Control Development for a Dual Active Bridge using RT-HIL

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Official Start Date:	16.02.2026		
Submission of Final Report:	June, 2026		
Presentations at Group Meeting:	Mid-term and Final Presentations (dates TBD)		
Delivery of project results:	RT-HIL Setup, Validated control implementation, Report		

Context, Background, and Motivation:

With the development and promotion of renewable energy technologies to achieve a low-carbon society, power electronics technology is becoming increasingly important. As a critical factor influencing the evolution of power electronics technology, continuous efforts are underway to achieve breakthroughs and advancements in power electronics devices. The Power Electronics Laboratory (PEL) has conducted a study on the viability of series-connected 3.3 kV Silicon-Carbide (SiC) devices to overcome the blocking voltage limitations of these devices and achieve a 10 kV voltage class in isolated DC/DC converters. In this regard, a 1kV/10kV 250kW dual active bridge (DAB) converter has been developed and demonstrated.

Project Objectives:

While the DAB hardware is extensively concluded and validated, there is a need to develop control hardware and software for the reliable and intended operation of this prototype. The motivation and primary goal of this project are to prepare a **control ecosystem** for the developed DAB hardware by utilizing an available **Hardware-in-The-Loop (HIL)** setup for this purpose, and thus, achieve a ready-to-use control to be deployed in the real hardware. In what follows, a detailed list of project tasks and expected steps is summarised.

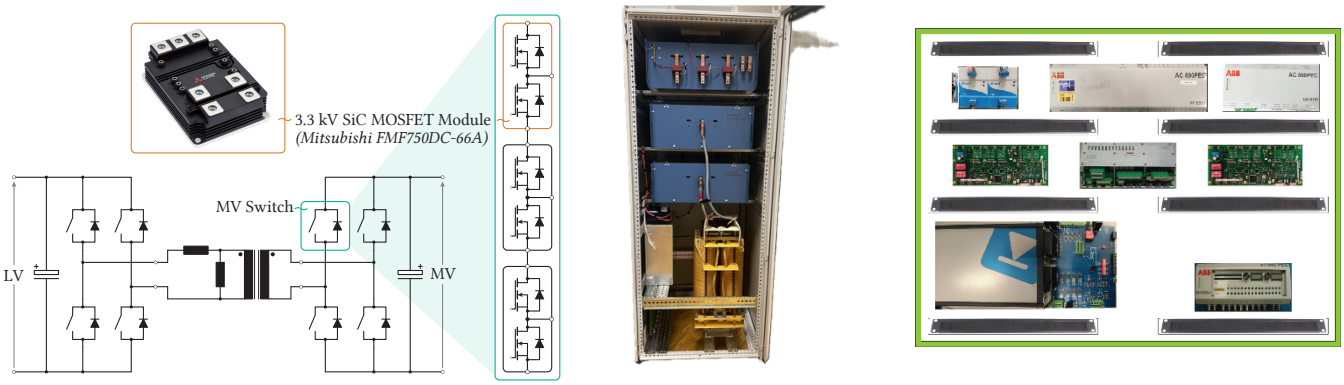

Figure 1. *Left: The DAB converter topology. Center: The photograph of the prototype. Right: RT-HIL setup building blocks.*

- Finalizing the available general-purpose RT-HIL setup in the lab
- Modelling of the DAB converter in the PLECS RT-box platform, which may require measurements of the parameters from the prototype
- Mastering the Power Electronics Controller (PEC) ecosystem of the ABB
- Mastering modulation schemes, control algorithms, and theory for DAB and its working principles
- State machine and firmware development for the DAB prototype
- DAB closed-loop control design and implementation on the PEC controller
- Extensive HIL test and validation, and closed-loop control optimization (if necessary)

Prerequisite knowledge:

- Power electronics DC-DC converters
- Magnetic devices
- DAB converter principles
- PWM schemes
- PLECS RT-box platform
- MATLAB

Available equipment:

- All the equipment required to fulfill the project's goals, such as the PEC controller, RT-box, and HIL platform, etc.
- No hardware development is needed

Methodology and foreseen steps of the project:

- Limited hardware implementation and assembly
- Modeling
- Control implementation
- Analysis
- Optimization (if required)

Student gain:

- Learning about the steps of preparing a HIL setup for power electronic-based systems
- Modeling of power electronics systems in PLECS for Real-Time simulations
- Mastering an industrial controller (PEC), programming with embedded code support in MATLAB
- Acquiring DAB converter principles and their basic operation

References:

- Will be provided as needed