

More energy from optimised Permanent Magnet Generator and full-power converter drive train package

The Switch, a Finland-based technology company, has been raising the standard for increased energy production from wind with its special drive train that utilises an optimised **Permanent Magnet Generator (PMG)** and **full-power converter package**. By selecting this technology as its chosen area of focus, The Switch has been able to capture the power of the wind more effectively and transform it into **considerably more energy**.

Commitment to the winning technology in the race to harness the wind, turbine manufacturers have sought an ideal drive train configuration that raises energy production and limits power losses. The Switch committed early-on to the PMG and full-power converter technology and became one of the leading pioneers. Based on years of experience, the company was able to transfer its know-how from successful industrial drive applications to the wind power business.

“The Switch Drive not only offers substantially improved costs, but the efficiency of the PMG at partial speed is superior to that of conventional double-fed or squirrel-cage systems. This technology has become the

obvious choice for the industry: in some operational points, up to 20% higher partial load efficiency yields more energy from wind turbines using our PMG and full-power converter,” states Jukka-Pekka Mäkinen, President and CEO of The Switch. “Another advantage of the Switch Drive is its ability to tune itself to the site and the season.”

The unique Switch Drive allows active power to be extracted from the turbine as well as the reactive power produced to be individually and precisely controlled over the entire operating speed range.

Permanent Magnet advantages

The advantages of PMGs have been recognised for some time over

conventional double-fed machines in the wind power industry. PMGs typically produce efficiency levels up to 98% at the rated point. In low-speed, direct-drive applications, generator efficiency is not quite as high, but this eliminates the need for a gearbox, therefore complete drive train efficiency is excellent. Still, PMGs show their true strength in partial load situations, which is the way that turbines operate for most of their life due to the wind’s inconsistency. This is where the PMG’s efficiency remains very high, close to nominal value – over a wide range of speeds, thereby producing much higher energy yields.

The PMG is a simple form of a synchronous generator, which requires



no connections and energy feed to the rotor. Permanent magnets are placed on the rotor to create excitation. This is a major factor in accounting for greater efficiency, since rotor losses are almost non-existent. Additional stator-side losses, too, are minimised by driving the generator with an optimal power factor using the PMG technology. PMGs also do not require any separate excitation systems; reducing cost, simplifying the system and improving system efficiency. Maintenance needs are lower since no slip rings are used.

By allowing a wide speed range, it is possible to run the drive train at the optimised operation point for the turbine. The control is based on the optimum turbine curve and is not limited by the drive train, thereby giving much better partial load rates. In comparison, a double-fed machine has a limited speed range not allowing the turbine to fully adapt to actual site conditions.

PMGs easily answer the needs of modern wind farm turbines, as they range from 500 kW to 5 MW and higher. The Switch has commercially produced and successfully delivered a whole range of PMGs, direct driven, medium speed and high speed, for OEM customers in Europe, China and – most recently – in the US. Direct-driven PMGs have minimum wearing parts, making them the most reliable. High-speed PMGs have the traditional three-stage

gearbox with known reliability problems. Therefore, the medium-speed drives are a type of compromise between the other two and look to be the choice of the big turbine players in the future. The double-fed generator can only be used with a three-stage gearbox, as the electrical characteristics fall sharply at lower revolutions per minute.

Benefits of a full-power converter

The Switch full-power converter has been optimised to work with all kinds of PMG concepts. It offers lightweight construction, modular power packs with liquid or air cooling and highly customisable software to match all turbine designs and wind conditions.

The full-power converter enables easy power factor control, which means that all the current can be used for active or reactive power generation. This allows a 100% reactive power feed, even without any wind, and allows the network protection to locate the fault.

The Switch full-power converter features a rugged design that gives greater fault tolerance and grid support with FRT (fault ride through) functionality. It is not as sensitive to changes in the network as traditional converters, and the full-power advantage provide fast control for the ever-changing operational conditions. Moreover, the robust grid-side converter assures stable and high-quality electricity. This is primarily thanks to

the fact that it has been designed for the highest performance, lowering the requirements on the grid. For example, low harmonics, which meet the IEEE 519 requirements, cause extremely low flicker and allow greater flexibility in selecting turbine sites.

Strengthening presence in the US Europe is currently leading in wind power production, but North America and Asia are growing at a faster rate. The United States is one of the highest growth areas of new wind turbine installations. With production facilities already operating in Hudson, New Hampshire, The Switch plans to further strengthen its presence in North America in 2009 and beyond.

The Switch provides unique power conversion systems – power converters, machines and other electrical equipment needed for distributed power generation and industrial processes. Customers use the innovative products and systems of The Switch as part of their own machines or systems in wind turbines and other renewable energy applications or energy conserving applications. The Switch solutions support the battle against climate change and help to preserve energy resources. ▀

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Switch to the gear that's powered to ride.

The Switch is a leading supplier of power converter and permanent magnet generator packages for wind power applications. Each solution is purpose-built for the highest achievable productivity. By tailoring to your needs, we create megawatt-class quality that lasts, whatever the conditions.

With our cutting-edge technology, your turbine can produce up to 20% more energy compared with a conventional double-fed system. We supply permanent magnet generators and power converters up to 6 MW for traditional geared, semi-geared and gearless systems. Our tailored solutions guarantee high system availability and an extended lifetime.



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