Interview with Michael Sleven from Infineon on Power Electronics in Wind Power Applications

By Bodo Arlt, Editor BPS

Bodo Arlt: What influence does the growing wind energy market have on the development of power semiconductors at Infineon?
Michael Sleven:
Infineon has covered the special requirements for power semiconductors in wind turbines depending on the inverter and turbine concept in the last years. As a consequence the new IGBT families comprehend several improvements especially increased thermal and power cycling capacity by a factor of 5 on average.

Bodo Arlt: What are the challenges/alternatives in this market?
Michael Sleven:
Utilities today want to operate a wind park as flexible as a gas fired power plant. A wind turbine has to connect to the grid when requested and provide the required active and reactive power under strict grid requirements (grid code). A modern wind turbine has to provide electrical energy under almost any wind condition for minimum 15 years without failure. Frequency converters constitute an important part and facilitate the grid compliant power supply. Building the core of these converters, modern power semiconductors from Infineon meet the requirements of this application for highest reliability.

Bodo Arlt: Which solutions does Infineon offer to stay ahead in the wind market?
Michael Sleven:
We offer the IGBT modules PrimePACK™ and IHM-B for the 1 to at least 6 megawatt range and the Econo™ family for less than 1megawatt range. For these 3 product families Infineon provides a broad portfolio of half bridges and chopper modules for each topology in the wind turbine. We also offer stack assemblies and scalable solutions in different designs. ModSTACK™ is a modular converter system based on several sizings wich included modern IGBT modules, heatsink, snubber caps, DC link busbar, driver, current and voltage measurements, temperature sensors and a reliable auxiliary power supply. For optimized adaption on the wind turbine topology are extensive options available e.g. control interfaces for master and slave operation mode.

Bodo Arlt: What semiconductor voltage would be requested for variable-speed wind turbines?
Michael Sleven:
The biggest demand is for 1700V modules used in doubly fed asynchronous generator systems. But also 1200V modules used in wind turbines with full converter and synchronous generator are popular. The advantages in these voltage classes comparing to higher voltages (e.g. 3.3kV) are lower system losses (35%) and lower system costs (30%). Also the size of the output filter is much smaller. Due to the lower voltage range the dv/dt is also smaller combined with less EMC problems considering the harmonic content.

Bodo Arlt: What sets Infineon apart from other module suppliers?
Michael Sleven:
Our intention is to analyze the requirements of an application and to include the solutions in the next IGBT module generation. Especially for wind turbine applications Infineon has increased the thermal and power cycling capability several times. Also we offer modules with higher creepage and clearance distances. Due to high humidity in a lot of countries and additional high salt content in the air close to sea side the clearance and creepage distances of the modules are quite important. Normally the wind turbine supplier won't use a splash water protected cabinet due to cost reasons. It is known that under these conditions flash- over could occurs on the modules. IHM and PrimePACK™ modules give the customer highest margins and are the best solutions especially for offshore turbines. Also significant at Infineon is that all know-how is concentrated in our company. We have own frontend semiconductor fabs in Europe and Asia and we can consider the requirements for special applications also direct in the chip development. In our module fab in Warstein also all engineers from module development, qualification lab and technical marketing are located. This means very short ways and short reaction time in case of questions or failure investigations. Furthermore increasing the power density with state-of-the-art semiconductor chips and simultaneously reducing the IGBT module sizes to allow our customers a compact design of the inverters are reasons for our success.

Bodo Arlt: How much is Infineon involved in the end customer's wind power applications?
Michael Sleven:
We work very close with our customers from the beginning until the series production to find out the optimized solution for each project and give strong support also during the driver development. We have a very strong engineering team. It is also important for us to analyse together with our customers the measurements and tests of their prototypes and later on the series converter to improve our new products continuously based on all investigated data.

Bodo Arlt: How do you see future innovations in IGBT gate driver technology for use in solar inverters and wind power applications?
Michael Sleven:
Depending on the wind turbine topology it is necessary to realize the reinforced isolation regarding the European norm EN50178 already in the driver board. The reinforced isolation is related on the signal channels and also on the voltage supply of the driver. Due to the

strong lifetime requirements in wind power it is not recommended to use optical transmitter devices because they aging is much faster and do not meet the application specific liefetime requirements of 15 years. In the ModSTACK™ we use our driver boards DR110 which transformed the PWM signals to the IGBT modules. The measured current and voltage values of the string current and DC link voltage will be dressed for the control unit and failure signals as over-current and overvoltage derived. In case of damaging the power electronic several protection features were included. For solar inverter one key issue is the efficiency of the system. To reduce the filter sizes it is common to operate with high switching frequencies. Customer specified solutions with silicon carbide diodes, IGBTs made for fast switching applications or MOSFETs are available to reduce the system losses.

Bodo Arlt: Do you expect monolithic inverters to be used in future wind power applications?
Michael Sleven:
I don't think so. I case of failures or problems it makes the customer quite inflexible. Sometimes it could be very helpful having the possibility to measure internal signals in the wind turbine. Within this huge power ranges our customers has to handle high di/dt and dv/dt values. In our days a second source strategy is typical at our customers. With monolithic inverter this would be very difficult. I think the trend will hold on to go to reliable, energy efficient standard modules with base plate which meets all the application requirements. Our strategy is to define new standards on the market.

Bodo Arlt: Can we expect to see more silicon carbide devices from Infineon or gallium nitride devices for wind power solutions?
Michael Sleven:
Infineon was the first semiconductor supplier world wide of SIC Schottky diodes and has introduced the first products in 2001. In the last 8 years we have done significant improvements e.g. for the surge current and the switching capability. First feasibility studies based on gallium nitride has also been started. In general modules with SIC diodes and SIC J-FETS are available from Infineon but from economically point of view it's not expedient to use the SIC module for wind power solutions due to the higher invest of approx. 40% comparing to modules based on Si. We have to find together with each customer the brake even to justify the low system losses comparing to costs.

Bodo Arlt: Mr. Michael Sleven, thank you very much for your time. We look forward to a bright future for power modules in wind power.

Biography

Michael Sleven,
born June 27th1968 in Ratingen.
1993-1998
Study of Automatisation Technology
1998-2005
Design Group Manager in Hardware-Development for Inverter Technology at REFU Elektronik in Metzingen.
2005-2007
Assistant Manager for IGBT Modules at Mitsubishi Electric.
Since June 2007:
Manager IGBT Modules at Infineon AG, responsible for the Technical Marketing of the PrimePACK(TM) IGBT Module