



PE:Region Newsletter - December 2018

Conference/Workshop Participation



Danish-German PE:Region Seminar

Christian-Albrechts-Universität zu Kiel - The Chair of Power Electronics

Wednesday 28 November 2018 at 11.30 - 15.00 in Kiel

[Demonstrator Development for Intelligent Grid Integration, High Speed Drives and Battery Charging](#)

On 28 November, the PE:Region biannual demonstrator workshop was held at CAU in Kiel, where the status of the 3 project demonstrators was presented and followed up by fruitful discussions and a guided tour to the laboratories of the Chair of Power Electronics.



The demonstrators, that are all developed in close cooperation with industrial network partners, are:

- #1 - Intelligent grid integration of wind and sun (CAU)
- #2 - Energy efficient, reliable and compact high speed drive (CAU)
- #3 - High power onboard bidirectional battery charger (SDU)

All demonstrators are progressing as planned. - For further information on the demonstrator status please see below.

Danish-German crossborder teaching

On 12 November 2018, five MSc Engineering students from SDU in Sønderborg joined a lecture in advanced simulations at CAU in Kiel as part of the PE:Region student exchange activities.

The lecture was provided by Mr. Federico Cecati and the topic was advanced thermal simulations of power electronic components with the PLECS simulation tool. More student exchange activities in the field of power electronics are currently being planned between CAU and SDU.



Professor Marco Liserre presented the power electronics laboratory at CAU where some of the PE:Region demonstrators are being developed.

UPCOMING EVENTS 2019



Advanced Power Electronics in the Baltic Sea Region

Conference at Alision in Sønderborg on 25 January 2019

[Programme and registration](#)

This conference is the final event and climax of a successful Interreg Baltic Sea region-project and is organized at Alision close to the new Centre for Industrial Electronics (CIE). During the last 3 years, about 20 partners from the entire Baltic Sea Region have worked on spreading knowledge and use of advanced power electronics in the BSR within the electromobility, energy effectivity and smart house sectors.

The conference allows you to meet experts from the BSR in Sønderborg and enter into an intense and fruitful discussion with them. Besides matchmaking we will also discuss new network- and project activities within advanced electronics.

We are looking forward to talking with you at the end of January.

Best wishes

Horst-Günter Rubahn, for the lead partner of the Green PE project

New Energy Days - March 2019



The PE:Region project will host the session “Application Cases of Power Electronics” at New Energy Days 2019 in Husum in March.

In its new style, New Energy Days has been split up in two parts, viz. one for experts and one for the

public. The expert part is taking place on 21 – 22 March as a congress presenting several topics related to renewable energies and their implementation in the existing energy sectors; eg. digitalization, mobility, power to X and planning of electricity and heat projects. Please click here for [further information](#).

The PE:Region session will briefly present the progress of the project as well as possible applications using power electronics to reach the aim of a sustainable future that is more efficient and reliable. Detailed information about the session will be provided early next year.



Source: www.new-energy.de

IEEE CPE POWERENG 2019

Conference at Alston on 23-25 April 2019

[Programme and registration](#)



The planning of the IEEE CPE-POWERENG 2019 in April is ongoing. Five additional special sessions have been approved by the technical committee, bringing the different topics covered by the conference up to thirteen! The special sessions can all be seen [here](#). So far, submitted papers cover both academic as well as more industry-related topics in the field of power electronics.

Demonstrator Status

Demonstrator #1: Intelligent grid integration of wind and sun

The Demonstrator has the target to increase the hosting capacity for renewable energy sources in the electrical distribution grid. However, the growing penetration of PV units and converter interfaced load has

reduced the inertia of the grid, which is a threat to the frequency stability. In this context, the smart transformer is proposed to enhance the inertia by means of charging /discharging the energy, which is stored in the capacitors of ST's DC link. Using the capacitor of DC link can significantly enhance the inertia and avoid installation of mass energy storage system in the meanwhile.

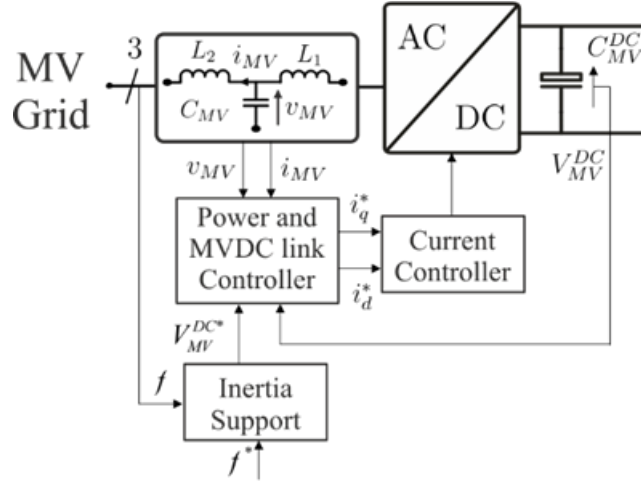


Fig 1. : The inertia support controller of ST's MV side converter

The inertia support control works as shown in Fig 1. The measurements of grid frequency is sent to the controller of ST's medium voltage side converter. If the frequency variations violate the limit, e.g. $\pm 200\text{mHz}$, the controller is activated. Based on either droop control or inertia emulation, the voltage of the DC link changes in response to the frequency variation. The stored energy of DC link is injected into grid to support the frequency.

Demonstrator #2: Energy efficient, reliable, and compact high speed drives

The demonstrator targets to decrease the size of the motor filter, mainly LC filters. One possible approach is the use of multilevel converters, combined with the previously develop model predictive control (MPC) strategies. Three-level inverters, namely the 3-level Neutral Point Clamped (NPC) and the T-Type inverter, are promising alternatives especially regarding the efficiency, low-order harmonics and common-mode voltage. For higher switching frequencies, the necessary chip area is lower. The topology of a three-level NPC is shown in Fig. 2. Drawbacks of those inverter topologies are the higher control effort and the higher number of power semiconductors.

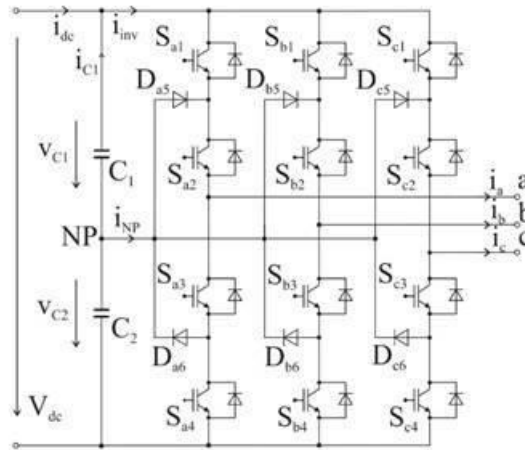


Fig. 2: 3-Level NPC with IGBTs

In Fig. 3 the comparison of a 2-Level and 3-Level NPC converter, using hysteresis based MPC, is shown. By reducing (halving) the switched DC-Link voltage, the distortion can be reduced significantly. Hence, the filter for the drive can be designed smaller, reducing the filter cost and resulting in a more compact system.

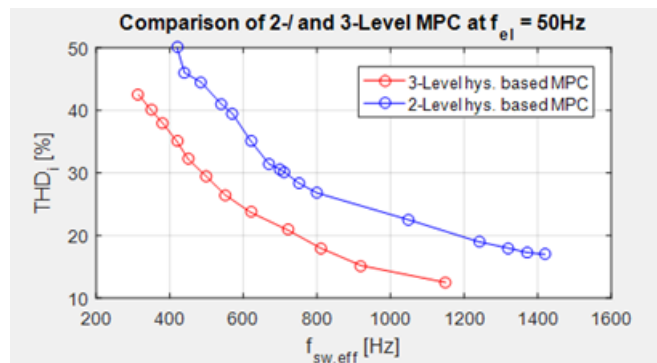


Fig. 3: 2-/3-Level comparison of total harmonic distortion (THD) of the motor current over the effective switching frequency $f_{sw,eff}$ at constant electrical frequency $f_{el} = 50\text{Hz}$

Demonstrator #3: High Power on-board bidirectional battery charger

For demonstrator #3, a 20 kW two-level three-phase power factor correction (PFC) rectifier has been designed with discrete SiC MOSFETs. The hardware prototype of the switchboard along with the measurement and the protection setup is shown in Fig. 3.1. Moreover, the Electromagnetic Interference (EMI) filter has been designed and implemented to satisfy the standards. Fig. 3.2 shows PFC rectifier along with the EMI filter.

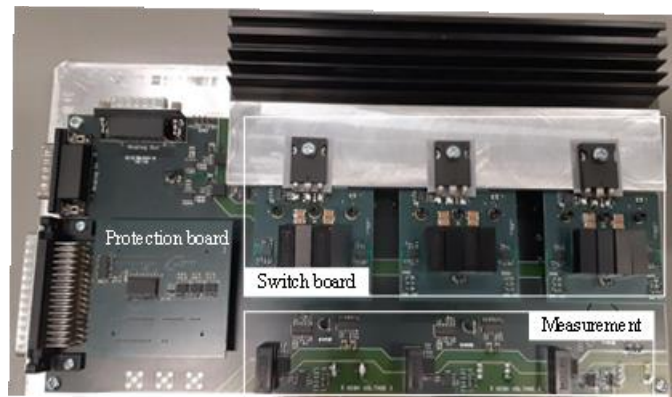


Fig. 3.1. Hardware prototype of a 20 kW PFC rectifier

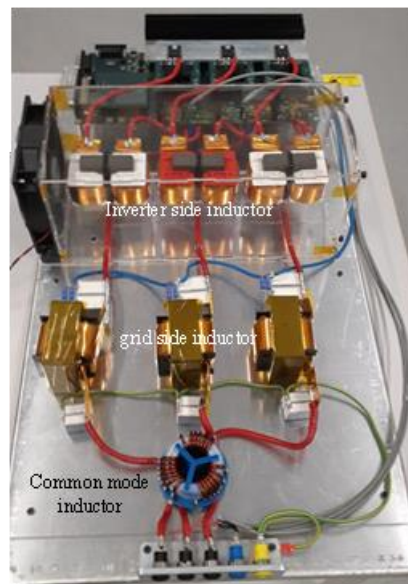


Fig. 3.2. PFC rectifier with the EMI filter

For the dc-dc converter part, a novel power module using SiC MOSFETs has been designed by FH, Kiel. PCB with the drive circuit for the power module has been designed and will be integrated with the power module in the next phase of the project. A 3-D model of the power module with the drive circuit is shown in Fig. 3.3.

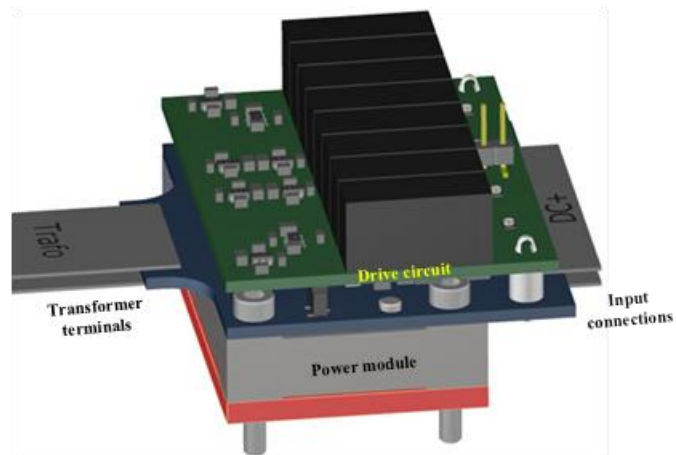


Fig. 3.3. 3-D Model of the power module integrated with the drive circuit.

Publications



C. Kumar, X. Gao and M. Liserre "Smart Transformer Based Loop Power Controller in Radial Power Distribution Grid", 2018 IEEE PES Innovative Smart Grid Technologies Conference Europe (ISGT-Europe), Sarajevo, 2018

L. Camurca, F. Costa, X. Gao and M. Liserre, "Design of a Medium Voltage DC Fast charging Station with Voltage Regulation and Central Modular Multilevel Converter," 2018 30th ECCE, Portland, USA, 2018

Kouchaki and M. Nymand, "Efficiency Evaluation of Three-phase SiC Power Factor Correction Rectifier with Different Controllers," 2018 20th European Conference on Power Electronics and Applications (EPE'18 ECCE Europe), Riga, 2018, pp. P.1-P.10.

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8515363&isnumber=8515301>

R. Ramachandran, M. Nymand, C. Østergaard, C. Kjeldsen and G. Kapino, "High efficiency 20kW SiC based Isolated DC-DC Converter for Battery Charger Applications," 2018 20th European Conference on Power Electronics and Applications (EPE'18 ECCE Europe), Riga, 2018, pp. P.1-P.9.

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8515369&isnumber=8515301>
