

imperix



OPAL-RT
TECHNOLOGIES

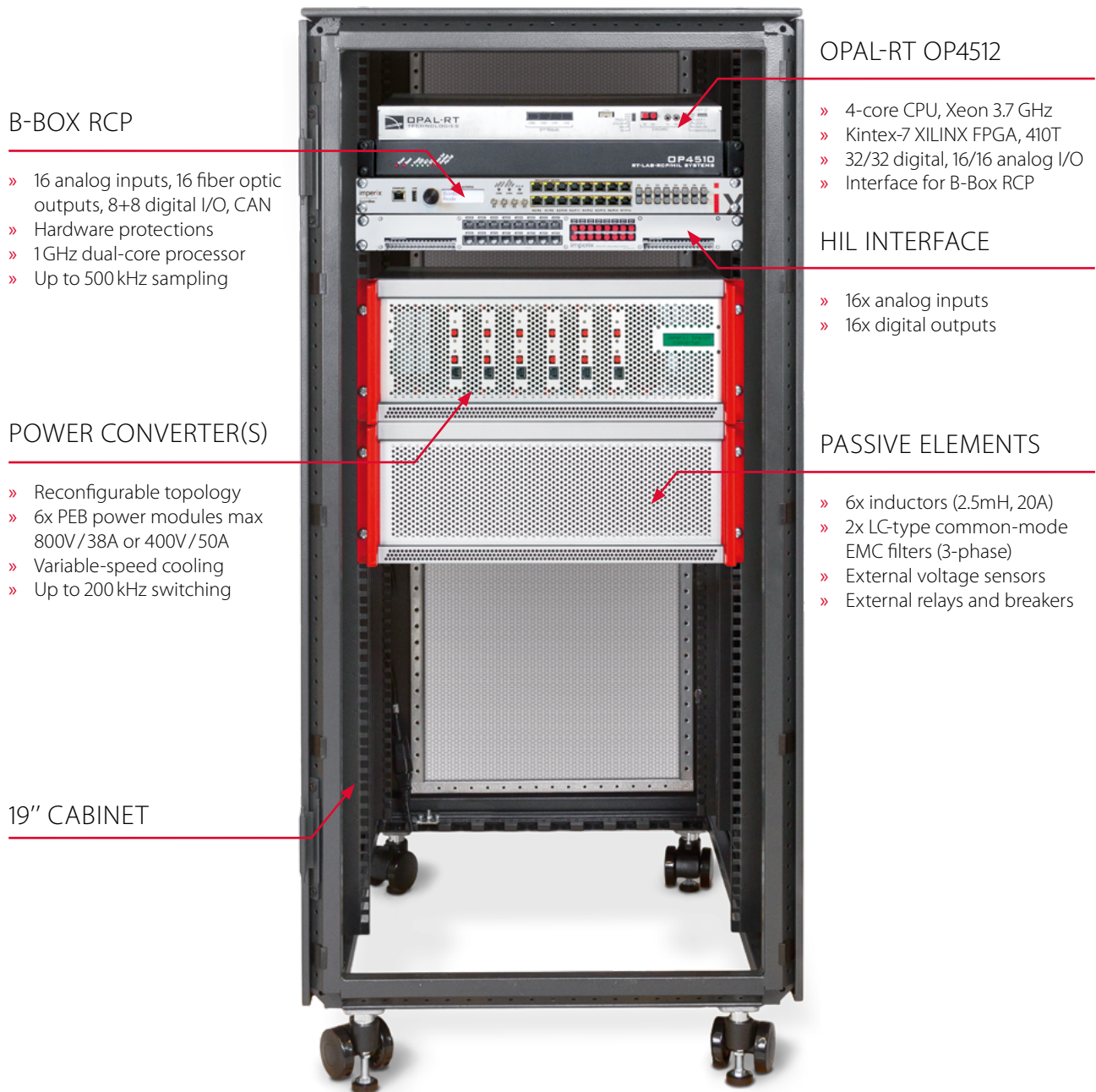


Microgrid test bench

From HIL simulation to real power

ONE STONE...

A double test-bench for both hardware-in-the-loop simulation and...



B-BOX RCP

- » 16 analog inputs, 16 fiber optic outputs, 8+8 digital I/O, CAN
- » Hardware protections
- » 1GHz dual-core processor
- » Up to 500 kHz sampling

POWER CONVERTER(S)

- » Reconfigurable topology
- » 6x PEB power modules max 800V/38A or 400V/50A
- » Variable-speed cooling
- » Up to 200 kHz switching

19" CABINET

OPAL-RT OP4512

- » 4-core CPU, Xeon 3.7 GHz
- » Kintex-7 XILINX FPGA, 410T
- » 32/32 digital, 16/16 analog I/O
- » Interface for B-Box RCP

HIL INTERFACE

- » 16x analog inputs
- » 16x digital outputs

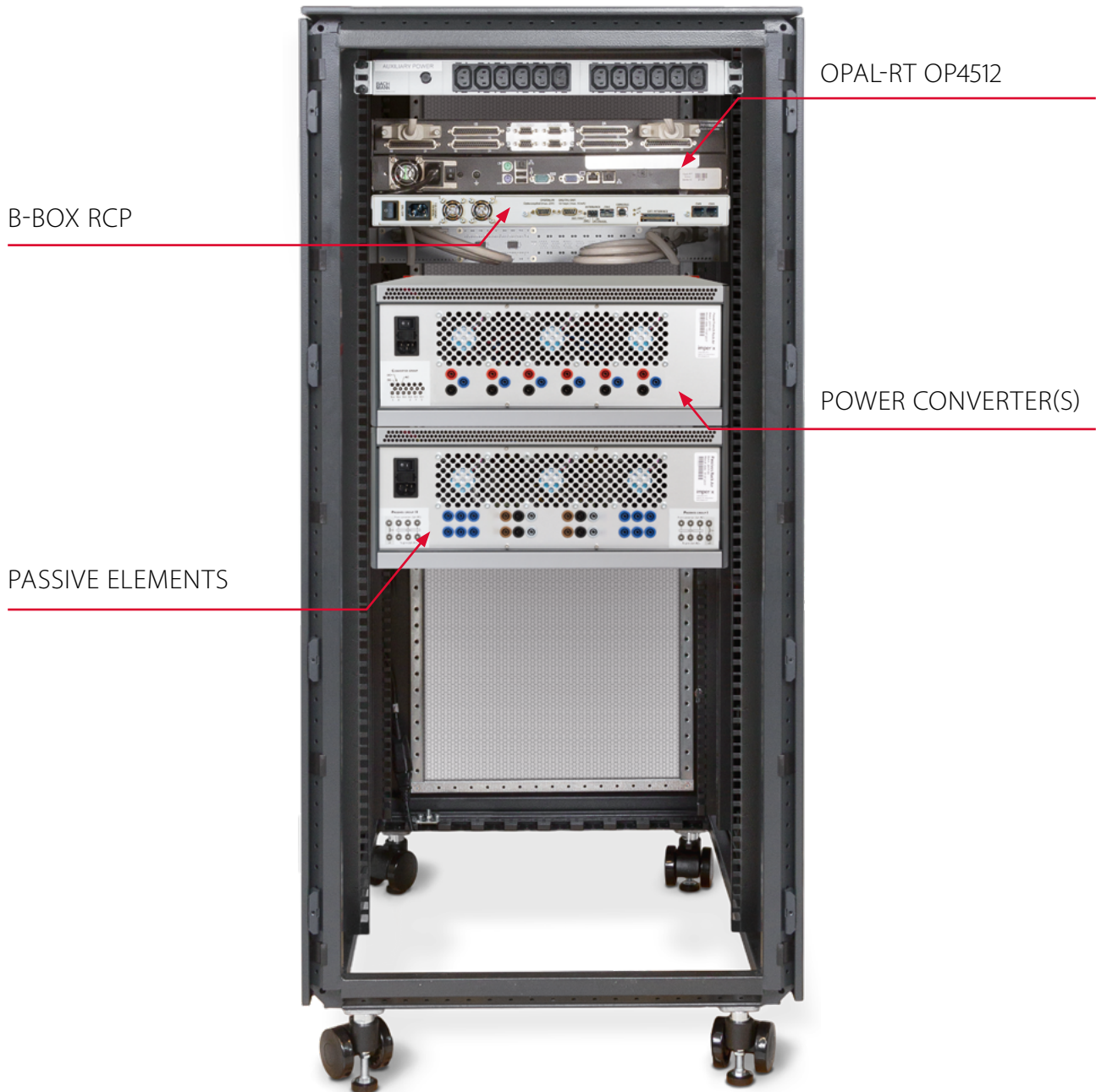
PASSIVE ELEMENTS

- » 6x inductors (2.5mH, 20A)
- » 2x LC-type common-mode EMC filters (3-phase)
- » External voltage sensors
- » External relays and breakers

“The OP1300 is a multi-purpose test bench for microgrids. 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...

B-Box RCP
Real time controller



RT-Lab / OP4512
Digital simulation



Power converter
Real power circuits



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

Nicolas Cherix, Chief scientist, Imperix Ltd.

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 B-Box 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.

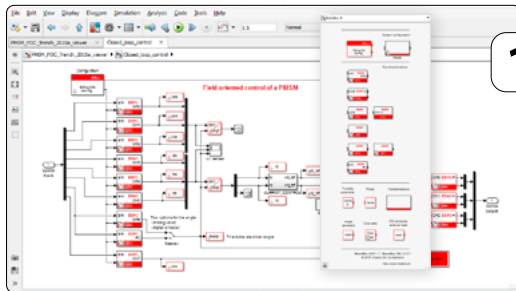
SAFETY

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

... TO REAL POWER

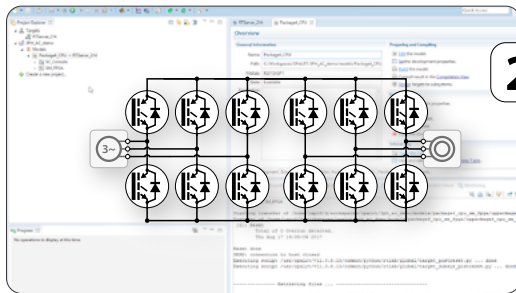
... validation of complex control techniques!

FROM IMAGINATION TO REAL-TIME SIMULATION...



IMAGINE AND DEVELOP

Imagine and develop your control on Matlab Simulink, and instantly download it into the B-Box RCP, a high performance and easy-to-use power electronics controller.



MODEL AND SIMULATE

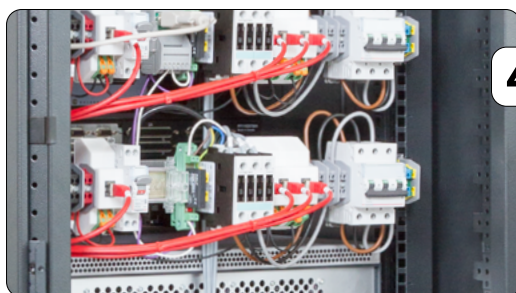
Simulate the power converters and their passive components on the OP4512, a high-fidelity and flexible HIL simulator based on RT-LAB and Matlab Simulink.

... AND FROM REAL-TIME SIMULATION TO REAL POWER!



DEBUG AND TEST

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.



IMPLEMENT AND VALIDATE

Connect the B-Box 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 !

B-BOX 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

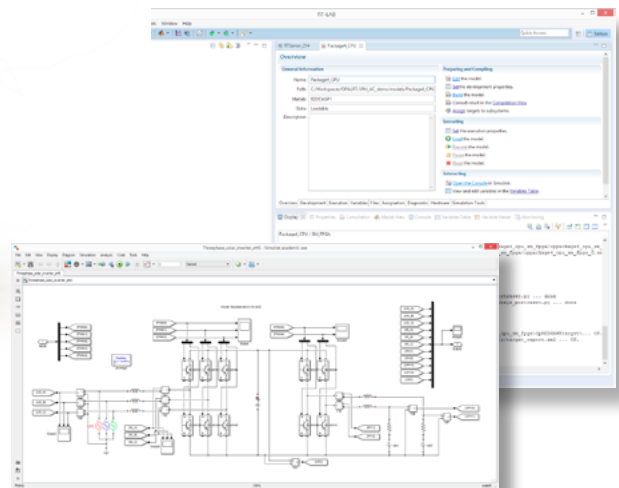
Thanks to our blockset for Simulink, control design and modeling can be done very easily. Then, once the control has been finely tuned in simulation, all you need is just click on one button to generate executable code and upload it into the B-Box!

REAL TIME MONITORING

Each unit is shipped with *B-Box 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 B-Box control platform.

[Read more online...](#)

OP4512 REAL TIME SIMULATOR



SMALL BUT STRONG!

The OP4512 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 integra-

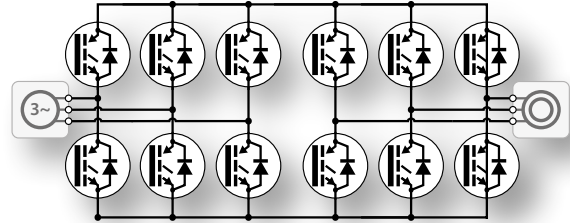
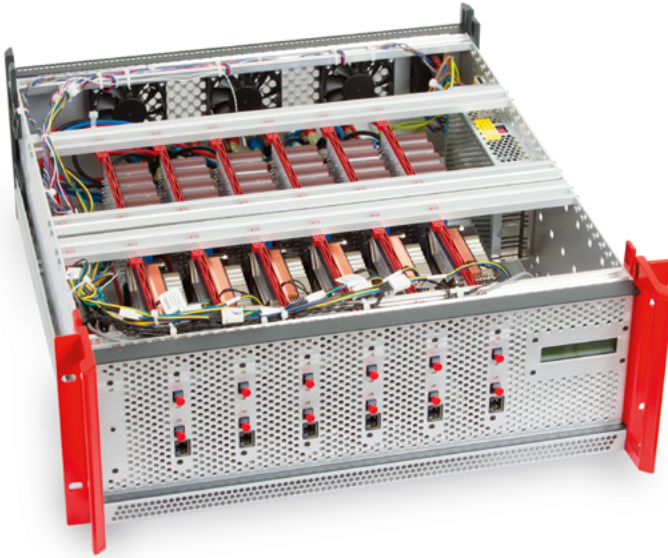
tion with RT-Lab, eHS also guarantees you a great flexibility and a complete control over your simulations, all this with a microsecond-scale time step!

[Read more online...](#)

POWER COMPONENTS

Freely configurable elements to build up various power converters !

POWER STAGE

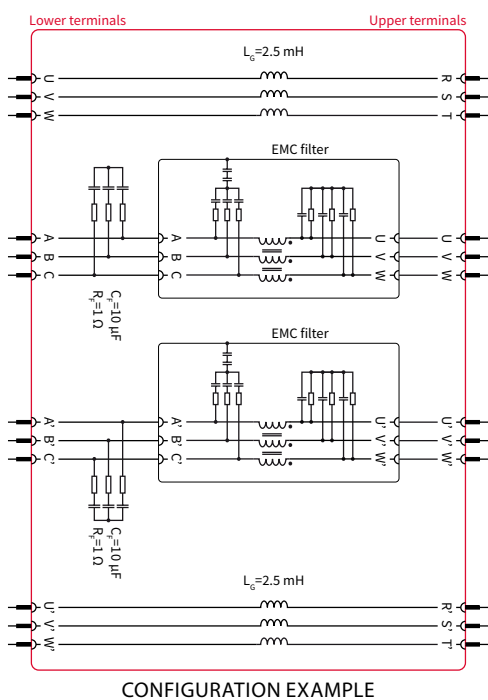


The power stage delivers ready-to-use and freely configurable power conversion, thanks to:

- 6x independent half bridge power modules
- Ratings **800V/38A** or **400V/50A** per module
- Integrated current sensors (LEM)
- Coordinated protection, variable-speed cooling

[Read more online...](#)

PASSIVE ELEMENTS



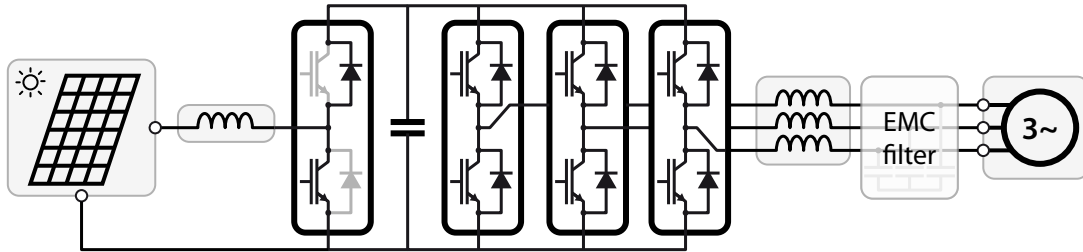
The auxiliary 4U rack is an optional unit for the necessary passive components, filters, etc. The standard configuration features:

- 6x independent inductors (2.5mH, 20A)
- 2x LC-type common-mode filters (3-phase)

[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!

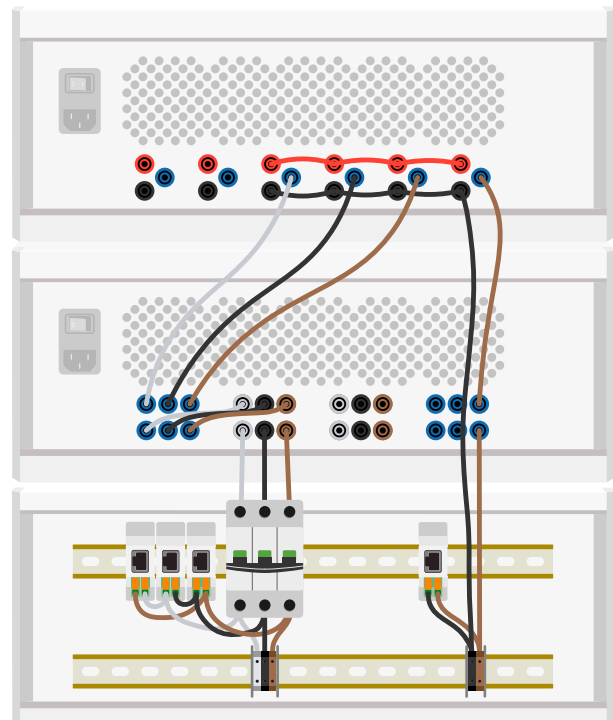
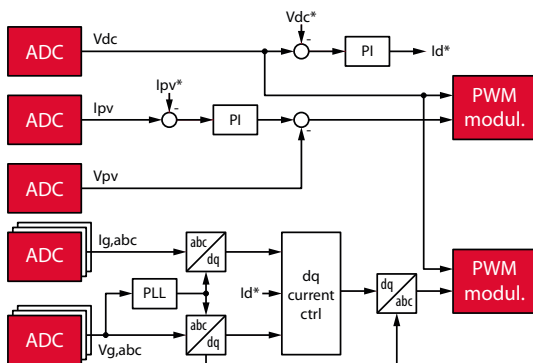
Simulate unbalanced or faulty grid conditions!



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

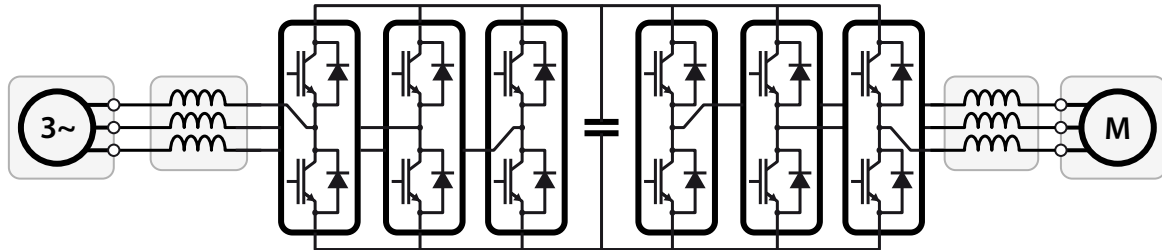
POSSIBLE RESEARCH TOPICS

- 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.



ELECTRIC DRIVE

Grid-tied variable frequency drive for various machine types

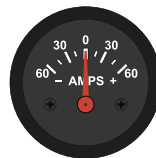


Work with a **simulated** motor to test any type of electric machine!



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

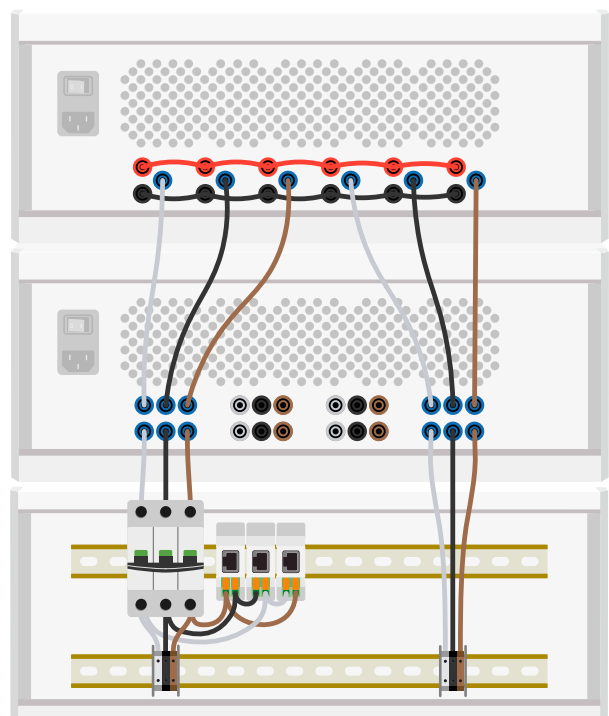
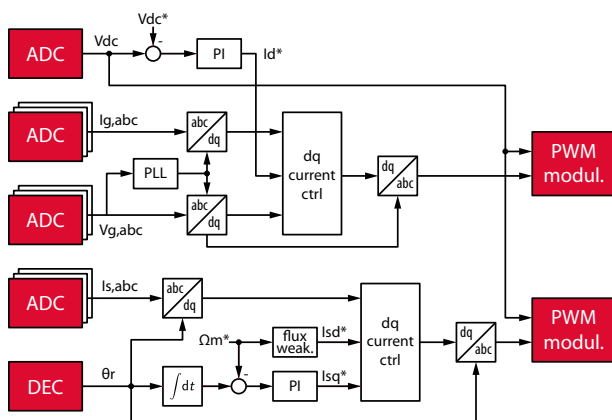
Simulate any load behavior, including abrupt changes!



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

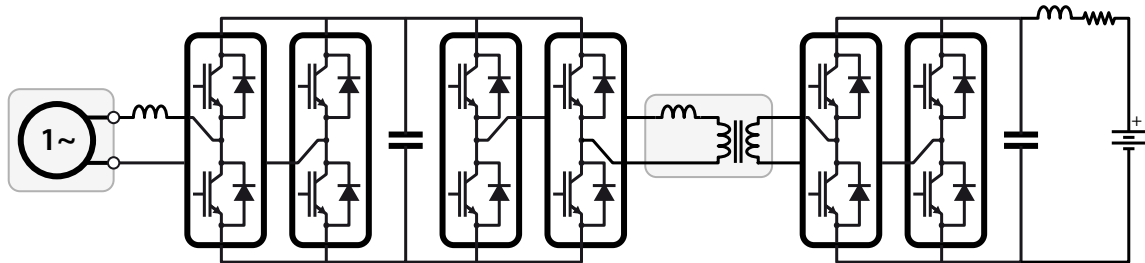
POSSIBLE RESEARCH TOPICS

- 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.



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!

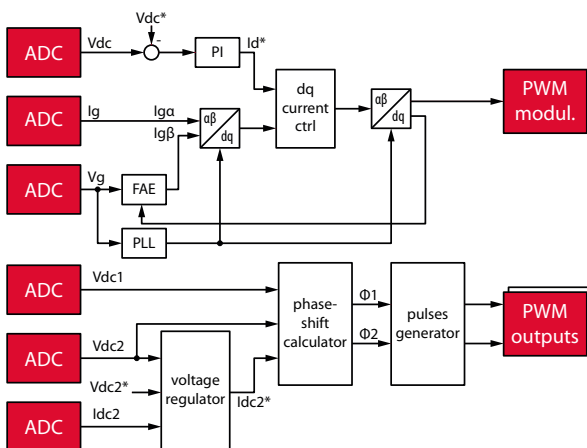
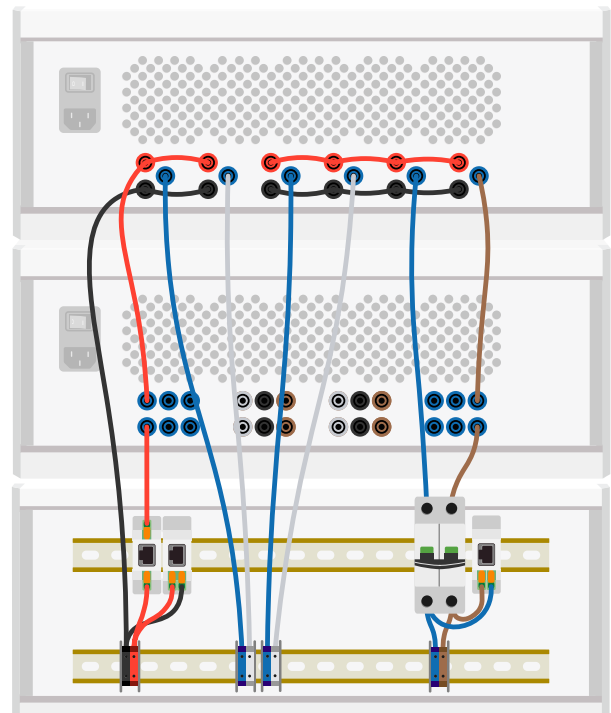
Simulate any battery characteristics and state of charge easily!



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.



KITS & BUNDLES

Flexible configurations for a broad range of needs



STARTER KITS

* HARDWARE + SOFTWARE

- Programmable controller (B-Box RCP)
- C/C++ development tools (CPP SDK)
- Open chassis with 3x PEB 8024
- 4x voltage sensors

— OPTIONS —

- Simulink + Plects blockset

— VARIANTS —

- Other power modules

* HARDWARE + SOFTWARE

- Programmable controller (B-Box RCP)
- C/C++ development tools (CPP SDK)
- Open chassis with 6x PEB 8024
- 6x voltage sensors

— OPTIONS —

- Simulink + Plects blockset

- Passives and filters box

- Grid side panel

— VARIANTS —

- Other power modules
- Other controller

HIL KIT

* HARDWARE + SOFTWARE

- Programmable controller (B-Box RCP)
- Software tools for Simulink and PLECS
- Interface for Opal-RT simulators
- Opal-RT OP 4512

— OPTIONS —

- C/C++ code development environment

— VARIANTS —

- Other simulator
- Add some real power hardware



POWER ELECTRONIC BUNDLE

* HARDWARE + SOFTWARE

- Programmable controller (B-Box RCP)
- C/C++ code development environment
- Converter box with 6x PEB 8024
- Passives and filters box
- Grid-side panel
- 4x voltage sensors

— OPTIONS —

- Simulink + Plects blockset

— VARIANTS —

- PEB 4046 for more current

LITE MMC BUNDLE

* HARDWARE + SOFTWARE

- 3x Programmable controller (B-Box RCP)
- Software tools for Simulink and PLECS
- 3x open chassis with 24x PEH 2015
- 6x inductors
- 4x voltage sensors
- 6x current sensors

— OPTIONS —

- C/C++ code development environment

— VARIANTS —

- PEB modules for more power
- 6x B-Box RCP + 6x racks

MICROGRID TEST-BENCH

* HARDWARE + SOFTWARE

- Programmable controller (B-Box RCP)
- Software tools for Simulink and PLECS
- Interface for Opal-RT simulators
- Opal-RT OP 4512
- Converter box with 6x PEB 8024
- Passives and filters box
- Grid connector box

— OPTIONS —

- C/C++ code development environment

— VARIANTS —

- Other simulator
- Power amplifier for PHIL

* All current prices are on imperix.ch



SWISS
MADE

imperix Ltd.
Rue de la Dixence 10
CH-1950 Sion
Switzerland

Phone +41 27 552 06 60
Fax +41 27 552 06 69

www.imperix.com
sales@imperix.com

Find your closest distributor on imperix.ch/resellers