

SPRING-SUMMER 2027

STUDENT PROJECT PROPOSALS

HARDWARE DESIGN PROJECTS

VERSATILE SMART GATE DRIVER CIRCUIT FOR HIGH-POWER SiC SEMICONDUCTORS

- Motivations:** At imperix, we would like to develop and qualify a versatile smart gate driver for high-power SiC modules, intended for high-power motor-drive testing and interfaced from a compact variant of the B-Board PRO.
- Objectives:** Design a complete gate driver stage, including its isolated power supply, for a 3.3kV / 700A SiC power module using NXP's GD3160 or GD3162 chip. First, ensure robust operation under test-bench conditions, with fast short-circuit and overvoltage protection using graded turn-off, a low-inductance gate loop and high common-mode immunity. Second, implement the interface to the controller, covering configuration, fault reporting and telemetry of temperature, DC-link voltage and gate supply. Third, evaluate the adjustable switching-speed and device-monitoring features, quantifying their effect on switching losses, overshoot and dv/dt . A full double-pulse test campaign, including short-circuit tests, will validate each of these steps.
- Skills:** Prior experience with PCB design is desired. Some knowledge of semiconductor physics is also useful.

GETTING-STARTED TUTORIALS FOR POWER ELECTRONICS, WITH VIDEOS

- Motivations:** Imperix's knowledge base currently lacks structured courseware for newcomers to power electronics control. This project addresses that gap by developing a coherent set of tutorial materials covering basic topologies.
- Objectives:** The student will implement and experimentally validate a progressive sequence of converters – buck, boost, single-phase and three-phase inverters – on the B-Box 4 using automated code generation from Simulink or PLECS. Each topology will be documented in written form, accompanied by an instructional video, and supplemented with suggested exercises for university lab sessions. The sequence is defined at the outset; the number of topologies covered will depend on progress.
- Skills:** Suitable for a pure internship in electrical engineering.

MULTI-MHZ CLOSED-LOOP CONTROL BENCHMARK

- Motivations:** Wide-bandgap devices make switching frequencies in the MHz range possible. However, the closed-loop control bandwidth that can actually be reached is limited by the total loop delay, by quantization effects and by how well measurements hold up during fast switching transients. This project investigates how far closed-loop bandwidth can be pushed with GaN-based converters.
- Objectives:** Implement a closed-loop controller on the B-Box 4 for a GaN-based power stage optimized for high switching frequency, using the controller's 250 ps PWM resolution and 20 Msps acquisition chain. Address three challenges: (1) minimize the total loop delay, including acquisition and conversion time, the FPGA-based control implementation, PWM modulation and gate-driver propagation delays; (2) suppress limit-cycle oscillations caused by ADC and PWM quantization; (3) preserve measurement integrity under the high dv/dt transients typical of GaN devices. Deliverables are a validated discrete-time model including the identified delay terms, an experimental characterization of the achieved closed-loop bandwidth, and a comparison with conventional sampled-loop implementations.
- Skills:** A background in power electronics, digital control theory and FPGA design is expected.

T-SHAPED LINE IMPEDANCE EMULATION BOX

- Motivations:** Imperix inverters are widely used for experimental microgrid research. However, most laboratories lack a realistic network between their converters, in particular one that other researchers recognise and can reproduce, such as the CIGRE low-voltage and medium-voltage benchmark networks. Without such a network, results obtained in different laboratories are difficult to compare. We would like to assess if a passive line impedance box could close this gap as a product.
- Objectives:** Survey existing microgrid facilities and published implementations of the CIGRE benchmarks, and determine how each can be reproduced at laboratory scale by impedance rescaling. From this survey, derive the specification of a composable box: three switchable four-wire R-L branches meeting at an internal tap node, so that the leading target networks can be built from at most six units. Design, build and characterise a prototype from 10Hz to 20kHz, stating its validity range. Establish its cost and an indicative selling price. Finally, demonstrate a complete microgrid using three TPI8032 inverters on a network built from the boxes.
- Skills:** A background in power systems and familiarity with the control of power converters are expected. Practical prototyping skills (magnetics, mechanical assembly, instrumentation) are required.

HIGH-BANDWIDTH HIGH-CURRENT HYBRID SENSOR

- Motivations:** No single current-sensing technology covers the range from DC to several MHz at high currents. Hall-effect sensors measure DC, but their bandwidth is constrained by noise. TMR sensors are faster, but saturate at a few millitesla, which makes high currents difficult to measure. Current transformers perform well at high frequency but cannot measure DC. Hybrid sensors address this by combining a DC-capable sensor with a high-frequency one. Above 200A, however, they exist only as laboratory instruments, and no compact sensor for converter integration combines currents above 500A with multi-MHz bandwidth.
- Objectives:** Develop a board-mountable hybrid current sensor for currents above 500A with a bandwidth of at least 3MHz. The work covers sensor selection, circuit and PCB design, and the construction of a prototype. The prototype will then be characterized and validated in real-world applications, with a view to a possible future imperix product.
- Skills:** Prior experience in both power electronics and PCB design is desired. Knowledge of magnetics is an asset.

YOUR PROFILE

An internship with us will suit you if:

- You are a PhD, MSc, or BSc student.
- You are looking for a 4-to-9 months on-site internship in Sion, Switzerland.
- You are seeking to work in a dynamic, fast-paced environment.
- You are self-motivated and capable of working both individually and as part of a team.
- You expect attentive supervision of your work from highly qualified engineers.
- You are looking for a position that values and makes room for your initiatives.
- You appreciate a young and friendly environment that is also serious and professional.

If you are interested in doing an internship with us, please send your CV along with a cover letter explaining your motivations and what you would bring to the team. We read every application carefully and reply within 10 days to the profiles that interest us.

Only complete applications are considered, and generic or obviously machine-generated letters are not.

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ABOUT US

Imperix is a leading global provider of high-performance control solutions and rapid prototyping hardware engineered specifically for power electronics. Founded in 2013 as a spin-off from the Swiss Federal Institute of Technology (EPFL), the company accelerates innovation by bridging the gap between numerical simulation and physical implementation.

At the core of the Imperix ecosystem is the flagship B-Box controller family, which unites robust digital processing, the intuitive Cockpit software, and automated code generation from Simulink and PLECS. These control development solutions are complemented by a comprehensive hardware portfolio encompassing modular power stages, high-fidelity sensors, fully integrated inverters, as well as hardware and software interfaces for real-time HIL/PHIL simulation. Together, these tools empower top-tier industrial and academic R&D teams to safely test advanced control algorithms on real hardware within minutes, drastically reducing time-to-market and time-to-publication.

Headquartered in Sion, Switzerland, Imperix serves a prestigious client base across more than 50 countries. By delivering specialized, modular tools for power conversion, smart grids, motor drives, electric mobility, and energy storage, Imperix stands at the forefront of the technology enabling the global energy transition.