Power electronics test benches
From HIL simulation to real power
ONE STONE...
A double test-bench for both hardware-in-the-loop simulation and...

"The OP1300 is a multi-purpose test bench for power electronics. It is able to support both HIL simulation and low-voltage experimentation with an easy-to-use reconfigurable hardware."
... TWO BIRDS!
... power electronics prototyping and in a single cabinet!

With the OP1300, comparing digital simulation and real-world experimental results has never been so easy!

Jean Bélanger, CEO and CTO, Opal-RT technologies
FROM SIMULATION...
A two-steps approach to facilitate and accelerate the development and...

EASE OF USE
Jump from real-time simulation to the physical prototyping by simply changing cable connections, without editing your control software.

PERFORMANCE
Execute fast closed-loop control on the BoomBox and run high-performance real-time simulation in RT-Lab. All this can naturally be later validated using real hardware.

TIME TO APPLICATION
Stop wasting time with technicalities. Focus on your real research objectives and the derivation of meaningful experimental results.

SAFETY
Rely on the software-independent protections of the BoomBox to keep your system safe at all times, even when your software remains incompletely tested.

The new OP1300 contains everything you need to accelerate your control validation workflow!

Nicolas Cherix, Chief scientist, Imperix Ltd.

Nicolas Cherix, Chief scientist, Imperix Ltd.
Imagine and develop your control on Matlab Simulink, and instantly download it into the BoomBox RCP, a high performance and easy-to-use power electronics controller.

Simulate the power converters and their passive components on the OP4510, a high-fidelity and flexible HIL simulator based on RT-LAB and Matlab Simulink.

By connecting the digital controller to the HIL simulator, test your control algorithms under all operating conditions. Observe any signal and produce insightful results and graphics.

Connect the BoomBox RCP to the real power hardware to test your control algorithms live and compare the experimental results with the previous simulation results.
DIGITAL COMPONENTS
High-end devices and software to cover all needs!

**BOOMBOX RCP**

**KEY FEATURES**
- DSP + FPGA processing units
- C/C++ programming
- Simulink-based programming
- Hardware protections

**KEY SPECIFICATIONS**
- 16x high-performance and highly configurable analog inputs
- 16x fiber-optical PWM outputs
- 8x digital inputs (with encoder)
- 8x digital outputs
- 2x CAN
- 4x analog output

**SIMULINK-BASED PROGRAMMING**
Thanks to our blockset for Simulink™, control design and modeling can be done very easily. Then, once the control has been finely tuned in simulation, all you need is just click on one button to generate executable code and upload it into the BoomBox!

**REAL TIME MONITORING**
Each unit is shipped with BoomBox control, a dedicated software allowing to monitor and tune any control variable in real time. It also helps producing data logs and other graphical results directly from the BoomBox control platform.

*Read more online...*

**OP4510 REAL TIME SIMULATOR**

**SMALL BUT STRONG!**
The OP4510 is a compact, entry-level simulator that combines all of OPAL-RT’s strengths for high-performance hardware-in-the-loop simulation.

**RT-LAB WITH eHS**
eHS is a generic and reprogrammable solver. It enables you to run your existing simulation models on FPGA, in real time. Thanks to its full integration with RT-Lab, eHS also guarantees you a great flexibility and a complete control over your simulations, all this with a microsecond-scale time step!

*Read more online...*
**POWER COMPONENTS**

Freely configurable elements to build up various power converters!

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### POWER STAGE

The power stage delivers ready-to-use and freely configurable power conversion, thanks to:
- 6x independent half bridge power modules
- Ratings 800V/32A or 400V/46A per module
- Integrated current sensors (LEM)
- Coordinated protection, variable-speed cooling

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### PASSIVE ELEMENTS

The auxiliary 4U rack is an optional unit for the necessary passive components, filters, etc. The standard configuration features:
- 6x independent inductors (2.5mH, 20A)
- 2x LC-type common-mode filters (3-phase)

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**Read more online...**
PV INVERTER
Grid-tied central inverter for photovoltaic application

Work with a simulated panel to easily control irradiance conditions!

Work with a real PV panel and improve the realism of your setup!

Simulate unbalanced or faulty grid conditions!

Measure real power flows and evaluate efficiency!

POSSIBLE RESEARCH TOPICS

- Current control of boost
- Cascaded voltage control
- MPPT algorithm
- MEPT (maximum efficiency point tracking)
- PLL implementation
- Vector current control
- Grid voltage forming
- Islanding detection/prevention
- Inertia emulation
- Multi-converter coordination
- Operation in unbalanced grid conditions
- etc.

ADC
Vdc
lpv
Vpv
Ig
PLL
Ig,abc
Vg,abc
ADC
ADC
ADC
ADC
ADC
ADC
PWM
modul.
PWM
modul.
dq
current
ctrl
id*
id*
id*
id*
id*
id*
ELECTRIC DRIVE
Grid-tied variable frequency drive for various machine types

Work with a **simulated** motor to test any type of electric machine!

Work with a **real motor** and have it spin in your lab!

**Simulate** any load behavior, including abrupt changes!

Measure **real power** flows and evaluate efficiency!

POSSIBLE RESEARCH TOPICS

- DC link voltage and PF control of the rectifier
- Rotor position with decoder or sensorless
- Scalar control (V/f)
- Field oriented control (FOC)
- Direct torque control (DTC)
- Field weakening strategy
- Highspeed operation
- Different machines (PMSM, BLDC, IM, SRM, ...)
- Multi-drive coordination
- Multi-phase machines
- etc.

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BATTERY CHARGER
Single-phase inverter with isolated DC/DC converter

Work with a simulated transformer to tune its design parameters!

Work with a real transformer and real batteries!

Simulate any battery characteristics and state of charge easily!

Measure real power flows and evaluate efficiency!

POSSIBLE RESEARCH TOPICS
- Pulse generator for phase-shifted waveforms
- Rectangular modulation of DAB
- Trapezoidal modulation of DAB
- PR controller for single-phase rectifier
- Fictive axis emulation (FAE)
- Stored energy recovery (bidirectional converter)
- Battery charging strategy
- BMS dealing with battery SoC, DoD, SoH,...
- Transformer design
- etc.

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STARTER KITS

* HARDWARE + SOFTWARE
- Boombox + Software "Lite"
- Open chassis with 3 x PEB 8032
- 4 x voltage sensors

OPTIONS
- Simulink™ blockset
- Other power modules

VARIANTS

POWER ELECTRONIC BUNDLE

* HARDWARE + SOFTWARE
- Boombox + Software "Standard"
- Open chassis with 6 x PEB 8032
- 6 x voltage sensors

OPTIONS
- Simulink™ blockset
- Passives and filters box
- Grid side panel
- Other power modules
- Other controller

VARIANTS
- Other power modules
- Other controller

LIGHT MMC BUNDLE

* HARDWARE + SOFTWARE
- 3 x Boombox + Software "Expert"
- 3 x open chassis with 24 x PEB 2015
- 4 x voltage sensors
- 6 x inductors

OPTIONS
- Simulink™ blockset

VARIANTS
- PEI 4046 for more current

HIL KIT

* HARDWARE + SOFTWARE
- Boombox + Software "Standard"
- Interface for Opal-RT simulators
- Opal-RT OP 4510

OPTIONS
- Simulink™ blockset

VARIANTS
- Other simulator
- Add some real power hardware

MICROGRID TEST-BENCH

* HARDWARE + SOFTWARE
- Boombox + Software "Standard"
- Interface for Opal-RT simulators
- Opal-RT OP 4510
- Converter box with 6 x PEB 8032
- Passives and filters box
- Grid connector box

OPTIONS
- Simulink™ blockset

VARIANTS
- Other simulator
- Power amplifier for PHIL

* All current prices are on imperix.ch