

CHALLENGES FOR RENEWABLE ENERGY



By Thomas Grasshoff

If we look back over the last 10 years, major changes have taken place in the market perception of power electronics. In the past, neither the public nor the press focused much on power electronics or the use of power electronics in motor, pump or elevator drives. With the boom of renewable energies, however, this has changed dramatically.

The onset of wind power generation was more than 20 years ago. SEMIKRON was already manufacturing intelligent power modules based on the new pressure contact technology and featuring integrated driver electronics, sensors and cooling unit – pre-tested and optimized systems.

Today, the onus is slightly different. In the fourth generation of SKiiP IPMs featuring integrated driver and heat sink, the main focuses are high power density and overall reliability. This is why every SKiiP module undergoes a 2-hour burn-in test under real 4Q inverter conditions before it leaves our premises.

Now, most wind turbines have an output of 2- 3MW. Work on the 5MW class has already

begun, with initial offshore and mainland installations already in the test stages. The next step up to the 7.5 - 10MW class is under development. For power electronics this is a major challenge. Available space in the nacelle is limited but power is increasing. More compact and more efficient solutions are required. The SKiiP4 is the most powerful intelligent power module with an output power of 3600A on the market and is 33% more powerful than its predecessor SKiiP 3. The design was optimized to cope with high DC link voltages and high installation altitudes of up to 4500m above sea level.

There are two ways to reduce the costs of power electronics - either by reducing the thermal resistances between the junction of the chips and the environment or by increasing temperature

towards operating temperatures at and above 150°C. Temperature increase has a major impact on module lifetime and new assembly technologies are the key to further improvements in this area. Solder melting temperatures of 250°C are too close to the maximum silicon operating temperatures and lead to delamination and ultimately module destruction. Sinter technology based on a thin silver interface with a melting temperature of 960°C prevents aging and reduces the thermal resistance by 20% compared to traditional solder joints.

In the area of thermal efficiency there is one major drawback: the thermal paste layer between the module and the heat sink has 400 times the thermal resistance of copper, is difficult to apply and is responsible for 60% of the thermal resistance between