

We are looking for a master student to work on

# e-Converter for Wireless Power Transfer

## Background

Wireless Power Transfer (WPT) is becoming increasingly popular in various application areas. This technique is already widely used for electric vehicle battery charging, underwater robotics, biomedical plants and railway applications. Thanks to the possibility of

transferring power through an air gap, it avoids the use of bulky cables making the system simpler and lighter. Depending on the exploited physical principle, WPT systems can be divided into two main categories: inductive wireless power transfer (IWPT) and capacitive wireless power transfer (CWPT) systems. The IWPT exploit the magnetic induction between two coils, while CWPT systems exploit the electric field generated between two metal plates. While IWPT is already a mature technology and numerous devices are already available in the market, CPWT systems are still a relatively new technology. Since in a CWPT the power is transferred using low-cost metallic plates and does not require expensive magnetic cores and litz wires to reduce the parasitic resistance due to skin and proximity effects, it represents a cheaper solution with respect to IWPT. In addition, since the power is transferred through an electric field between the metal plates, this technology is characterized by lower electromagnetic emissions with respect to IWPT systems where the magnetic field between coils tends to propagate in any direction.

In low-voltage low-power application, the E converter is a viable solution to to obtain very compact converter. This topology is made up by a single switch. If the system is adequately designed, the power MOSFET can operate under Zero Voltage Switching (ZVS) and Zero Current Switching (ZCS), leading to low switching power losses and high conversion efficiency.

Using GaN devices technology the switching frequency can be increased with a reduction of the passive component size to reach ZVS and ZCS operations.

The thesis is oriented to design and developing a 60 W Class-E converter for capacitive wireless power transfer starting from the experimental developing board of Figure 2.

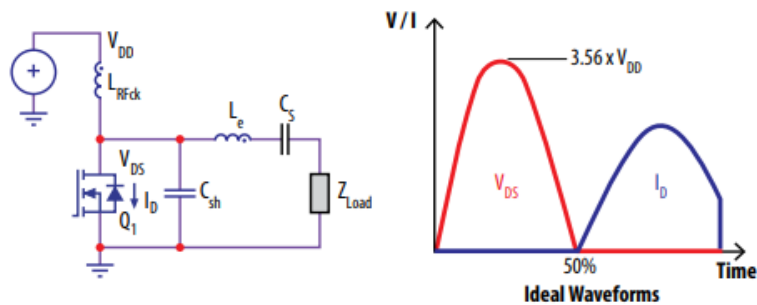


Figure 1 E-converter Schematic and ideal waveforms operation.



Figure 2 Experimental developing board of E-converter with GaN devices.



### Your tasks

- Literature survey of the state-of-the-art of wireless power transfer with focus in the capacitive coupling solution;
- Literature investigation on the MOSFETs and GaN device characteristic and application in the low voltage converter;
- Simulation and design of the 60W E-converter passive components;
- Study of E-converter with controlled inductor and capacitors to optimize the alignment issue
- Experimental Implementation and testing of the simulated E-converter system.

### Necessary skills

- Power Electronic basics in DC-DC converter topologies and introduction on the power devices applications;
- PLECS and/or LT spice.

### What you will learn

- To analyze high level technical literature (mandatory and requested by the companies producing high level technology);
- Power electronics DC-DC converter operation in ZVS and ZCS and advanced power device applications;
- Low-voltage power DC-DC converter design issue in ZVS and ZCS operation
- Power electronics simulation skills using PLECS, and LT SPICE;
- Experimental skills: how to organize an experiment (measuring equipment, testbench...), how to implement the E-converter, how to report the results of the experimental activity.

**Duration of the thesis:** 6 months

### Application

We are looking forward to receiving your application. Please include your CV and a short explanation why you fit the position (Italian or English). Send your application to [salvatore.musumeci@polito.it](mailto:salvatore.musumeci@polito.it) and [luigi.solimene@polito.it](mailto:luigi.solimene@polito.it).