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Soft switching combines efficiency and improved electro-magnetic compatibility

This year's topic of the PCIM Conference in May, in Nuremberg, is the future of power electronics. Prof. Manfred W. Gekeler will present his research results regarding efficiency and electro-magnetic compatibility at the international leading trade fair and conference for power electronics, intelligent drive technology, renewable energies and energy management.

Inverters are used to convert DC voltage into AC voltage and are deployed in three-phase drives, for feeding power of renewable sources (solar or wind) into the mains supply, for uninterruptible power supply or as an active dynamic filter. Lately, the uses of highly promising 3-level pulse inverters have become increasingly popular. Today's conventional design inverters are of the hard-switching type. However, this type produces switching losses, which result in reduced efficiency. At the Konstanz University of Applied Sciences Prof. Dr.-Ing. Manfred W. Gekeler developed the S3L inverter, which steers clear of the disadvantages of the conventional hard-switching inverter. With this inverter, Prof. Gekeler has solved the problem of loss of energy in a simple way, namely by adding a snubber circuit. Thanks to its functional principle, this circuit avoids switching losses and significantly increases efficiency. It consists of merely a few simple, passive components and connects the topology of the multi-level inverter with the soft-switching technology. The "Soft-Switching Three Level (S3L) Inverter" distinguishes itself through its particularly high efficiency and favorable EMC behavior, even when used with standard Si power semiconductors (IGBT, IGCT, GTO). Now Prof. Gekeler has additionally developed a new variant of the switching, the SS3L inverter topology. The S3L inverter is a pulse-width modulated inverter that operates at switching frequencies of over 30 kHz and output frequencies to approx. 500 Hz. The total harmonic distortion was tested for inverters in the photovoltaic sector and meets the strict regulations in this field. The S3L inverter can be operated at any load angle, from 0 up to 360 degrees (as pulse inverter or pulse rectifier). Another interesting feature of the S3L inverter is the option to limit the rate of rise of output voltages du/dt and currents di/dt . External du/dt filters are then no longer required and are quasi "integrated". Advantages of S3L inverters include low losses and high switching frequencies. Their efficiency is excellent, even at high switching frequencies. They thus enable inexpensive "cooling", e.g. in smaller, lightweight cooling elements, fans and chokes. S3L inverters are smaller and more compact than other inverter solutions. Thanks to the high switching frequencies used, no annoying whistling noises occur. S3L inverters are "robust". There is no "dead time" required in the control signals. In addition, short faulty pulses in the control signals of IGBTs would not lead to a switch-off, but operation would simply continue. Moreover, there are only few inductive voltage peaks, which ensure high reliability. S3L inverters stand out due to their high electro-magnetic compatibility. As they cause less harmonic current in motor current, there are less motor power losses and utilization of the motor is

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higher. Due to the du/dt limit of the output voltages, capacitive compensation currents via ball bearings and motor problems are avoided. S3L is also suitable for the use in inverter circuits with SiC and GaN transistors. In this case, it is not about reducing the losses but limiting du/dt and voltage peaks – which are caused by parasitic inductivities and high du/dt (particularly important for motor control units). Professor Manfred W. Gekeler will present his inverters and test results at the PCIM Conference. The scientist, who teaches and does research at the Konstanz University of Applied Sciences, will present the results of his EMC and efficiency comparison measurements at the leading trade fair for power electronics and intelligent drive technology. The PCIM conference will take place in Nuremberg from May 10-12, 2016. Prof. Gekeler will be holding a presentation on the "Comparison of the EMC and Efficiency Characteristics of Hard and Soft Switching Three-Level Inverters" on Tuesday, May 10, 2016. The Konstanz University of Applied Sciences has entrusted Technologie-Lizenz-Büro (TLB) GmbH with the marketing of its innovation and the global economic implementation of this cutting-edge technology. So far experts have shown strong interest in the invention. Licensing of this new technology is once again available for photovoltaics, motor control, uninterruptible power supply and wind power. Patent applications for the invention have already been granted in major industrialized nations (DE, JP, KR, CN, USA, CA, EP). For further information - including on licensing - please contact the TLB Innovation Manager Dipl.-Ing. Emmerich Somlo (somlo@tlb.de).