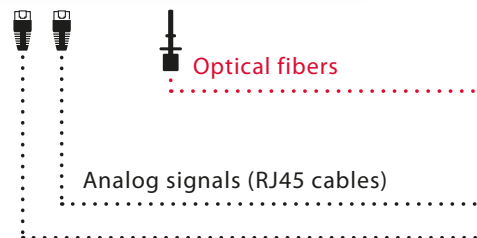# imperix

POWER MODULES
MODULAR POWER ELECTRONICS

" *Experiment on downscaled prototypes, while facing all the challenges of advanced converter control in realistic conditions using imperix power modules.*

BUILDING BLOCKS FOR LOW-VOLTAGE
POWER CONVERTER PROTOTYPES

PROTOTYPING SOLUTIONS
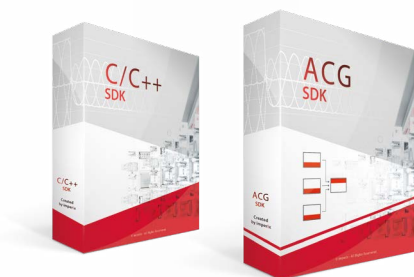
Speed up your developments from the lab to the field

Optical fibers

Analog signals (RJ45 cables)

1 **Software**

2 **Real time controller**

C/C++ **SDK**

ACG **SDK**

B-**Box RCP**

B-**Board PRO**

SOFTWARE

Imperix offers two distinct Software Development Kits (SDK) that contain everything needed in order to program real time controllers from either C/C++ code or directly from within a simulation software such as Matlab Simulink™ and Plexim PLECS™.

Notably, the Automated Code Generation (ACG) SDK provides a blockset and an automated toolchain so that both simulation and device programming can be done with just a few clicks.

REAL TIME CONTROLLERS

The B-Box RCP is a controller dedicated to rapid control prototyping (RCP) applications. It distinguishes by its specialized analog front end with hardware protections and offers best-in-class control and modulation performance, making it the perfect platform for the validation of advanced control techniques.

The B-Board PRO is a product-embeddable module that guarantees a seamless portability of developments made on B-Box RCP.
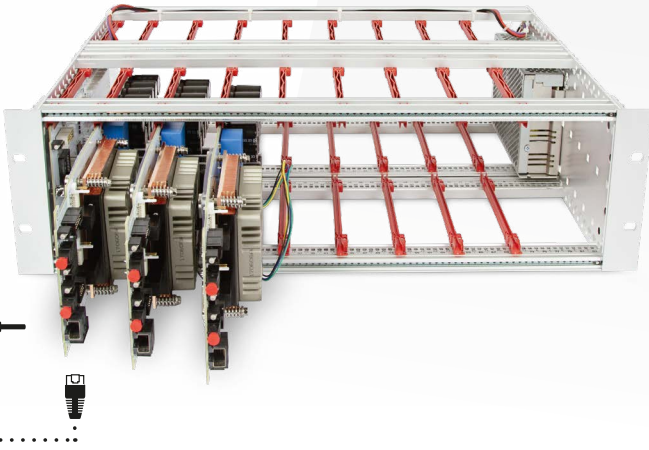
(3) **Power converter**

(4) **Sensors**
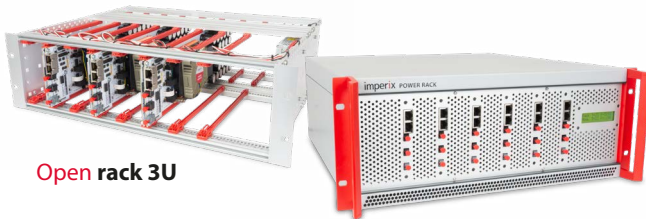
Open **rack 3U**

Closed **rack 4U**

Current **sensor**

Voltage **sensor**

POWER MODULES

With the help of power modules and their associated chassis, power converters of practically any topology can be built up within minutes. Topologies can of course always be altered and modules reused in multiple scenarios.

Four types of power modules are available, with different ratings and internal structures. All modules possess integrated current and voltage sensors, as well as internal protections.

SENSORS

Imperix equipment – especially the B-Box RCP – is meant to be used with any third-party products. This notably applies to sensors, of which any type can be easily integrated with B-Box RCP.

Nevertheless, for those who do not already have the equipment or prefer to privilege 100% plug-and-play behavior, imperix offers two types of sensors, for current measurements up to ±50 A and voltage measurements up to ±800 V.

POWER MODULES

A broad choice of building blocks for various types of applications

SEMI-INDUSTRIAL MODULES

PEB-type modules are based on a half-bridge of power semiconductors. They also embed decoupling capacitors (DC bus), gate drivers, as well as on-board measurements and protections.

Modules exist with various voltage and current ratings, hence offering multiple variants that can closely fit to various applications. When needed, modules can also be used in parallel operation for increased current capabilities.

Among the available modules, the PEB 8024 and PEB 8038 make use of 1200V Silicon Carbide MOSFETs for state-of-the-art switching speed and conversion efficiency.

TEACHING-ORIENTED MODULES

The PEH and PEN modules possess reduced ratings when compared to the PEB variants, but focus instead on different topologies, aiming to proof-of-concept applications.

PEH modules are based on a H-bridge of power switches, while PEN modules embed a phase-leg of a 3-level NPC structure. Furthermore, as with PEB boards, gate drivers as well as measurements and protections are available onboard.
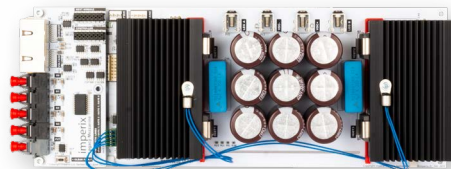
All power modules are plug-and-play compatible with the B-Box RCP control platform, thanks to RJ45 analog outputs (voltage and current measurements), and fiber-optical PWM inputs.
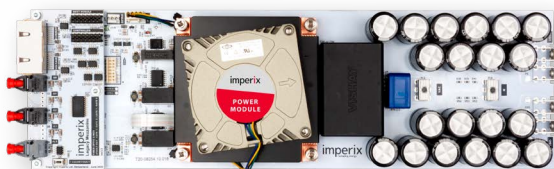
PEB 8024 / 8038 SiC HALF-BRIDGE
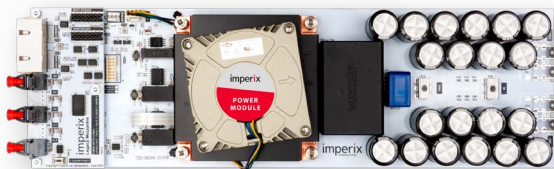
- 800 V / 24 A or 800 V / 38 A
- Up to 8 kVA per module
- Up to 200 kHz hard switching
- V + I measurements, onboard protections

PEH 2015 / 4010 IGBT FULL-BRIDGE

- 400 V / 10 A or 200 V / 15 A
- Up to 400 W per module
- Usable in full- or half-bridge mode
- V + I measurements, onboard protections

PEB 4050 IGBT HALF-BRIDGE

- 400 V / 50 A
- Up to 8 kVA per module
- Up to 50 kHz hard switching
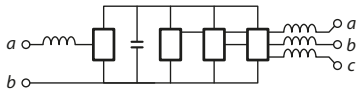- V + I measurements, onboard protections

PEN 8018 NPC PHASE-LEG

- 800 V / 18 A
- Up to 5 kVA per module
- Three-level NPC topology (I-type phase-leg)
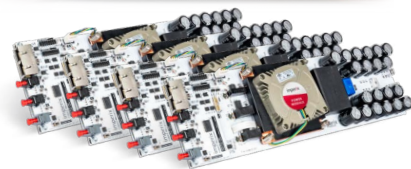- V + I measurements, onboard protections

UNLIMITED TOPOLOGIES
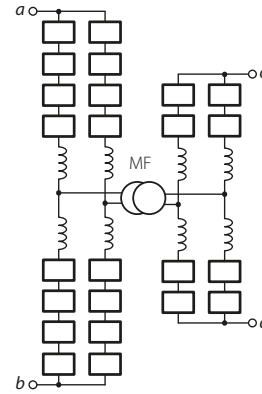
Build whatever you can imagine based on building blocks
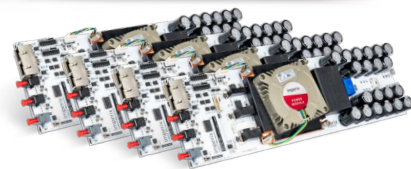
1X

4X

- *10-20 kW* on 230 / 800V AC grid
- Up to *800 V_{DC}*
- Available with SiC and Silicon devices

3X

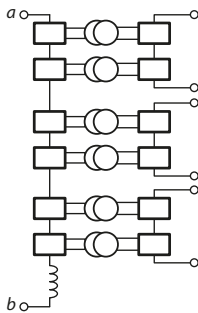**24X**

- *10-25 kW* between 1200 V_{DC} and 600 V_{DC}
- Up to *1200 V_{DC}*
- Available with various IGBT devices and capacitor banks
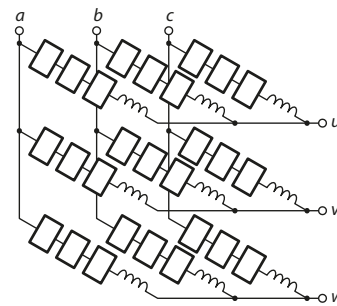
3X

12X

- *3-10 kW* depending on the topology
- Up to *800 V_{DC}*
- AC and DC configurations are possible

6X

45X

- *6-12 kW* on 230 / 400V AC grid
- Up to *600 V_{AC}*
- Usable with a lower cells count

MMC QUICK-START PACKAGE

The easiest way to enter the world of Modular Multilevel Converters

The Modular Multilevel Converters (MMC) quick-start package enables engineers to make a grand entrance in the world of modern multilevel converters, with a ready-to-use power conversion system!

The standard MMC prototyping bundle contains everything needed to implement a 230/400 V grid-tied converter of 5-8 kW, including three B-Boxes, 24 submodules and the necessary software and cabling.

Various modulators are also provided as part of standard FPGA firmware, including MMC-specific modulation and balancing algorithms (sort-and-select). The only missing part is the upper-level control strategy, and even for that control code examples are provided!

For later projects, the bundle guarantees a high reusability: many more topologies can be implemented by simply reusing the power modules and control units.

3x

24x
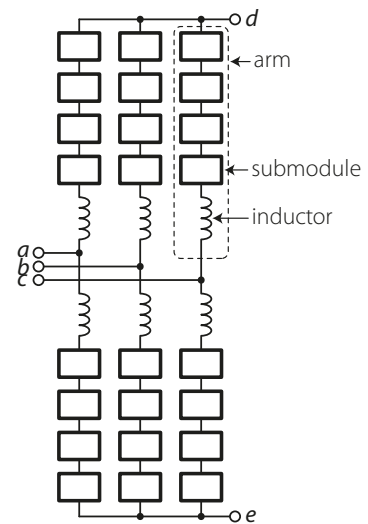
- *5-8 kW* on 230 / 400V AC grid
- Up to *800 V_{DC}*
- Upgradable to full-bridge operation

KITS & BUNDLES

Flexible configurations for a broad range of needs

STARTER KIT

* HARDWARE + SOFTWARE

- B-Box RCP + C/C++ SDK
- Open chassis with 3 x PEB 8024
- 4 x voltage sensors
- All needed cables

──────── OPTIONS ────────

- ACG SDK (Simulink and PLECS blockset)

──────── VARIANTS ────────

- Other power modules

LITE KIT

* HARDWARE + SOFTWARE

- B-Box RCP + C/C++ SDK
- Open chassis with 6 x PEB 2024
- 6 x voltage sensors
- All needed cables

──────── OPTIONS ────────

- ACG SDK (Simulink and PLECS blockset)

──────── VARIANTS ────────

- Other power modules
- Other controller

HIL KIT

* HARDWARE + SOFTWARE

- B-Box RCP + ACG SDK
- Interface for Opal-RT + cables
- Opal-RT OP 4510

──────── OPTIONS ────────

- Without ACG SDK (Simulink and PLECS blockset)

──────── VARIANTS ────────

- Other simulator
- Add some real power hardware

POWER ELECTRONIC BUNDLE

* HARDWARE + SOFTWARE

- B-Box RCP + C/C++ SDK
- Power Trench with 6 x PEB 8024
- Passives filters box
- Grid-side panel
- 6 x voltage sensors
- 4 x current sensors
- All needed cables

──────── OPTIONS ────────

- ACG SDK (Simulink and PLECS blockset)

──────── VARIANTS ────────

- PEB 4046 for 110VAC operation

LITE MMC BUNDLE

* HARDWARE + SOFTWARE

- 3 x B-Box RCP + ACG SDK
- 3 x Open chassis with 24 x PEH 2015
- 6 x inductors
- Grid-side panel
- 4 x voltage sensors
- 6 x current sensors
- All needed cables

──────── OPTIONS ────────

- Without ACG SDK (Simulink and PLECS blockset)

MICROGRID BUNDLE

* HARDWARE + SOFTWARE

- B-Box RCP + ACG SDK
- Interface for Opal-RT simulators
- Opal-RT OP 4510
- Power Trench with 6 x PEB 8024
- Passives filters box
- All needed cables

──────── OPTIONS ────────

- Grid connection box
- Power amplifier for PHIL

* All current prices are available on imperix.com

SWISS
MADE