Bidirectional Isolated Wide Range Battery DC Charger for Electromobility

Summary

Electric mobility market is expected to grow rapidly in the following decade, endorsed by recent developments of Li-ion battery technology and various governmental initiatives. In order to fulfill the electric vehicle (EV) user expectations and make the ownership experience comparable to conventionally fueled vehicles, the availability of the charging infrastructure has to be improved. To reduce investment and maintenance costs of new installations, new power electronics solutions are necessary, as the standard ones are already very close to the technological limits. To accommodate a growing EV fleet in the future, functionalities such as bidirectional operation with vehicle-to-grid (V2G) mode for grid support features are necessary. Moreover, the wide range of EV battery types requires support for a large range of DC voltages. For mass deployment, all the mentioned features should be realized at low cost and material use.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Dmitri Vinnikov Dr. Andrei Blinov
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between January 01, 2025 00:00 and January 24, 2025 23:59 (Europe/Zurich)

Description

The Ph.D. project is focused on the study of **power electronic solutions for electric vehicle chargers (EVCs)**. The primary outcome lies in the development of an EVC that would not only meet today's requirements but also be future-proof and applicable to mass installations. The study will cover analysis and improvements for well-known configurations but will mostly focus on emerging solutions.

Project tasks

- Analysis and synthesis of EVC based on bidirectional isolated DC-DC converter topologies.
- Implementation of grid-connected operation strategy with necessary soft-start and protection functions.
- Implementation of smooth transitions between various operating modes.
- Optimizing the voltage and current stresses in components at different operating modes.
- Development of effective supervisory, management, and control functions for the EVC.
- Experimental verification of developed concepts and control methods.

Duration

The duration of the project is planned for four years, starting in February 2024.

Preferred qualifications *(in order of importance)*

- Experience in the design of power electronic DC-AC and/or DC-DC converters.
- Experience in the modeling of electronic circuits in software like PSIM, PLECS, or MATLAB/Simulink.
- Experience in the design of control systems and their implementation in microcontrollers and DSPs.
- Good understanding of power semiconductor components and their driving.
- Experience with mixed-signal PCB design.
- Experience with closed-loop control systems comprising sensors with analog and digital interfaces.

Applicant Requirements

The successful candidate should hold an **M.Sc. degree in Electrical Engineering**. A strong background and interest in **Power Electronics** are expected. Prior practical experience with galvanically isolated DC-DC converters and/or three-phase inverters is preferred. The candidate will work in an international team and collaborate with partner universities and companies. Hence, **fluency in spoken and written English** is expected.

Questions about the position can be directed to **Prof. Dmitri Vinnikov** (dmitri.vinnikov@taltech.ee) or **Dr. Andrei Blinov** (andrei.blinov@taltech.ee).

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