Additional information                                                                                                                                                                       |
|--------------------------------------------------|-------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High voltage connections                         | -DUAL (***) | Two galvanically isolated three-phase systems                       | 1 x M32 cable gland per phase, total of 6 pcs M32 cable glands                                                                                                                               |
|                                                  | -QUAD       | Four galvanically isolated three-phase systems                      | 1 x M32 cable gland per phase, total of 12 pcs M32 cable glands                                                                                                                              |
| Low voltage connections (signal and auxiliaries) | *           | Low voltage connections done with connector                         | See Connections – section of the data sheet                                                                                                                                                  |
|                                                  | +LVB1       | Low voltage connections done with connection box and terminal strip | D-end: LV connection box with 1 x M16 cable gland + terminal strips<br>N-end: LV connection box with 1 x M25, 2 x M16 and 1 x M12 cable glands + terminal strips (see user guide for pinout) |
| D-end shaft                                      | *           | Male shaft, cylindrical                                             | Cylindrical shaft, diameter 70 mm h7                                                                                                                                                         |
|                                                  | +S3 (***)   | Male shaft, spline                                                  | DIN 5480 W70x2x30x34x8f                                                                                                                                                                      |
| N-end attachment                                 | *           | None                                                                |                                                                                                                                                                                              |
|                                                  | +NE4 (***)  | Male shaft, no flange                                               | Cylindrical shaft, diameter 70 mm h7 (standard)<br>DIN 5480 W70x2x30x34x8f (+S3)                                                                                                             |
| Foot mounting                                    | *           | None                                                                |                                                                                                                                                                                              |
|                                                  | +FM1        | Foot                                                                | Foot mounting, shaft height 315 mm                                                                                                                                                           |
| 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                                               | Inbuilt grounding ring                                                                                                                                                                       |
| Rotation sensor                                  | *           | None                                                                | No resolver                                                                                                                                                                                  |
|                                                  | +RES1       | Resolver                                                            | Inbuilt non-contacting resolver, 8-pole pair                                                                                                                                                 |
|                                                  | +RES2       | Double resolver                                                     | Inbuilt non-contacting resolver, 8-pole pair                                                                                                                                                 |
| Winding temperature sensors                      | *           | Temperature surveillance                                            | DUAL: 6 x PT100 (two-wire) in windings<br>QUAD: 12 x PT100 (two-wire) in windings                                                                                                            |
|                                                  | +TEMP5      | Redundant temperature surveillance                                  | DUAL: 12 x PT100 (two-wire) in windings<br>QUAD: 24 x PT100 (two-wire) in windings                                                                                                           |
| Bearing temperature sensors                      | *           | None                                                                |                                                                                                                                                                                              |
|                                                  | +BTMP1      | PT100 in bearings                                                   | Plugin connector                                                                                                                                                                             |
| Anti-condensation heaters                        | *           | None                                                                |                                                                                                                                                                                              |
|                                                  | +HEAT2      | Two anti-condensation heaters                                       | 2 x 230 V <sub>AC</sub> / 130 W (see user guide for more information)                                                                                                                        |
| Machine coating                                  | *           | None                                                                |                                                                                                                                                                                              |
|                                                  | +C5         | High corrosion category                                             | Dark grey RAL7024<br>Type of coating: Epoxy<br>Minimum number of coats (MNOC): 2<br>Minimum nominal dry film thickness: 240 µm                                                               |

(\* Standard option

(\*\*\* Option not currently launched. Available on request.

Table 9 Option list

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