

# PMM 2000M

## 0-130 rpm



### Designed and built for shaft generator and propulsion motor applications

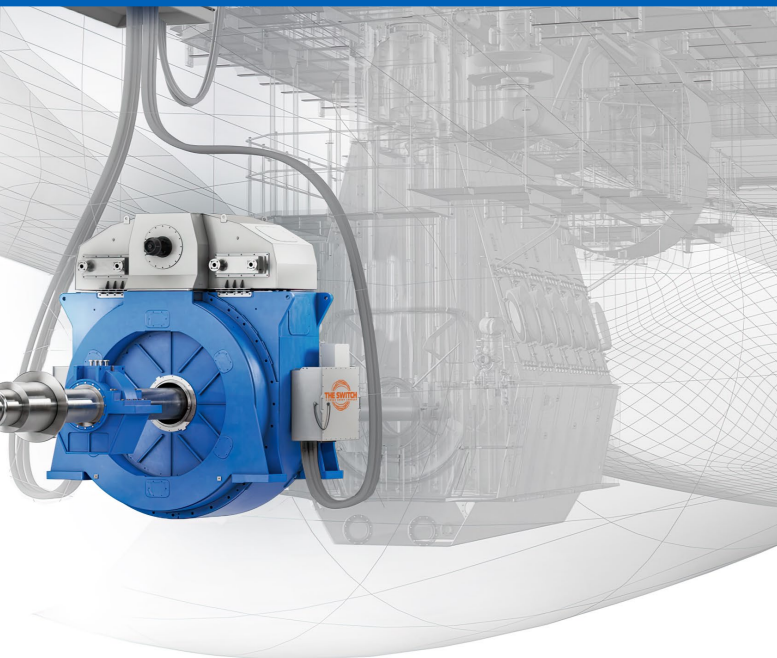
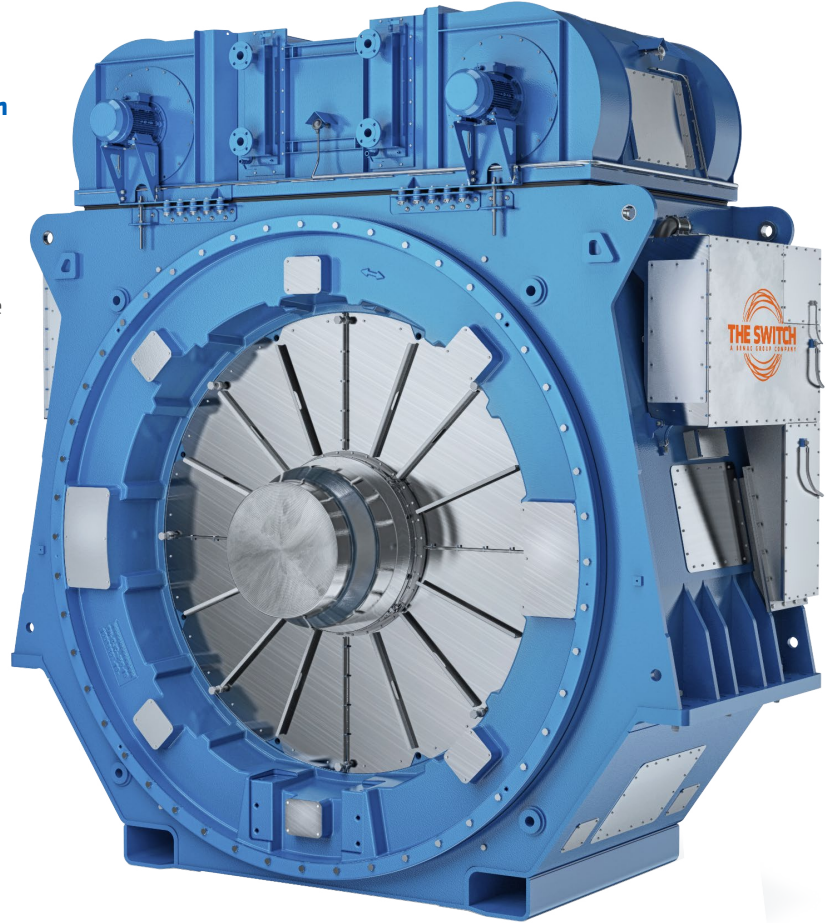
For various vessel types, such as container vessels, LNG carriers, product tankers and more.

- 100% designed for marine applications
- Brushless permanent magnet (PM) synchronous machine
- High efficiency, reducing fuel consumption and lowering emissions
- Compact and lightweight design
- Easy to install
- Low operating costs
- Built according to international standards
- Certificates from leading classification societies worldwide

Always tailored to application-specific requirements by adjusting:

- Speed range
- Cooling
- Voltage
- Machine length based on torque
- Other key parameters

Each machine is comprehensively tested in our own testing facilities before delivery.



| Technical data <sup>1</sup>                               |                                                                         |        |        |        |        |        |        |        |        |
|-----------------------------------------------------------|-------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Frame                                                     | 2000M                                                                   |        |        |        |        |        |        |        |        |
|                                                           | 8                                                                       | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     |
| Max. continuous torque [kNm]                              | 585                                                                     | 655    | 725    | 795    | 866    | 936    | 1,006  | 1,076  | 1,147  |
| Shaft center height [mm]                                  | 2,000                                                                   |        |        |        |        |        |        |        |        |
| Continuous speed range [rpm]                              | 0-130                                                                   |        |        |        |        |        |        |        |        |
| Stator winding type                                       | 2-layer form-wound diamond coil winding with mica insulation            |        |        |        |        |        |        |        |        |
| Max. momentary torque [% of nominal]                      | 130                                                                     |        |        |        |        |        |        |        |        |
| Machine mass excluding shaft or bearings [t]              | 43                                                                      | 46     | 50     | 51     | 53     | 54     | 56     | 59     | 61     |
| Rotor mass including magnet modules and bolting [t]       | 7.5                                                                     | 8.0    | 8.5    | 9.1    | 9.6    | 10.1   | 10.6   | 11.1   | 11.7   |
| Rotor inertia including magnet modules and bolting [kgm²] | 14,700                                                                  | 15,800 | 17,000 | 18,100 | 19,300 | 20,400 | 21,500 | 22,600 | 23,800 |
| Protection class <sup>2</sup>                             | IP44                                                                    |        |        |        |        |        |        |        |        |
| Cooling type                                              | IC8A6W7 (Forced air cooling with external air-to-liquid heat exchanger) |        |        |        |        |        |        |        |        |
| Number of poles                                           | 60                                                                      |        |        |        |        |        |        |        |        |
| Nominal voltage [V] <sup>3</sup>                          | 450/500/690                                                             |        |        |        |        |        |        |        |        |
| Max. ambient temperature [°C]                             | 45                                                                      |        |        |        |        |        |        |        |        |
| Max. cooling liquid temperature [°C]                      | 38                                                                      |        |        |        |        |        |        |        |        |
| Insulation class <sup>4</sup>                             | 155                                                                     |        |        |        |        |        |        |        |        |
| Thermal class                                             | 155                                                                     |        |        |        |        |        |        |        |        |

<sup>1</sup>Numbers shown here are subject to change depending on project-specific requirements

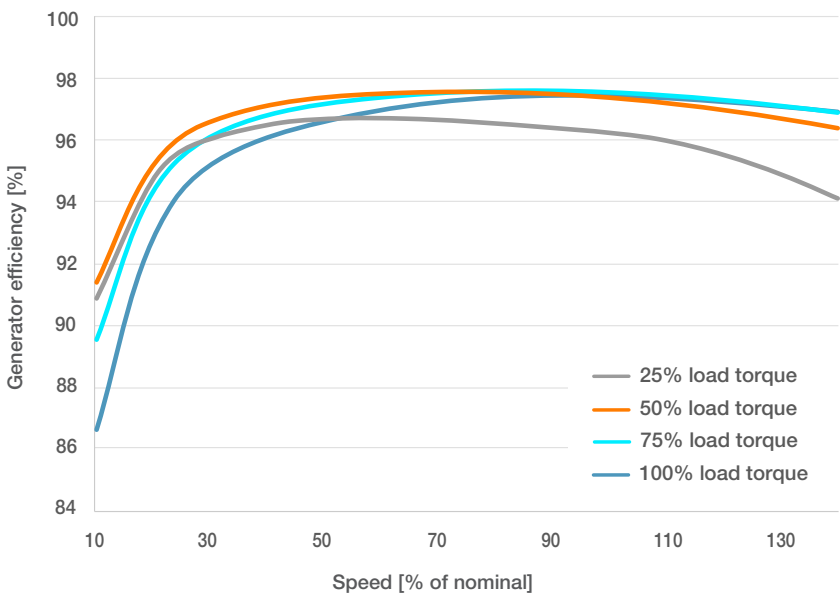
<sup>2</sup> Higher class optional, <sup>3</sup> Medium voltage optional, <sup>4</sup> 180 class optional

| Features                                                       | Main benefits                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Excitation with Neodymium magnets                              | <ul style="list-style-type: none"><li>- Excellent efficiency, especially at part loads</li><li>- Brushless, no slip rings needed, no wearing parts</li><li>- No external exciters needed</li><li>- No automatic voltage regulator (AVR) needed</li><li>- Low rotor weight and inertia</li><li>- In generator mode, possible to start from blackout</li><li>- Very low vibration levels</li></ul>                              |
| Form-wound, mica-insulated winding impregnated with global VPI | <ul style="list-style-type: none"><li>- Best possible protection against mechanical vibrations, chemical corrosion and electrical surges</li><li>- Proven technology with a solid track record in marine</li><li>- Easily scalable up to medium voltages</li></ul>                                                                                                                                                            |
| Control with frequency converter                               | <ul style="list-style-type: none"><li>- Variable speed operation, decouples the machine rotation speed from grid's voltage and frequency</li><li>- Maximized system efficiency</li><li>- In shaft generator applications, both PTI and PTO modes available</li><li>- Full torque available starting from zero speed</li><li>- Momentary overloading for clearing ice loads, foreign parts on the propeller or other</li></ul> |
| IP44 protection class                                          | <ul style="list-style-type: none"><li>- Closed system, no external particles or dirt can enter the machine</li></ul>                                                                                                                                                                                                                                                                                                          |
| Compact machine                                                | <ul style="list-style-type: none"><li>- Design optimized for each delivery project using proven technology and product platform</li><li>- Short machine because external rotor excitation is unnecessary</li></ul>                                                                                                                                                                                                            |

| Features                   | Main benefits                                                                                                                                                                                                                                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Redundancy                 | <ul style="list-style-type: none"><li>- With dual winding machine, possibility to safely operate the machine with reduced power in case of converter failure</li><li>- Possible to operate the machine on reduced power with one cooling fan out of order</li></ul>                                                    |
| Rotor                      | <ul style="list-style-type: none"><li>- In shaft generator applications, it is possible to decouple the rotor from the propulsion shaft line in less than 3 hours</li><li>- Low-inertia design compared to other generator technologies and even permanent magnet solutions</li></ul>                                  |
| Flexible design            | <ul style="list-style-type: none"><li>- Variable machine torque by varying length (number of substacks)</li><li>- Modular design allows customization</li><li>- Cable interfaces in different directions in terminal boxes</li><li>- Interchangeable main and star-point terminal boxes</li></ul>                      |
| Easy and fast installation | <ul style="list-style-type: none"><li>- Common bearings with propulsion shaft line</li><li>- Rotor inserted in stator for transport</li><li>- Easily accessible terminal boxes</li><li>- HEX rubber bellow expansion joints</li><li>- New eccentricity adjustment method with dial indicators</li></ul>                |
| Low operating expenses     | <ul style="list-style-type: none"><li>- High efficiency, lower fuel consumption</li><li>- Simple, robust and reliable machine</li><li>- Less maintenance</li><li>- No bearings, rotor windings, slip rings, exciters or automatic voltage regulators (AVRs)</li><li>- Terminal boxes with forced air cooling</li></ul> |

Typical efficiencies of The Switch PMM at various speeds and load levels

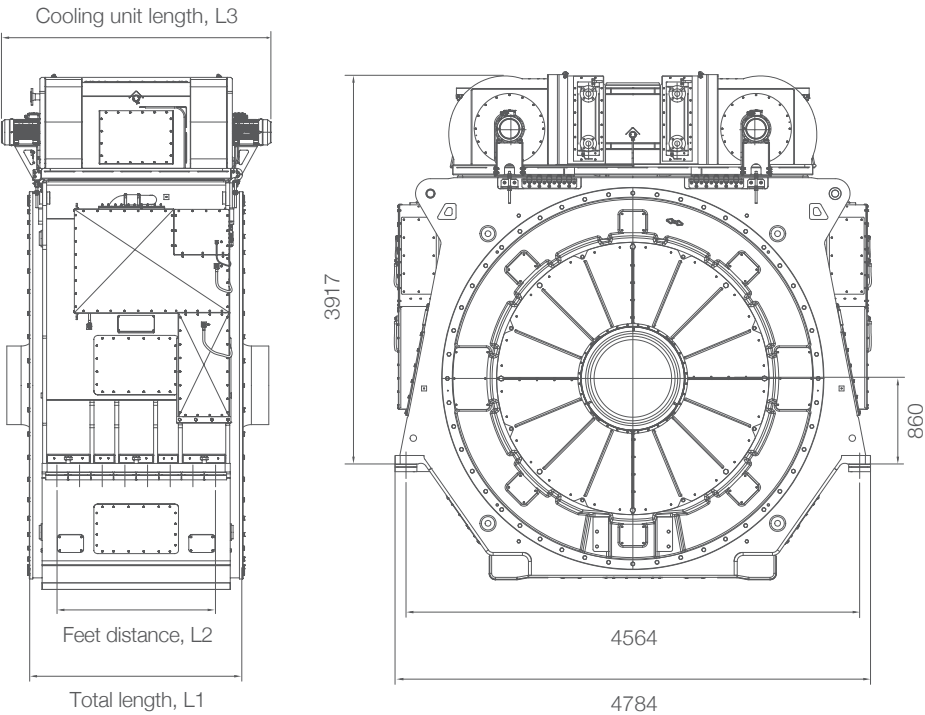
This chart illustrates typical efficiencies vs speed at different load levels, taking into account external cooling fan power consumption.



The exact efficiency value depends on the nominal speed of the application.

Technical drawings

The dimensions below are for a shaft generator without bearings or shaft. Ask about dimensions for the propulsion motor version, as they vary according to customer requirements.



Machine dimensions

| Frame                        | 2000M |       |       |       |       |       |       |       |       |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                              | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
| Total length, L1 [mm]        | 1,813 | 1,890 | 1,967 | 2,044 | 2,121 | 2,198 | 2,275 | 2,352 | 2,429 |
| Feet distance, L2 [mm]       | 1,275 | 1,350 | 1,418 | 1,490 | 1,575 | 1,650 | 1,725 | 1,800 | 1,878 |
| Cooling unit length, L3 [mm] | 2,367 | 2,444 | 2,521 | 2,598 | 2,675 | 2,752 | 2,829 | 2,906 | 2,983 |

Direct-drive propulsion

The Switch permanent magnet machine (PMM) can be used as a direct-drive propulsion motor in a standard configuration with its own bearings. Alternatively, it can be used as a novel concept, utilizing the common bearings between the propulsion shaft and the motor. A tandem setup is also possible on request.

