

## Design and control of an isolated bidirectional DC-DC converter

**Prima Electro** is a strategic EMS partner in high-tech sectors such as railway, energy and industrial automation. For over forty years, we have been converting ideas into full-custom embedded products, becoming the reference point for all those companies wishing to improve the features and performances of their systems with industrial-grade solutions. Always at the cutting edge of technology in power and control electronics design and production, Prima Electro offers support from the concept and preliminary analysis through the qualification and production stage, supervising the whole manufacturing process. Our business model can be summed up in the acronym DOTS (Dedicated Off The Shelf), because we are able to offer custom “end-to-end” turnkey solutions with a fast time-to-market and competitive costs.

### Background:

Power electronics converters are used in a wide range of applications such as renewable energy generation, automotive, railway and industrial motor drives. In all these applications, the isolated bidirectional DC/DC power converters play an important role since can provide an isolation stage between the input and the output side. The isolated high-frequency DC/DC converters are also known as solid state transformer (SST). Compare to low frequency transformer (50Hz), the SST converters can provide several benefits: active control of the power flows and reduced weight and volume. Several topologies have been proposed in the scientific literature as bidirectional resonant converters, dual active bridge converters (DAB) and three-phase DAB. In all these solutions, the soft-switching operation capability is of great interest since can provide high efficiency and reduce the components stress. In addition, the control techniques able to extend the soft-switching operation limits are of great interest and must be carefully evaluated by power converter designers.

### Type of work: Master Thesis

The goals of the thesis are the analysis and comparison of the state-of-the-art solutions for high-frequency isolated DC-DC converters. The candidate, supported by the R&D department, is expected to compare the proposed solutions in terms of soft-switching operation limits, to develop the control routine in a simulation platform and to find the converter worst-case operating conditions for the components stress evaluation.

The thesis activity will be carried out in the Prima Electro R&D department.

### Expected tasks:

- Literature survey of the state-of-the-art topologies for the isolated bidirectional DC-DC converters (30% of time)
- Control simulation (40% of time)
- Design consideration and hardware predesign (10% of time)
- Experimental testing (10% of time)
- Documentation of all the activities (10% of time)

### Requirements:

- Basic knowledge of power electronics converters principles and topologies
- Background on power electronics components
- Background of control theory and digital control
- Good knowledge of MATLAB and PLECS tools
- Basic knowledge of analog circuit design
- Analytical skills

**Duration:** 6-9 months

### Contact:

Matteo Gregorio (Prima Electro)

Please send your CV to [matteo.gregorio@primaelectro.com](mailto:matteo.gregorio@primaelectro.com)

The master thesis project will be carried out at Prima Electro S.p.A.  
Strada Carignano, 48/2 - 10024 Moncalieri (TO)

[primaelectro.com](http://primaelectro.com)