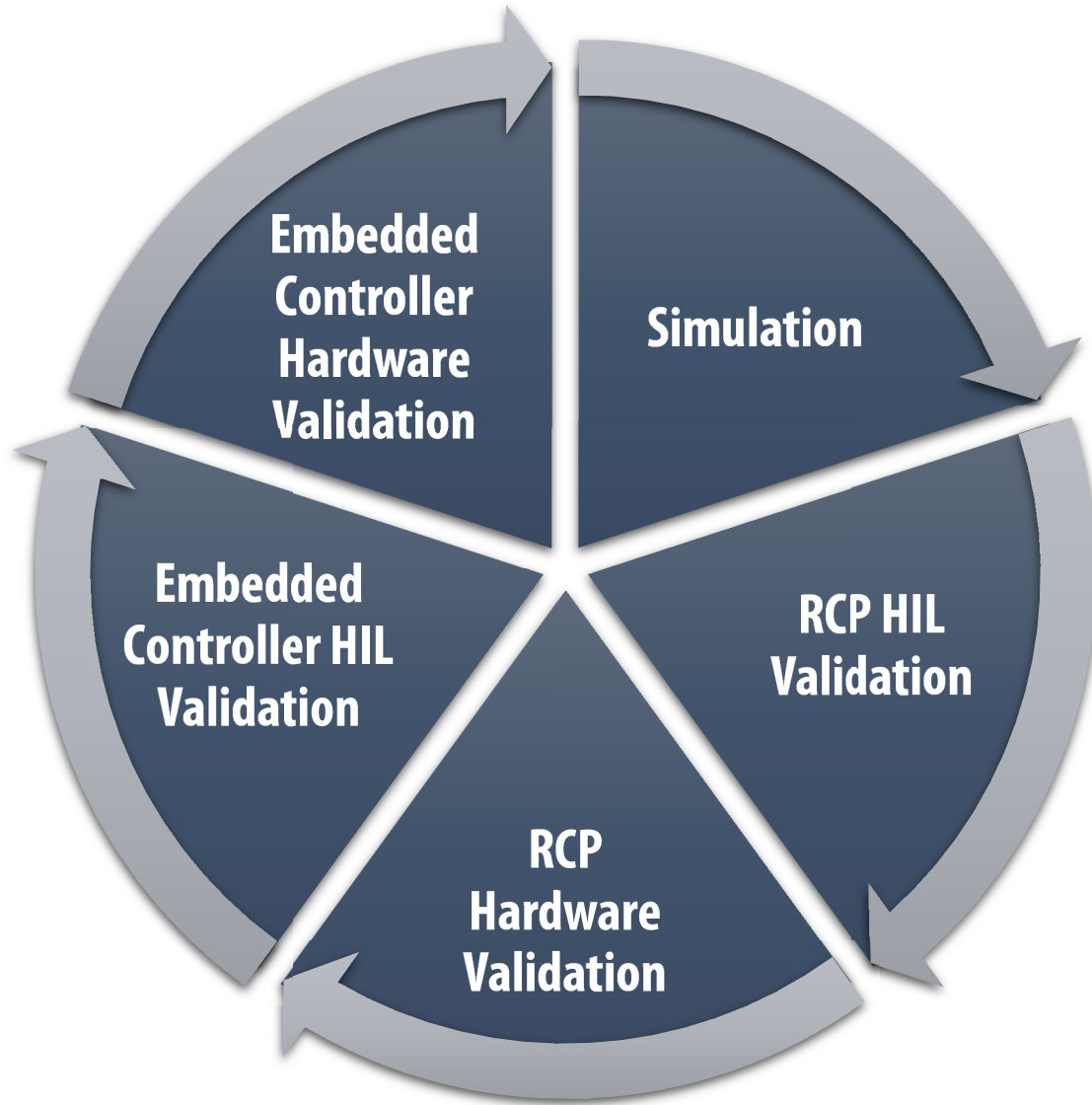# PELab | Power Electronics Rapid Developement System

Simulation: *Simulate the Control System & Circuit Topology*

RCP HIL Validation: *Develop Control System in RCP & Test it with HIL Real-Time Simulator*

RCP Hardware Validation: *Test the Developed Control System in RCP with Power Electronics Hardware*

Embedded Controller HIL Validation: *Develop Control System in Industrial Controller & Test it with HIL Real-Time Simulator*

Embedded Controller Hardware Validation: *Test the Developed Control System in the Industrial Controller with Power Electronics Hardware*

Filters — EMC Filters / Relays

Inductors

Power Modules

+DC U V W -DC

Measurements

i/v
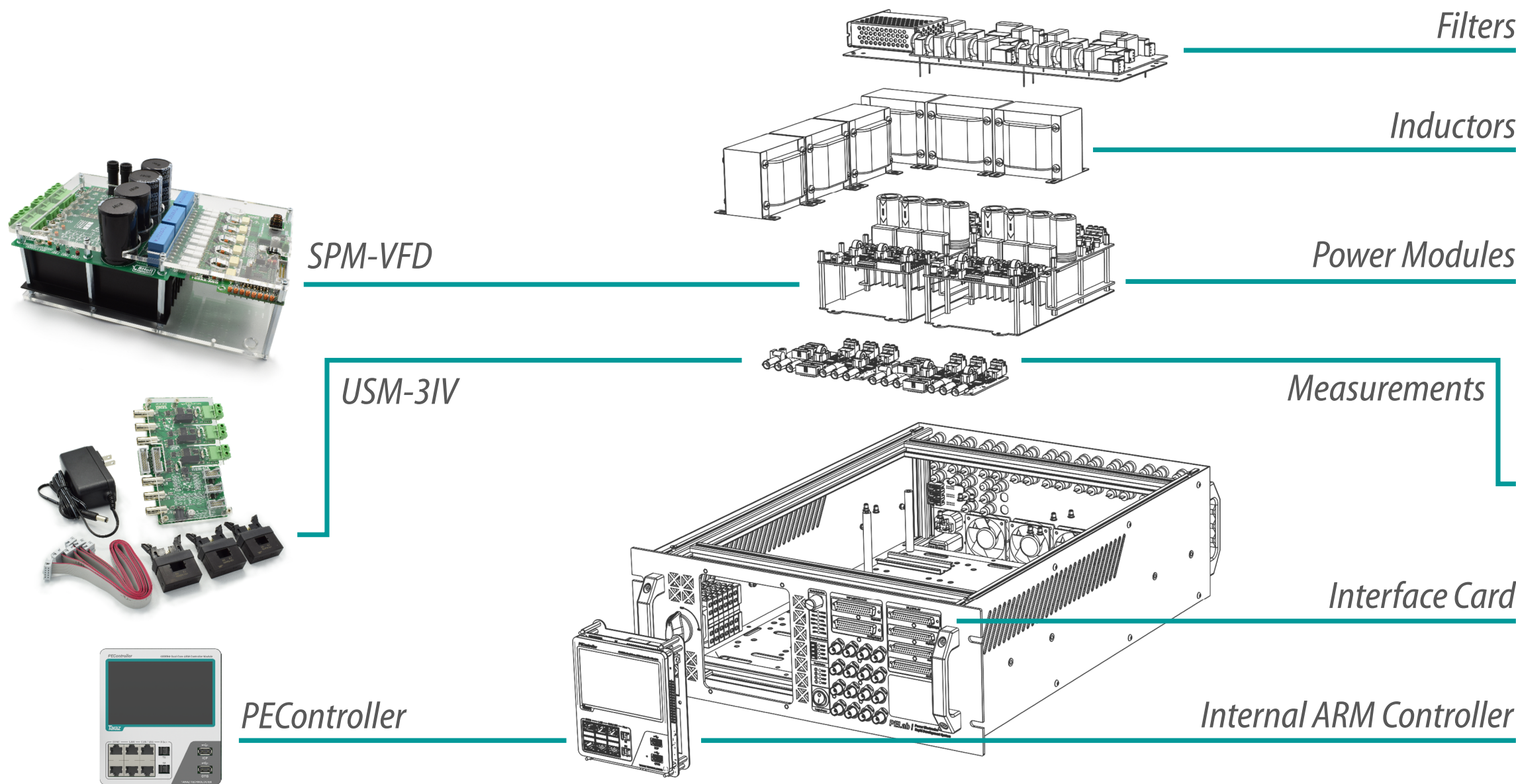
Interface Card — Analog/Digital Multiplexer

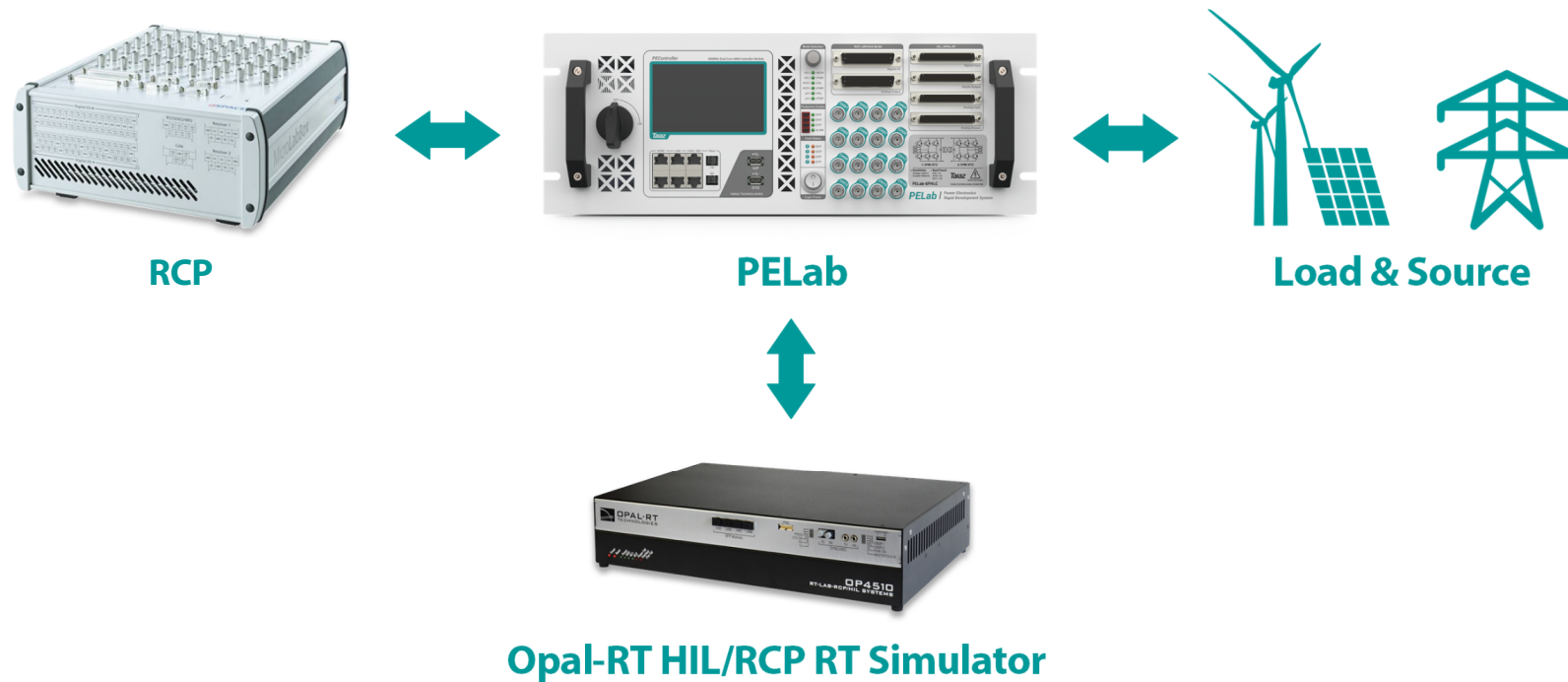Internal ARM Controller — Embedded Controller

SPM-VFD

USM-3IV

PEController

INTRODUCTION | Features Overview

✓ A Modular Power Electronics Development System that Makes the Research Faster & Safer.

✓ Connects to Multiple Controllers and Real-Time Simulator Simultaneously.

✓ Support the Entire Research & Development Cycle by Operating in Multiple Modes.

✓ Fully Isolated Measurements for Oscilloscopes.

✓ Built-in Hardware Protections Such as SCP, OCP, OVP & OTP.

✓ Optional Industrial ARM Cortex M7/M4 Dual Core Controller with Integrated 5"Touch Display, Communications & Programming Ports.

✓ Available in Multiple Commonly used Power Electronics Topologies.

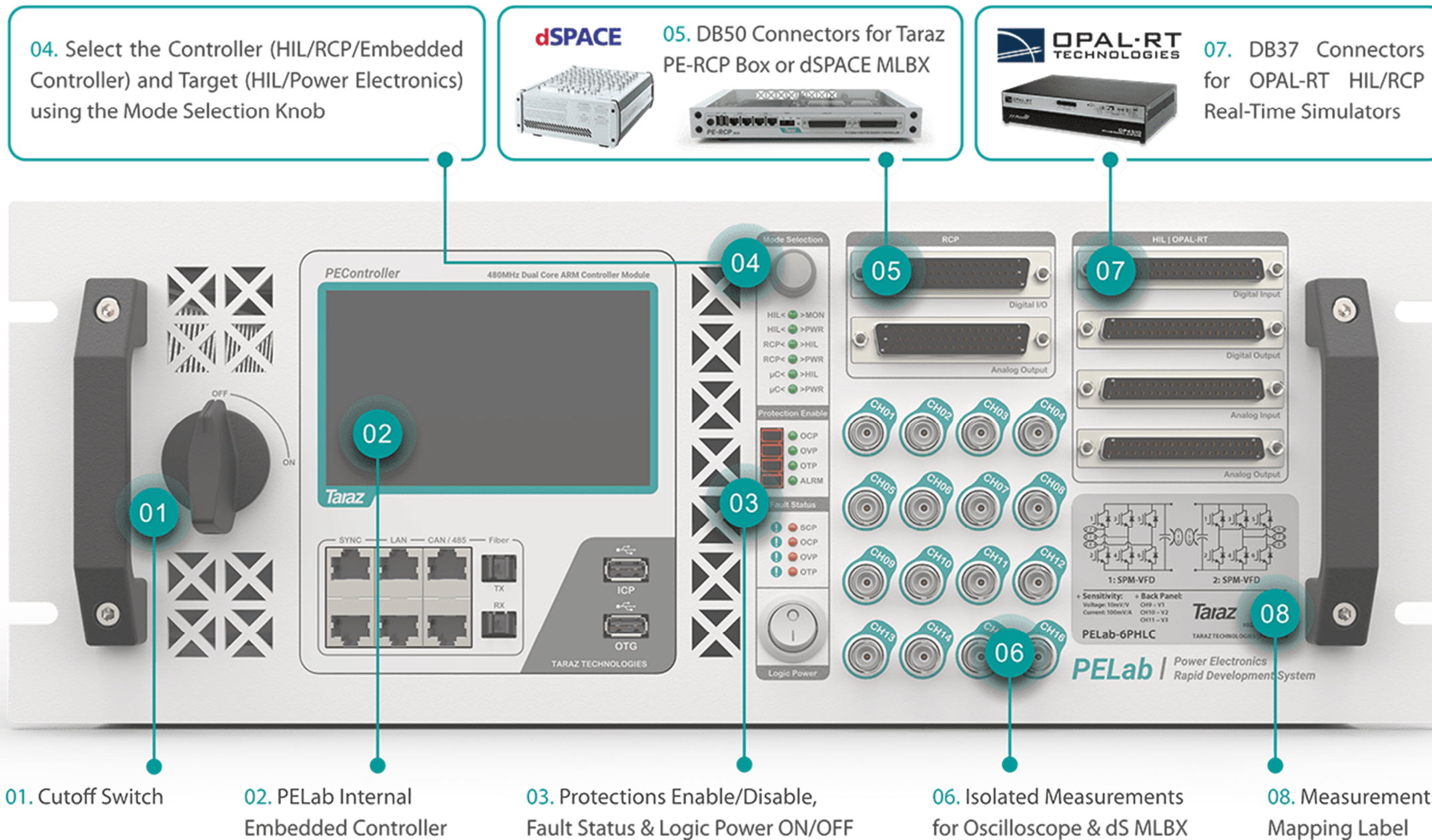✓ Configurable Application Circuit using the Standard Banana Connectors.

RCP

PELab

Load & Source

Opal-RT HIL/RCP RT Simulator

Controllers

Opal-RT Simulator

RCP

Internal Embedded Controller

Interface Card

Targets

Opal-RT Simulator

Power Electronics

✓ PELab connects simultaneously to Real Time Simulator, RCP, and loads & sources.

✓ Different operation modes of the PELab enable rapid development environment where setup is constant while modes are changing by a control knob.

✓ PELab internal multiplexing logic routes the signals from and to each device.
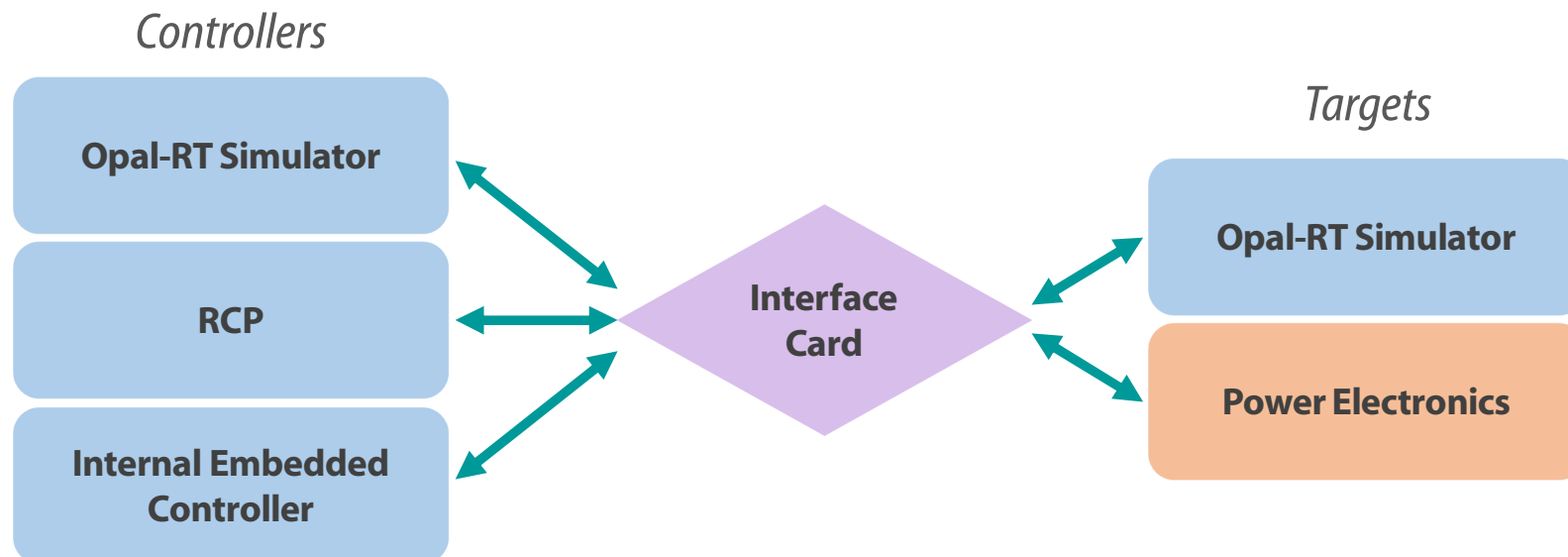
04. Select the Controller (HIL/RCP/Embedded Controller) and Target (HIL/Power Electronics) using the Mode Selection Knob

dSPACE **05.** DB50 Connectors for Taraz PE-RCP Box or dSPACE MLBX

OPAL-RT TECHNOLOGIES **07.** DB37 Connectors for OPAL-RT HIL/RCP Real-Time Simulators

01. Cutoff Switch

02. PELab Internal Embedded Controller

03. Protections Enable/Disable, Fault Status & Logic Power ON/OFF

06. Isolated Measurements for Oscilloscope & dS MLBX

08. Measurements Mapping Label

FRONT PANEL

OVERVIEW

02. Configure your own Application Circuit by Connecting the available blocks and power modules
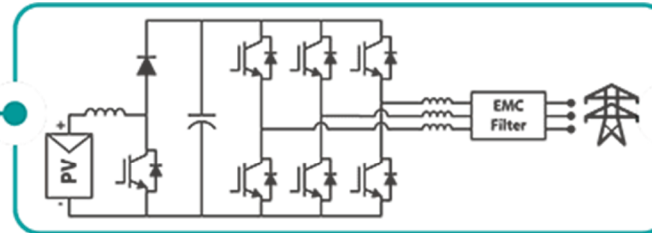
Monitor Loads and Sources using the optional Voltage (07.) and Current (08.) Sensors such as Grid, PV and Battery etc.

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1   C1 D1   E1 F1   G1 H1   I1 J1   K1 L1   V1
A2 B2   C2 D2   E2 F2   G2 H2   I2 J2   K2 L2   V2
A3 B3   C3 D3   E3 F3   G3 H3   I3 J3   K3 L3   V3
A4   L4   V4
A5   L5
                                                L6

LC Filter | EMC Filter | Relays

A1
A2   EMC Filter   B1   C1 — D1
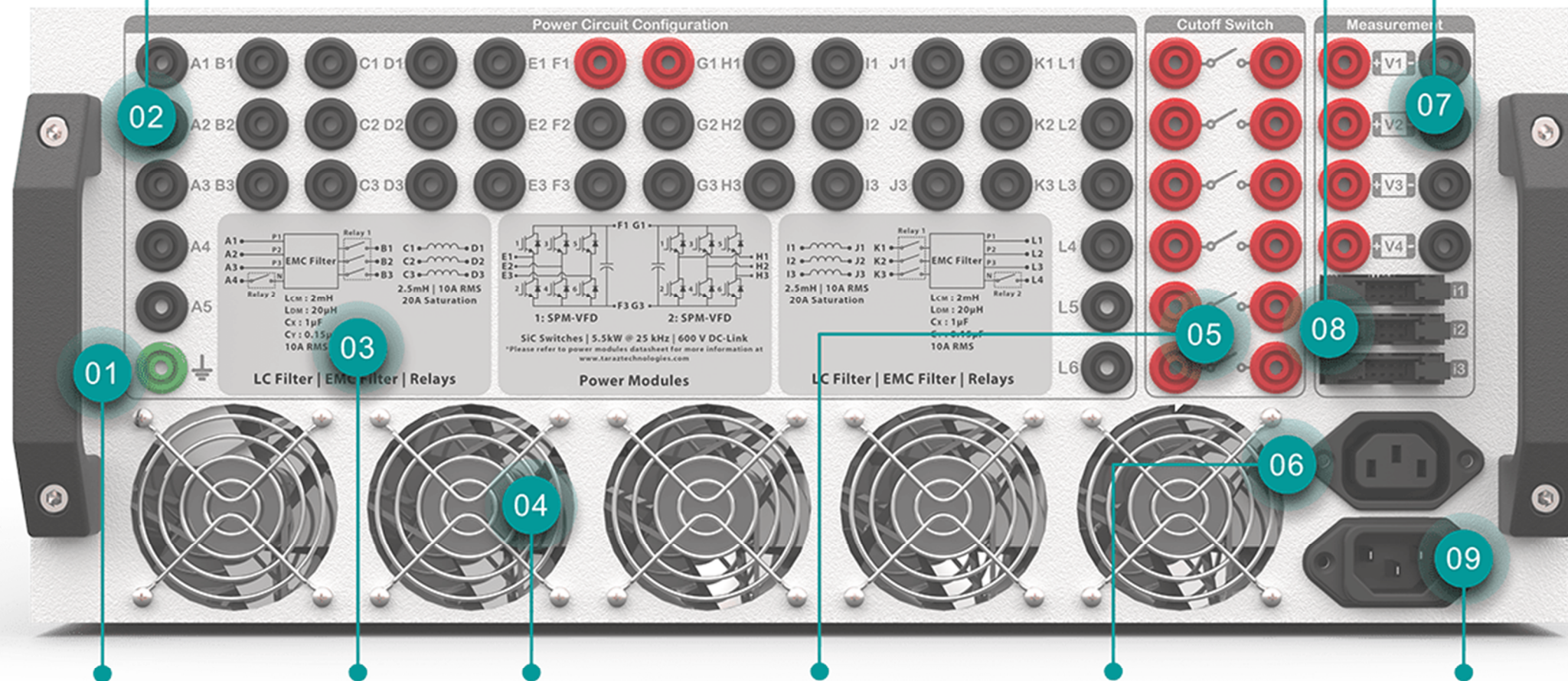A3   B2   C2 — D2
A4   Relay 2   B3   C3 — D3
Relay 2
Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS
2.5mH | 10A RMS
20A Saturation

Power Modules

F1 G1
E1
E2
E3
F3 G3
1: SPM-VFD   2: SPM-VFD
SiC Switches | 5.5kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1 — J1   K1
I2 — J2   K2   EMC Filter   P1 — L1
I3 — J3   K3   P2 — L2
2.5mH | 10A RMS   P3 — L3
20A Saturation   Relay 2   N — L4
Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

I1
I2
I3

01. A Must Connect Safety Earth Terminal

03. PELab Circuit Configuration Labels

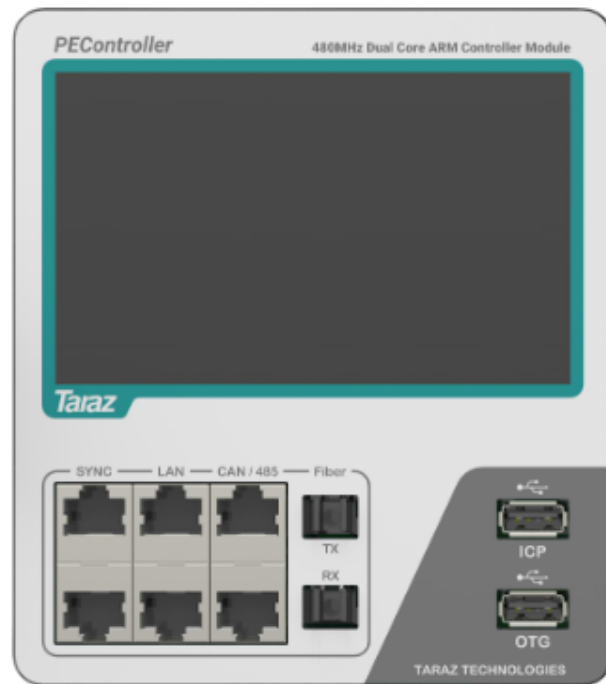**04.** Cooling Fans Exhaust

05. Cutoff Switch to Safely Disconnect Loads/Sources

06. Logic Power Supply Output to Next PELab

09. Logic Power Supply Input (85~264VAC | 120~373 VDC)

REAR PANEL

OVERVIEW

High-Performance Architecture

PEController | ST ARM STM32H475 Based

Integrations

intelliSENS Software

Programming

C

Performance & GUI

✓ 480MHz (M7) / 240MHz (M4), Dual-Core
✓ 5" Touch Display

Analog
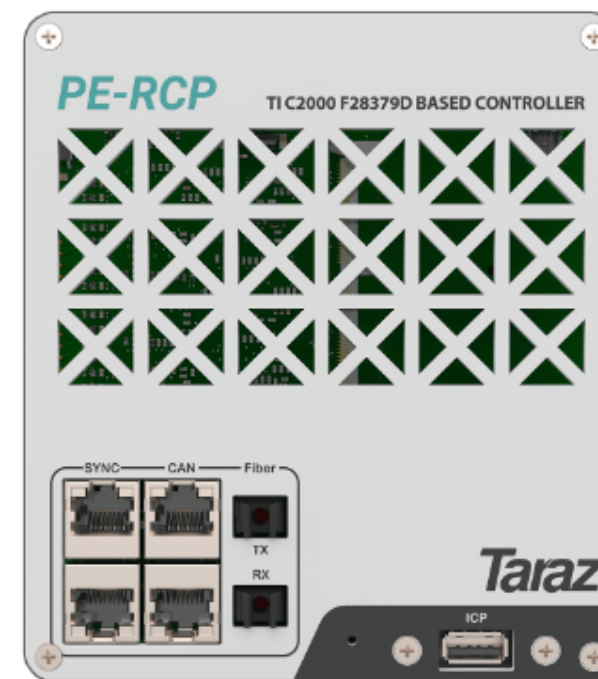
✓ 16CH, 250ksps @ 16-Bit, ±10V Input
✓ Simultaneous Sampling
✓ High-Accuracy Dedicated ADC Chips

Communications

✓ LAN, CAN, RS-485, Fiber Optics & Sync
✓ High-Speed USB for DAQ

Rapid Control Prototyping

PE-RCP | TI C2000 F28379D Based

Programming

MATLAB PSIM plecs C

Performance

✓ 200MHz, Dual-Core

Analog

✓ 8CH, 360KSps @ 16-Bit, ±10V Input
✓ 8CH, 430KSps @ 12-Bit, ±10V Input

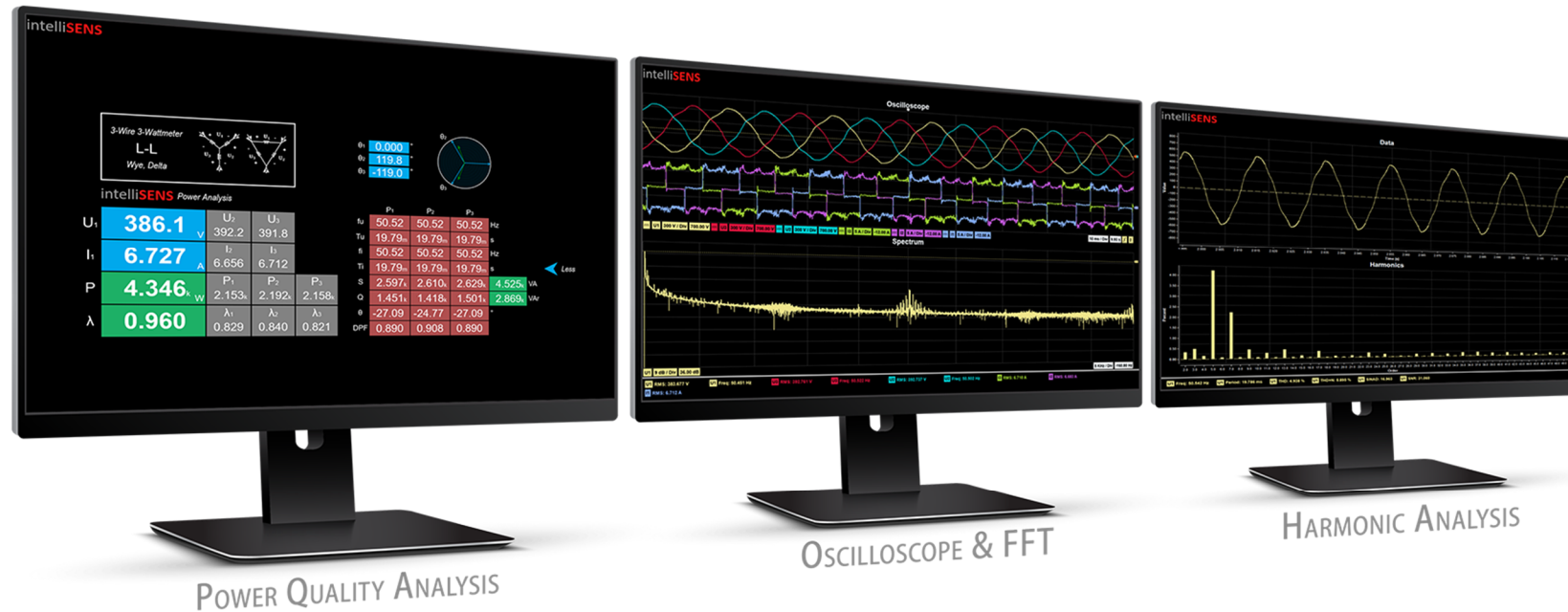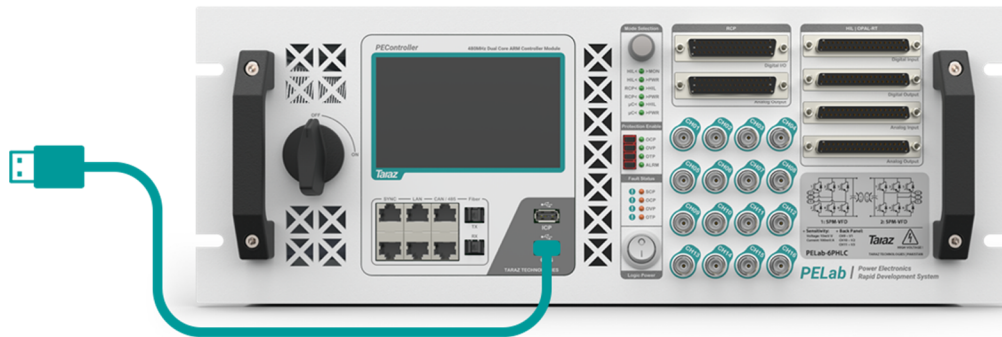### Communications

✓ CAN, Fiber Optics & Sync

✓ High Performance Dual Core ARM Cortex M7 (480MHz) & M4 (240MHz) Microcontroller.

✓ Dual 16-bit, 8 Channel ADCs with Simultaneous Sampling at 250ksps with ±10V Inputs.

✓ 5" Capacitive Touch Display with 800x480 (WVGA) Resolution.

✓ 50MBd Isolated Sync/Fiber Optic Communication for Module to Module Communication, for e.g. Distributed Control System, Load Sharing, Master-Slave Control.

✓ LAN, CAN & RS-485 for Industrial Communication.

✓ USB ICP (In Circuit Programmer) for Programming & Debugging.

✓ USB OTG (On-The-Go) for Data Acquisition & Communication.

✓ 16 Digital Outputs (All PWM Capable), 16 Digital Inputs & 16 Analog Inputs (PELab Mode).

✓ STM32H745BI Microcontroller is used from ST Microelectronics.

POWER QUALITY ANALYSIS

OSCILLOSCOPE & FFT
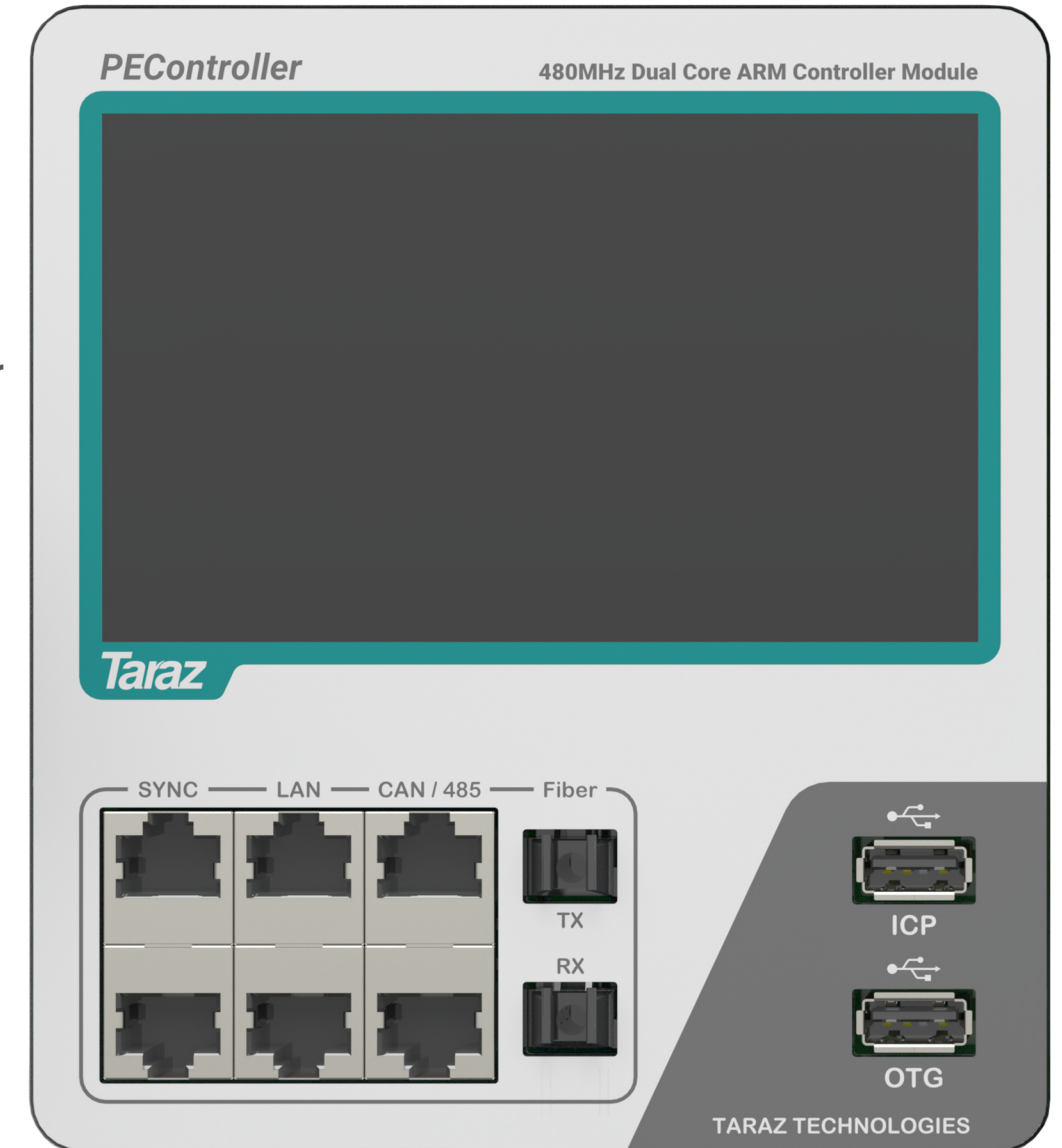
HARMONIC ANALYSIS

intelliSENS Integration Provides:

✓ 16CH Data Acquisition at 100KSps, 16-Bit, Simultaneous Sampling

✓ Oscilloscope with Measurements, Math Functions & FFT

✓ Harmonic Analysis such as THD & THD+N

✓ Power Quality Analysis such as PF, Real & Reactive Power

✓ Recorder Functionality while Retaining Complete Analysis Capabilities

✓ MATLAB Simulink, PSIM, PLECS and Embedded C Programming

✓ Dual-Core TI C2000 TMS320F28379D 200MHz Controller

✓ Up to 74 I/Os Including 24 PWM Outputs & 16 Analog Inputs

✓ 8CH 16-Bit & 8CH 12-Bit ADC with $\pm$10V Range

✓ Isolated CAN, Sync, Fiber Optics & USB 2.0 FS

✓ Up to 2 Quadrature Encoders, SPI, SCI & I2C Interfaces

✓ Isolated USB In-Circuit Programming & Debugging

✓ MicroSD Card Support
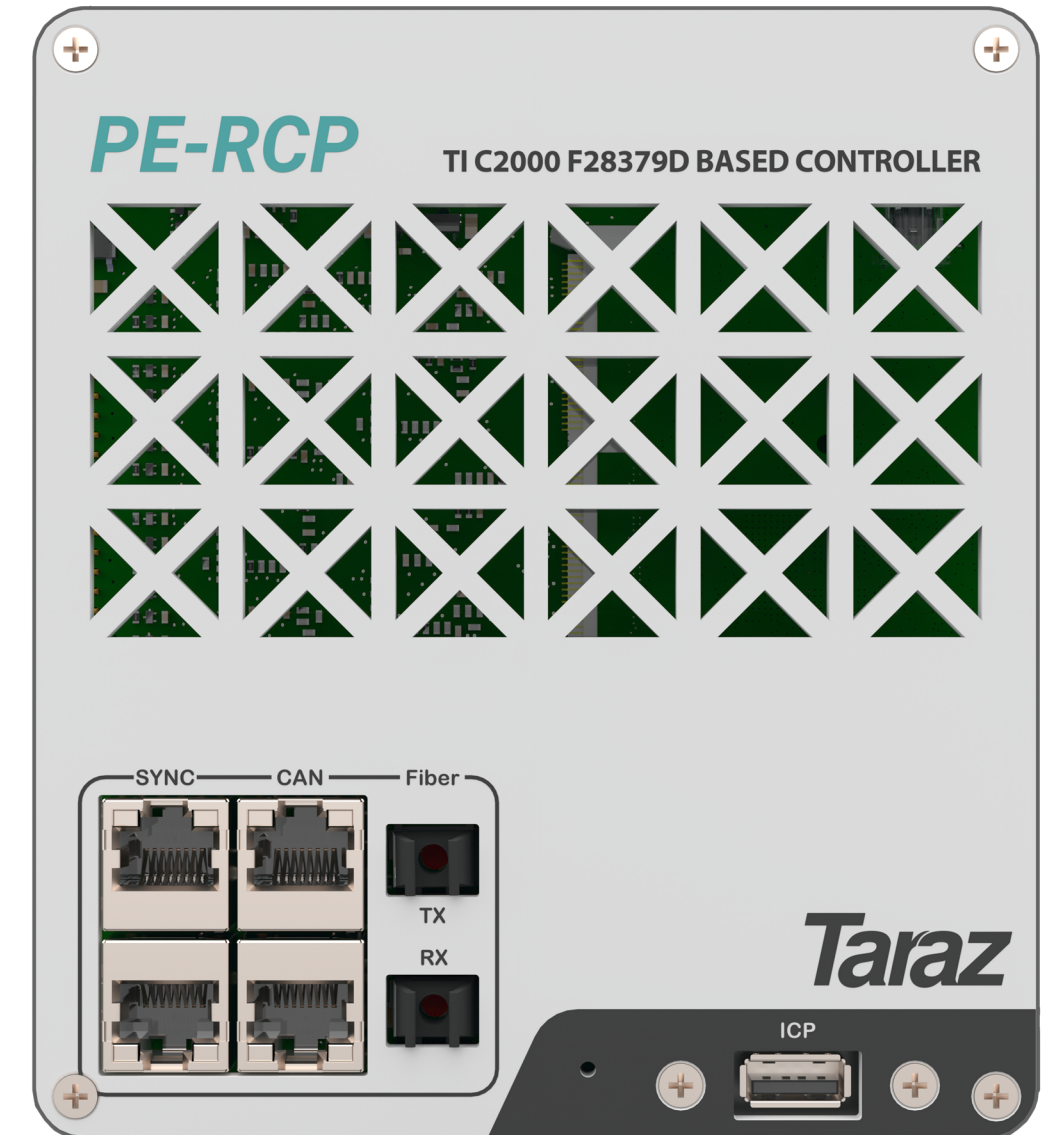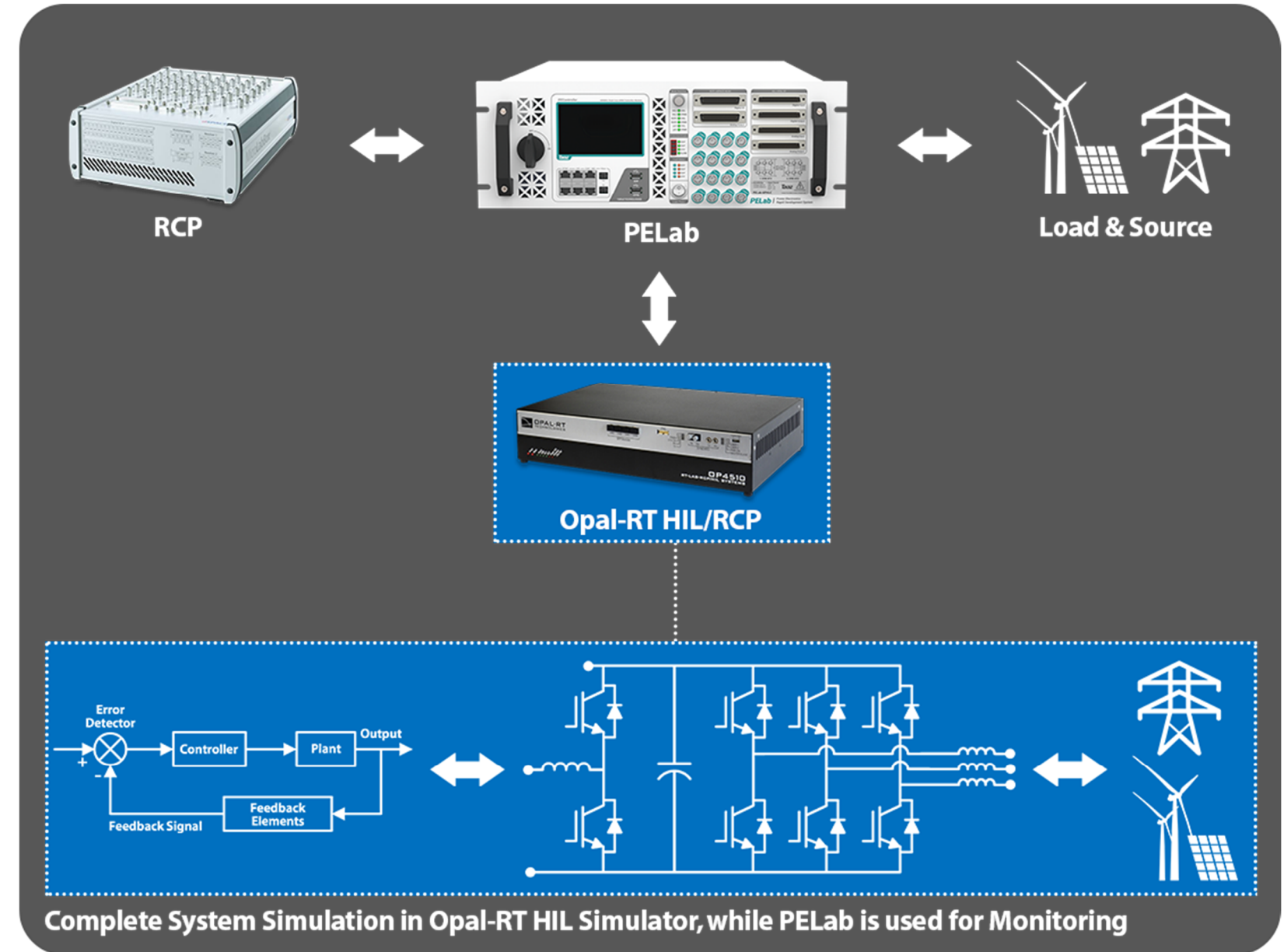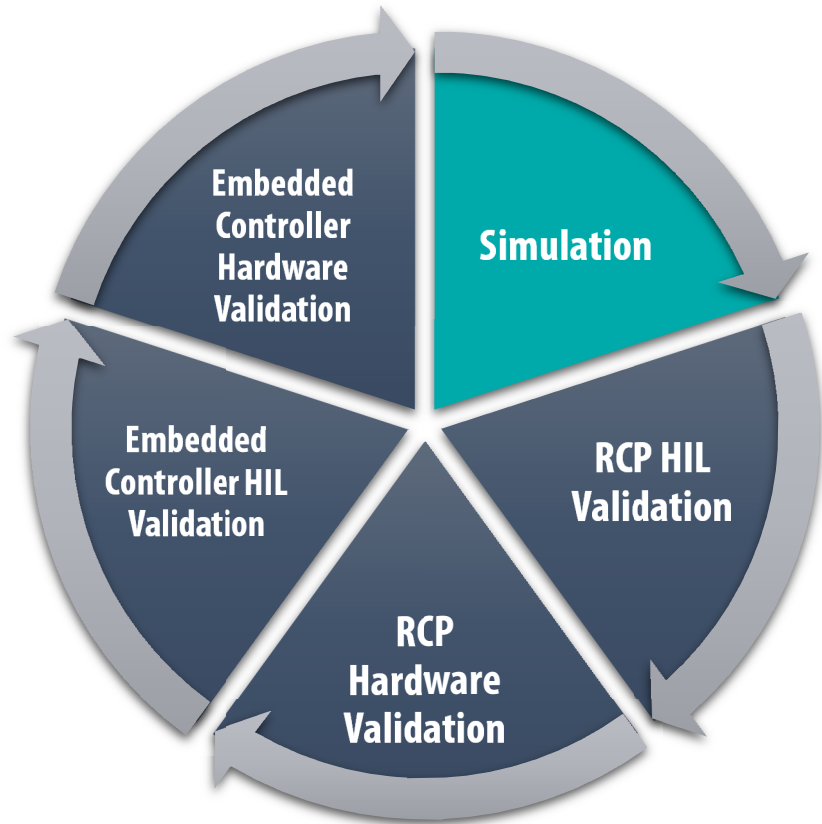
Simulate the control system and power electronics topology in the real-time simulator, while PELab can be used for monitoring using the BNC connectors.

Complete System Simulation in Opal-RT HIL Simulator, while PELab is used for Monitoring

MODES | HIL<>PWR: Opal-RT RCP with Hardware Validation
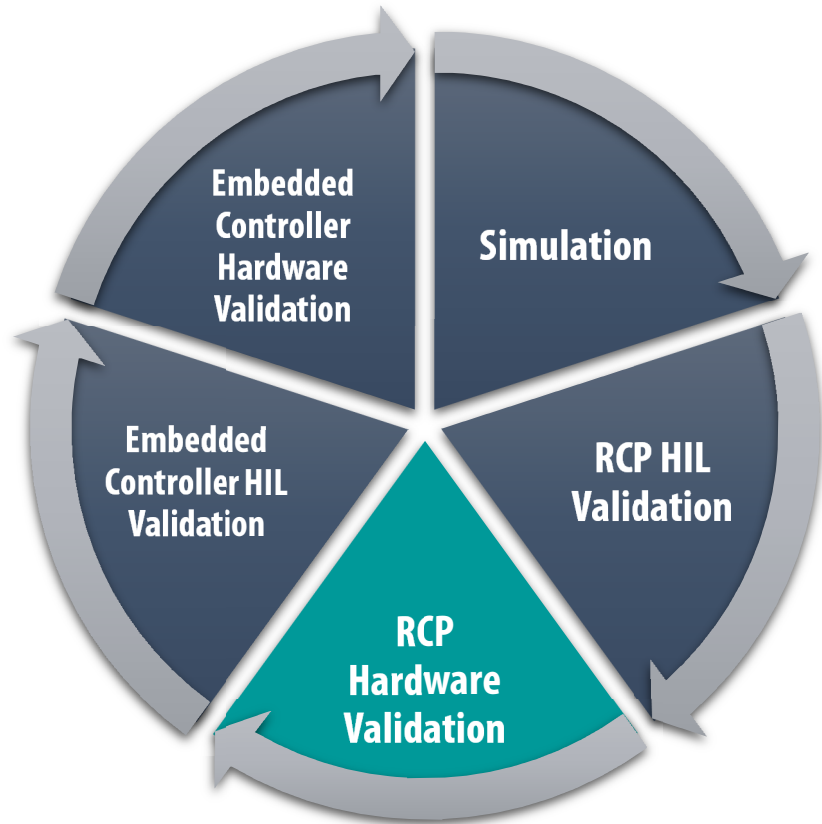
Once system is verified in simulation, Opal-RT Simulator can rapidly prototype the control system, and test it with actual power electronics hardware inside the PELab.

Cycle diagram:
- Simulation
- RCP HIL Validation
- RCP Hardware Validation
- Embedded Controller HIL Validation
- Embedded Controller Hardware Validation

System diagram labels:
- RCP
- PELab
- Load & Source
- Opal-RT HIL/RCP
- Control System in Opal-RT RCP
  - Error Detector
  - Controller
  - Plant
  - Output
  - Feedback Signal
  - Feedback Elements
- Inverter in PELab
- Load & Source
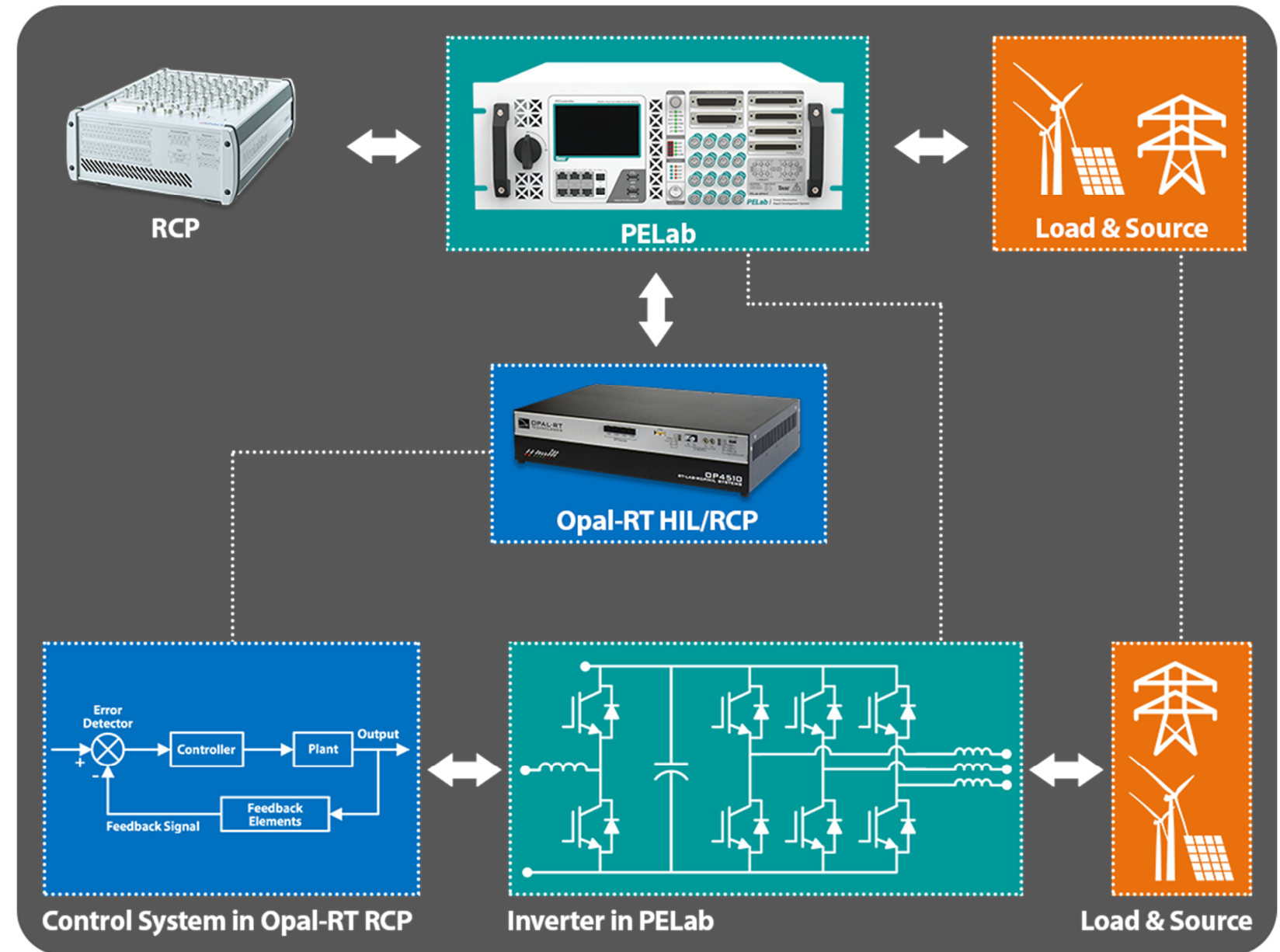
MODES | RCP<>HIL: RCP with HIL Validation

Taraz
TECHNOLOGIES
Think Beautifully®
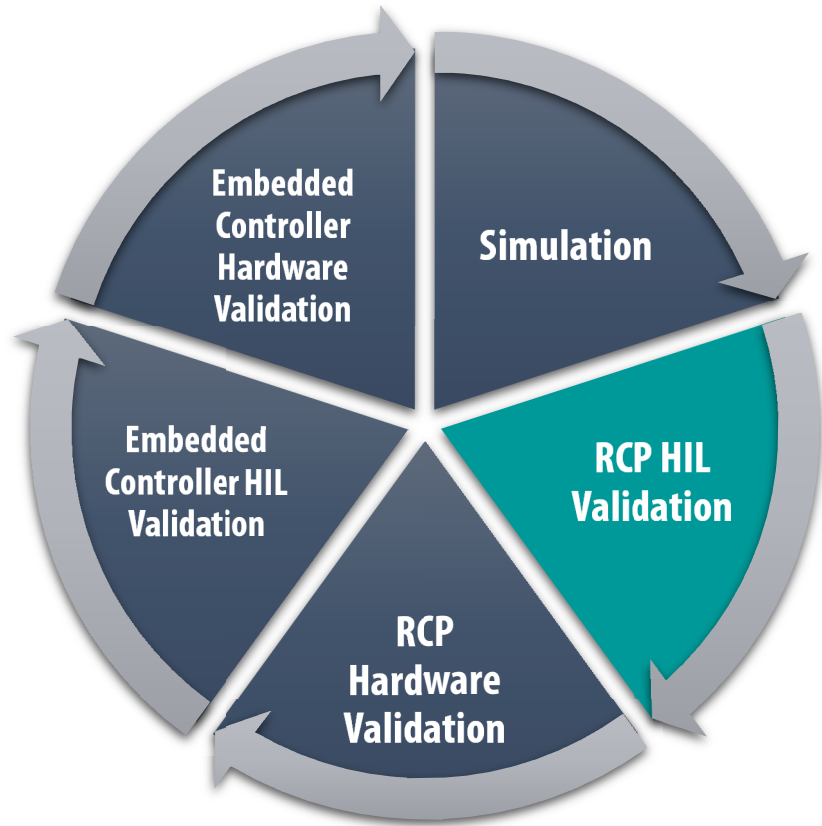
Alternately, RCP is used to prototype the control system, while HIL real-time simulator is used to simulate the power electronics hardware, load & source with different conditions.

Embedded Controller Hardware Validation

Simulation

RCP HIL Validation

RCP Hardware Validation

Embedded Controller HIL Validation

RCP

PELab

Load & Source

Opal-RT HIL/RCP

Error Detector
Controller
Plant
Output
Feedback Signal
Feedback Elements

Control System in RCP

Inverter, Load & Source Simulated in Opal-RT HIL Simulator
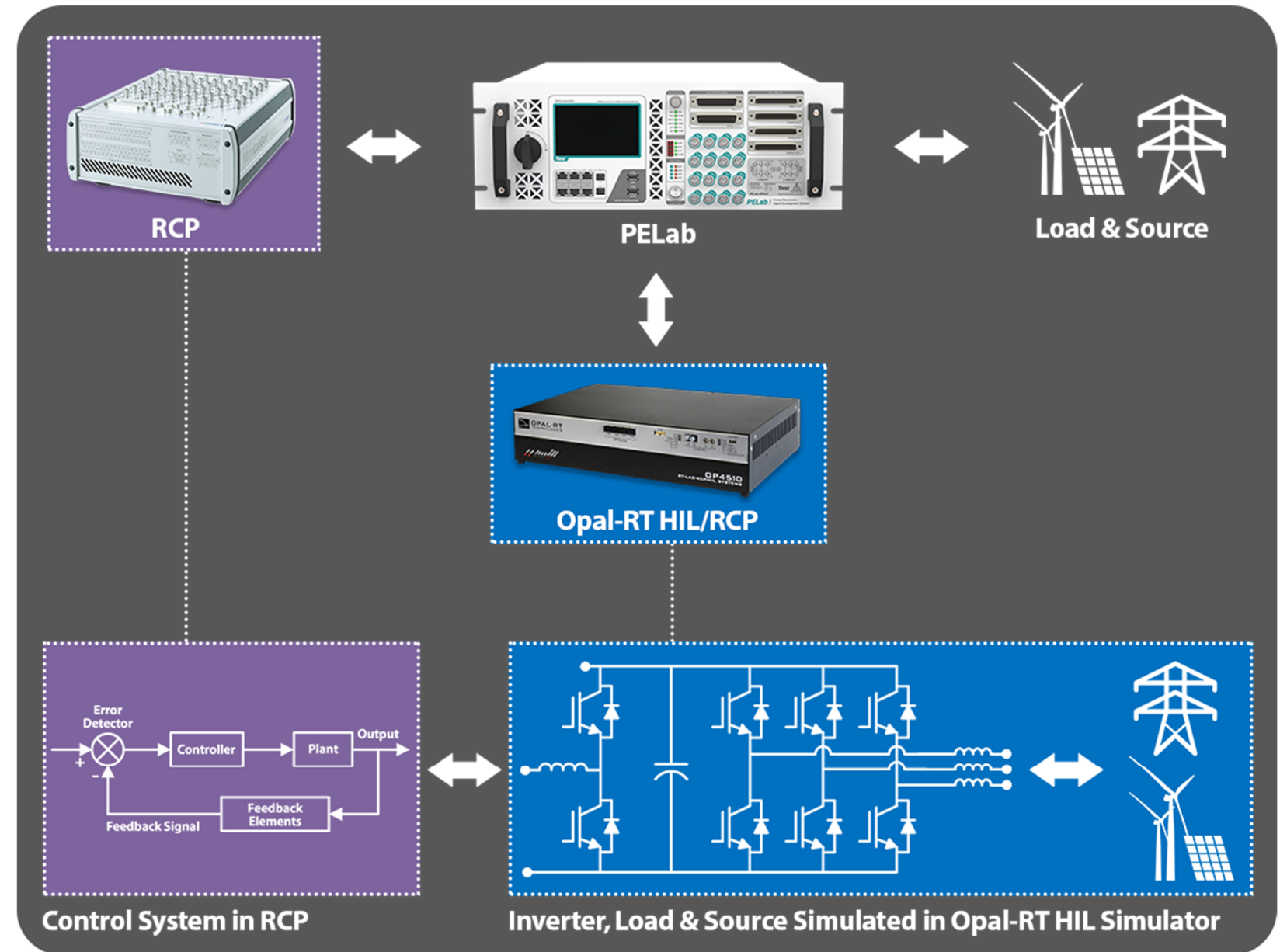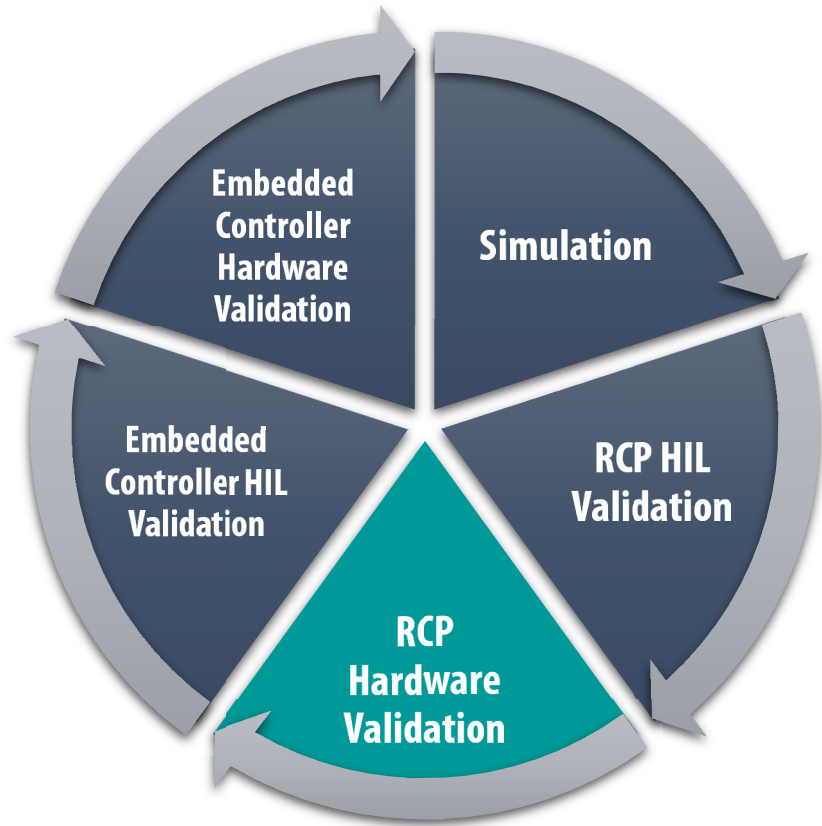
Once RCP controller HIL validation is successful, power electronics hardware inside the PELab is used to validate the RCP controller with real power as well.

Embedded Controller Hardware Validation

Simulation

Embedded Controller HIL Validation

RCP HIL Validation

RCP Hardware Validation

RCP

PELab

Load & Source

Opal-RT HIL/RCP

Control System in RCP

Inverter in PELab

Load & Source

Error Detector

Controller

Plant

Output

Feedback Elements

Feedback Signal

MODES | µC<>HIL: PEController HIL Validation

Taraz TECHNOLOGIES — Think Beautifully®

Simulation

RCP HIL Validation

RCP Hardware Validation

Embedded Controller HIL Validation

Embedded Controller Hardware Validation

To develop a product, the control system is implemented on an industrial grade embedded controller, such as the PEController, and validate it with HIL simulation using the real-time simulator.

RCP

PELab

Load & Source

Opal-RT HIL/RCP

Error Detector — + − → **Controller** → **Plant** → **Output**

Feedback Signal ← **Feedback Elements**

Control System in PELab

Inverter, Load & Source Simulated in Opal-RT HIL Simulator

MODES | μC<>PWR: PEController Hardware Validation
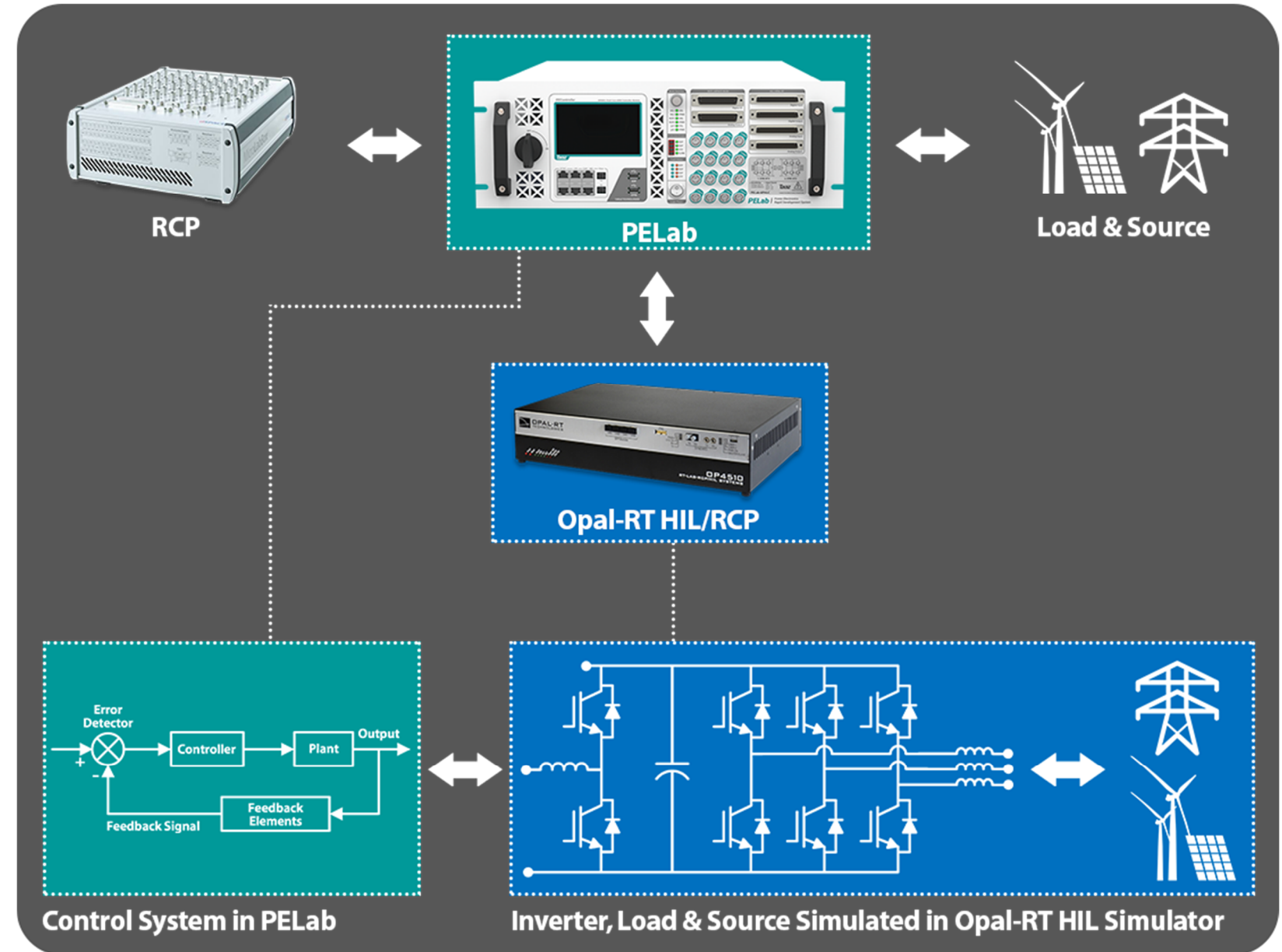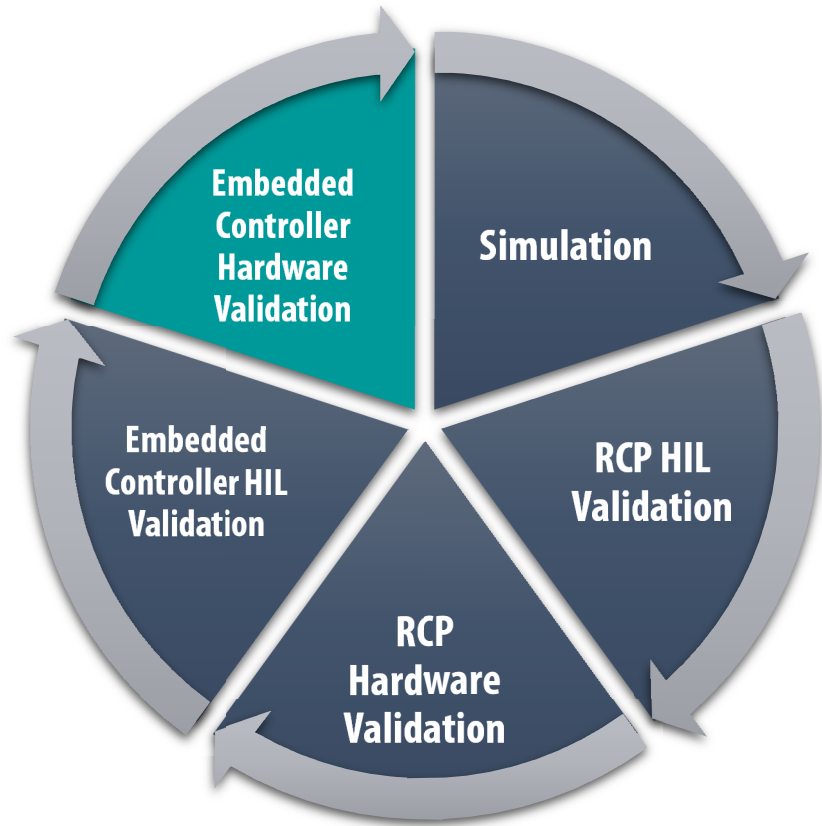
Once HIL validation is successful, the PEController is tested with actual power electronics hardware and real power. In the end, an integrated power electronics system is achieved and ready for field validation.
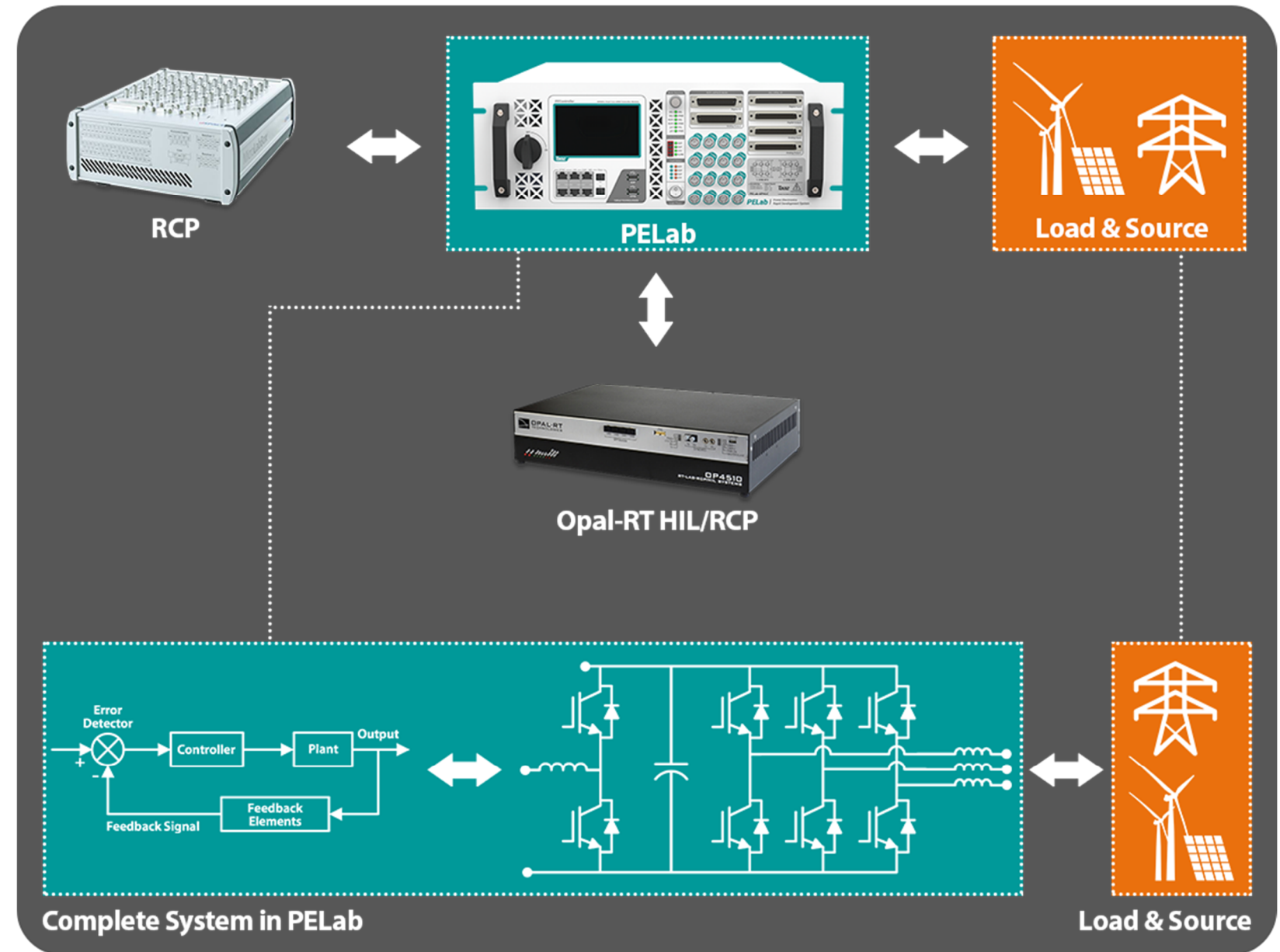
PELab-6PH

PELab-MMC

PELab-TNPC

PELab-NPC

x2

x4

x4

Power Circuit Configuration
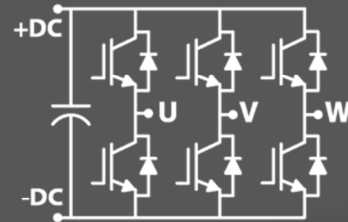
Cutoff Switch

Measurement

A1 B1   C1 D1   E1 F1   G1 H1   I1 J1   K1 L1   V1

A2 B2   C2 D2   E2 F2   G2 H2   I2 J2   K2 L2   V2

A3 B3   C3 D3   E3 F3   G3 H3   I3 J3   K3 L3   V3

A4   V4

A5   L4

L5

L6
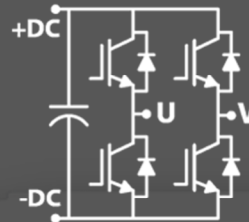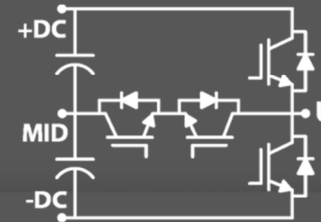
LC Filter | EMC Filter | Relays

Power Modules

LC Filter | EMC Filter | Relays

LCM : 2mH
LDM : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

2.5mH | 10A RMS
20A Saturation

1: SPM-VFD   2: SPM-VFD

SiC Switches | 5.5kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

2.5mH | 10A RMS
20A Saturation

LCM : 2mH
LDM : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

- Configurable Number of Power Modules & Topologies.

- Available in SiC, MOSFET & IGBT Switches.

- Available in Multiple Power & Voltage Ratings.

- Optional LC & EMC Filters with Disconnection Relays.

- Optional External Voltage & Current Measurements.

- Standard 6 Pole Cutoff Switch.

- Up to 8 Voltage & 8 Current Measurements Can be Configured in a PELab.

- Up to 4 Voltage & 3 Current External Measurements Can be Configured on Rear Panel.

- Total 16 Digital Input Channels Available, Which will Control all Switches, Disables & Relay Controls.

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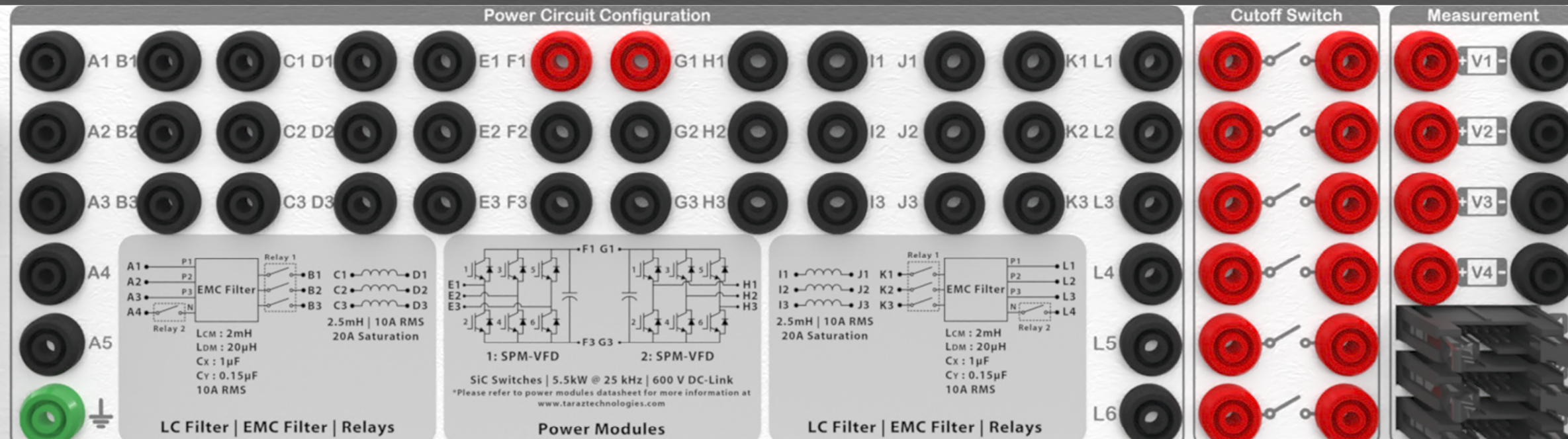
PELab-6PH
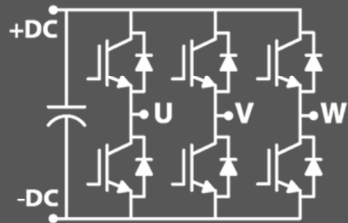
x2

- 8A | 470uF @ 800V | IGBT/SiC

- 16A | 1500uF @ 400V | MOSFET/SiC

- 16A | 2700uF @ 200V | MOSFET/SiC

- 30A | 400uF @ 800V | IGBT/SiC

- 50A | 400uF @ 800V | IGBT/SiC

- Optional Inductors & EMC Filter with Disconnection Relays

- Banana Connectors not used for Currents > 36A

- Optional External Voltage & Current Measurements.

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1 C1 D1 E1 F1 G1 H1 I1 J1 K1 L1 +V1−

A2 B2 C2 D2 E2 F2 G2 H2 I2 J2 K2 L2 +V2−

A3 B3 C3 D3 E3 F3 G3 H3 I3 J3 K3 L3 +V3−

A4 A1 → P1 Relay 1 +V4− L4

A2 → P2 B1 C1 → D1
A3 → P3 B2 C2 → D2
A4 → N EMC Filter B3 C3 → D3
Relay 2 2.5mH | 10A RMS
20A Saturation
Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

LC Filter | EMC Filter | Relays

F1 G1

I1 J1 K1
I2 J2 K2 EMC Filter
I3 J3 K3
2.5mH | 10A RMS
20A Saturation

Relay 1
P1 → L1
P2 → L2
P3 → L3
N → L4
Relay 2
Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

LC Filter | EMC Filter | Relays

A5

1: SPM-VFD   2: SPM-VFD
F3 G3

SiC Switches | 5.5kW @ 25 kHz | 600 V DC-Link
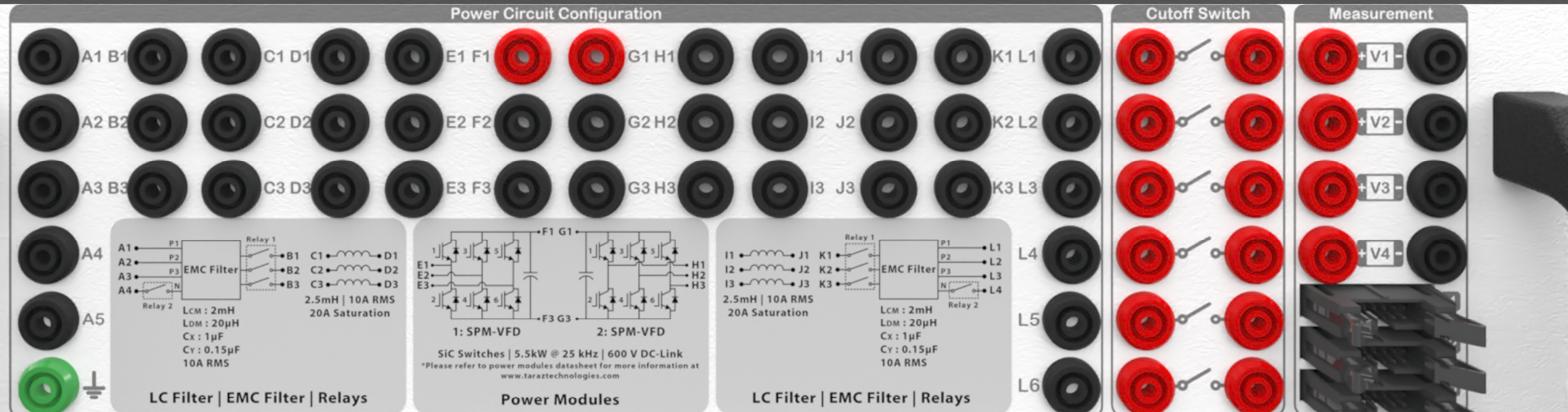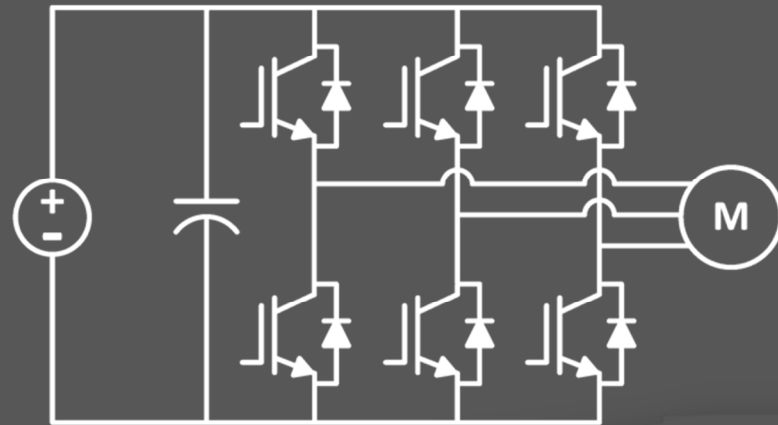*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

Power Modules

L4 L5 L6

Three Phase Motor Drive

Three Phase Solar Grid-tie/Off-grid Inverter

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1   C1 D1   E1 F1   G1 H1   I1 J1   K1 L1   V1

A2 B2   C2 D2   E2 F2   G2 H2   I2 J2   K2 L2   V2

A3 B3   C3 D3   E3 F3   G3 H3   I3 J3   K3 L3   V3

A4   L4   V4

A5   L5

L6

LC Filter | EMC Filter | Relays

A1 P1
A2
A3 P3   EMC Filter
A4   N
Relay 2   Relay 1   B1
B2
B3
C1   D1
C2   D2
C3   D3

Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

2.5mH | 10A RMS
20A Saturation

Power Modules

F1 G1

1: SPM-VFD   2: SPM-VFD

H1
H2
H3

F3 G3

SiC Switches | 5.5kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1   J1 K1
I2   J2 K2
I3   J3 K3
EMC Filter
Relay 1   P1   L1
P2   L2
P3   L3
N   L4
Relay 2

2.5mH | 10A RMS
20A Saturation

Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

Three Phase Back to Back Inverter
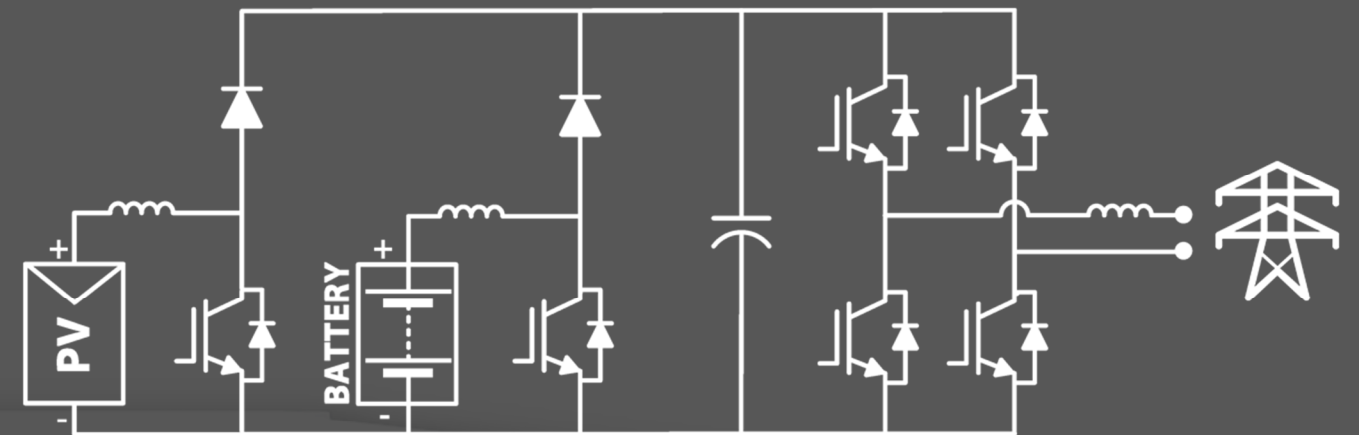
Single Phase/Three Phase Solar Grid-tie Inverter with Battery Backup

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1 C1 D1 E1 F1 G1 H1 I1 J1 K1 L1
A2 B2 C2 D2 E2 F2 G2 H2 I2 J2 K2 L2
A3 B3 C3 D3 E3 F3 G3 H3 I3 J3 K3 L3
A4
A5

V1
V2
V3
V4

L4
L5
L6

LC Filter | EMC Filter | Relays

A1
A2
A3
A4
P1
P2
P3
N
EMC Filter
Relay 1
B1
B2
B3
C1
C2
C3
D1
D2
D3
Relay 2

Lᴄᴍ : 2mH
Lᴅᴍ : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

2.5mH | 10A RMS
20A Saturation

Power Modules

F1 G1
F3 G3
H1
H2
H3

1: SPM-VFD   2: SPM-VFD

SiC Switches | 5.5kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at
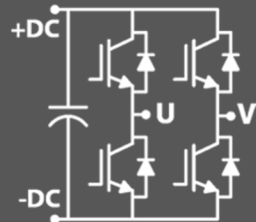www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1
I2
I3
J1
J2
J3
K1
K2
K3
Relay 1
EMC Filter
P1
P2
P3
N
L1
L2
L3
L4
Relay 2

2.5mH | 10A RMS
20A Saturation

Lᴄᴍ : 2mH
Lᴅᴍ : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

PELab-MMC

x4

- 8A | 470uF @ 800V | IGBT/SiC
- 16A | 1500uF @ 400V | MOSFET/SiC
- 16A | 2700uF @ 200V | MOSFET/SiC

- Up to 4 SPM-MMC Power Modules Can be Used
- Optional Inductors & EMC Filter (Relays Always ON due to Digital Input Channel Limitations).
- Maximum 1000V System Voltage in MMC/Cascaded H-Bridge Applications.

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1 | C1 D1 | E1 F1 | G1 H1 | I1 J1 | K1 L1
A2 B2 | C2 D2 | E2 F2 | G2 H2 | I2 J2 | K2 L2
A3 B3 | C3 D3 | E3 F3 | G3 H3 | I3 J3 | K3 L3

A4 | L4
A5 | L5
| L6

+V1−
+V2−
+V3−
+V4−

Power Modules

A1 ... B2 | C1 ... D2
A2 | C2
A3 | C3

1: SPM-MMC | 2: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
*Please refer to power modules datasheet for more information at www.taraztechnologies.com

Power Modules

E1 ... F2 | G1 ... H2
E2 | G2
E3 | G3

3: SPM-MMC | 4: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
*Please refer to power modules datasheet for more information at www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1 — J1 K1 | Relay 1
I2 — J2 K2 | EMC Filter | P1 — L1
I3 — J3 K3 | P2 — L2
2.5mH | 10A RMS | P3 — L3
20A Saturation | N — L4
Relay 2

L_{CM} : 2mH
L_{DM} : 20µH
C_X : 1µF
C_Y : 0.15µF
10A RMS

Bidirectional EV Charger with DAB/LLC DC-DC Converter

All Above Mentioned and...

External

Power Circuit Configuration

A1 B1 C1 D1 E1 F1 G1 H1 I1 J1 K1 L1
A2 B2 C2 D2 E2 F2 G2 H2 I2 J2 K2 L2
A3 B3 C3 D3 E3 F3 G3 H3 I3 J3 K3 L3
A4   L4
A5   L5
                                      L6

Cutoff Switch

Measurement

+V1−
+V2−
+V3−
+V4−

Power Modules

1: SPM-MMC 2: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
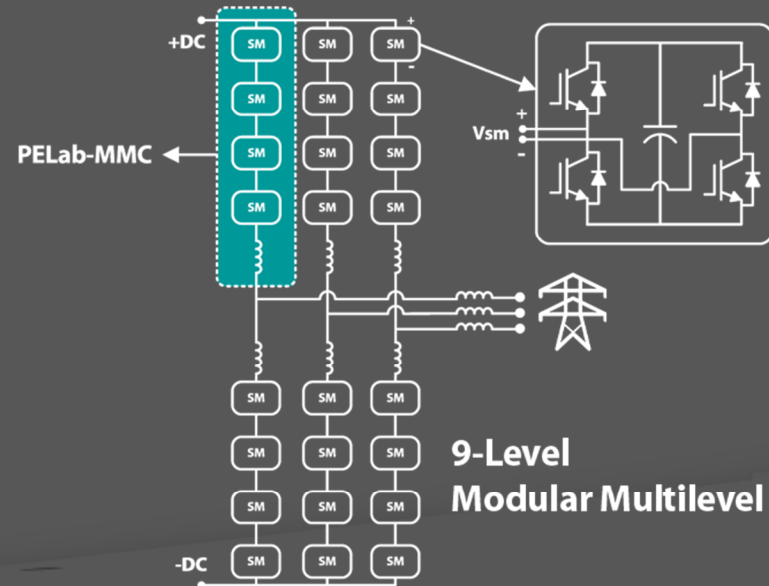*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

Power Modules

3: SPM-MMC 4: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
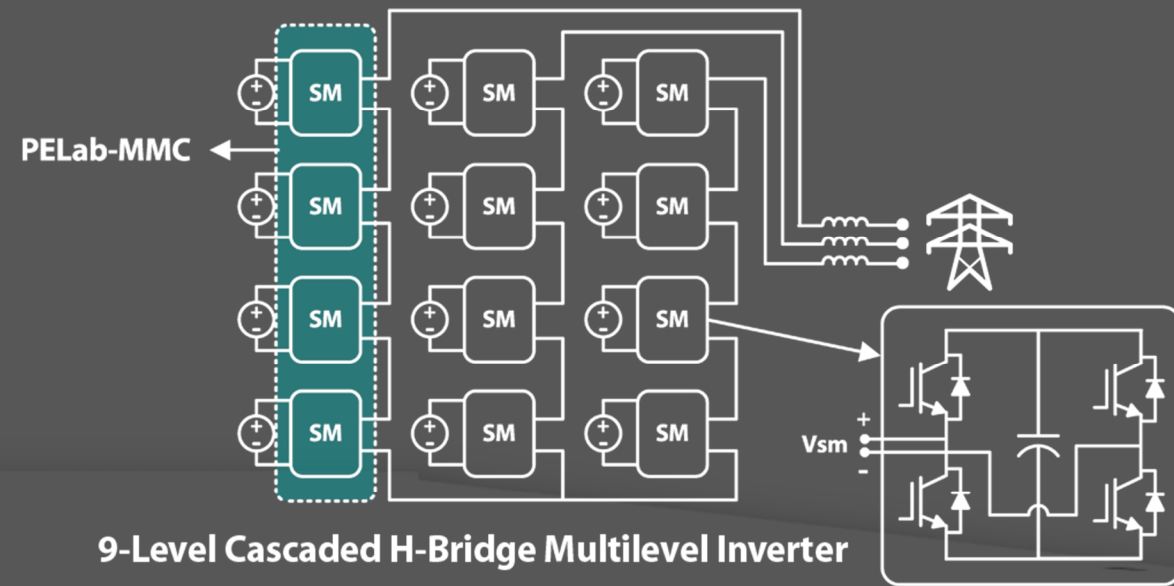*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1 → J1 K1 Relay 1 P1 → L1
I2 → J2 K2 EMC Filter P2 → L2
I3 → J3 K3 P3 → L3
2.5mH | 10A RMS N → L4
20A Saturation Relay 2

L_CM : 2mH
L_DM : 20μH
C_X : 1μF
C_Y : 0.15μF
10A RMS

9-Level Modular Multilevel Converter (MMC)

9-Level Cascaded H-Bridge Multilevel Inverter

Power Circuit Configuration

Cutoff Switch

Measurement

A1 B1   C1 D1   E1 F1   G1 H1   I1 J1   K1 L1   +V1–

A2 B2   C2 D2   E2 F2   G2 H2   I2 J2   K2 L2   +V2–

A3 B3   C3 D3   E3 F3   G3 H3   I3 J3   K3 L3   +V3–

A4   L4   +V4–

A5   L5

L6

Power Modules

A1
A2
A3
1: SPM-MMC

C1
C2
C3
2: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
*Please refer to power modules datasheet for more information at www.taraztechnologies.com

Power Modules

E1
E2
E3
3: SPM-MMC

G1
G2
G3
4: SPM-MMC

MOSFET Switches | 2kW @ 25 kHz | 200 V DC-Link
*Please refer to power modules datasheet for more information at www.taraztechnologies.com

LC Filter | EMC Filter | Relays

I1 → J1 K1   Relay 1
I2 → J2 K2   EMC Filter   P1 → L1
I3 → J3 K3   P2 → L2
                  P3 → L3
2.5mH | 10A RMS   N → L4
20A Saturation   Relay 2

L_CM : 2mH
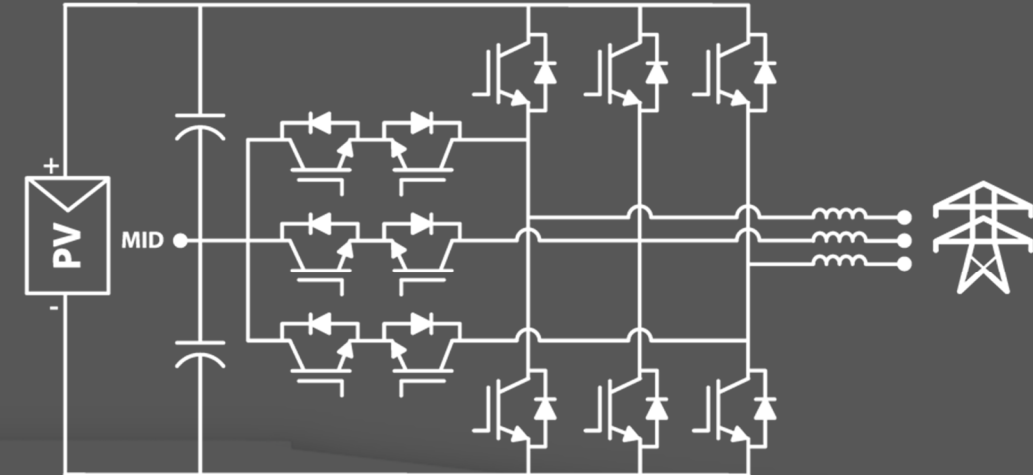L_DM : 20µH
C_X : 1µF
C_Y : 0.15µF
10A RMS

PELab-TNPC

x4

- 8A | 470uF @ 800V | IGBT/SiC
- 16A | 1500uF @ 400V | MOSFET/SiC
- 16A | 2700uF @ 200V | MOSFET/SiC
- Combination of Power Modules Possible

Three Phase T-Type NPC Grid-tie Inverter

Power Circuit Configuration

Cutoff Switch

Measurement

1: SPM-TNPC   2: SPM-TNPC
SiC Switches | 2kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

Power Modules

3: SPM-TNPC   4: SPM-TNPC
SiC Switches | 2kW @ 25 kHz | 600 V DC-Link
*Please refer to power modules datasheet for more information at
www.taraztechnologies.com

Power Modules

Relay 1
EMC Filter
P1 L1
P2 L2
P3 L3
N L4
Relay 2

I1 J1 K1
I2 J2 K2
I3 J3 K3
E3 G3
2.5mH | 10A RMS
20A Saturation

L_{CM} : 2mH
L_{DM} : 20µH
C_X : 1µF
C_Y : 0.15µF
10A RMS

LC Filter | EMC Filter | Relays

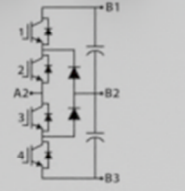**PELab-NPC**

+DC
MID
-DC
U
X4
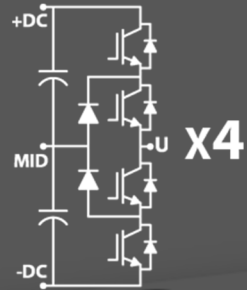
- 8A | 117.5uF @ 1000V | IGBT/SiC
- 16A | 375uF @ 800V | MOSFET/SiC
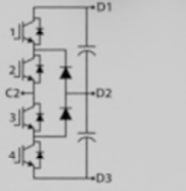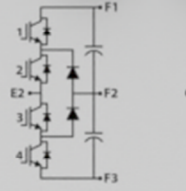- 16A | 675uF @ 400V | MOSFET/SiC
- Combination of Power Modules Possible

PV
MID
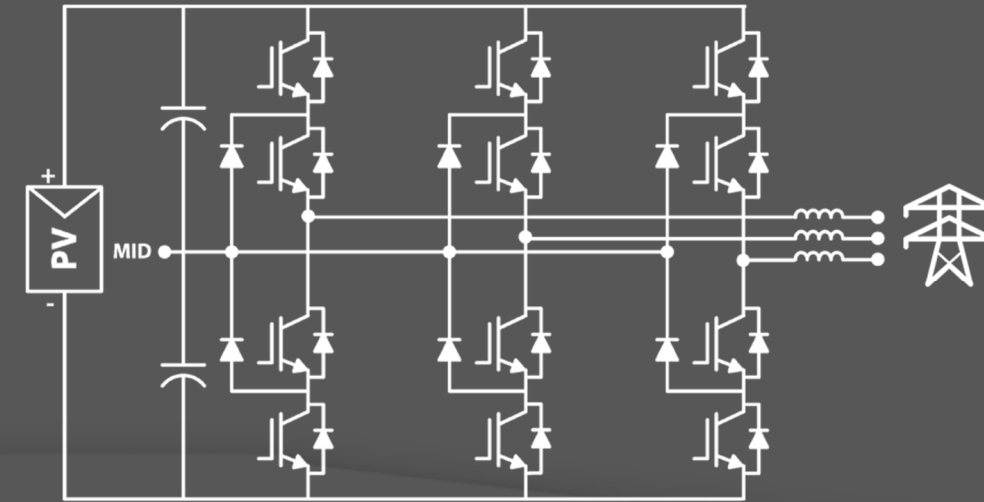
Three Phase NPC Grid-tie Inverter

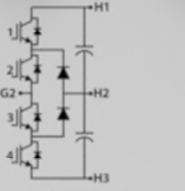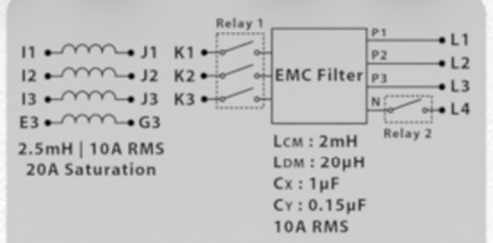## Power Circuit Configuration

A1 B1 C1 D1 E1 F1 G1 H1 I1 J1 K1 L1
A2 B2 C2 D2 E2 F2 G2 H2 I2 J2 K2 L2
A3 B3 C3 D3 E3 F3 G3 H3 I3 J3 K3 L3
A4
A5

Cutoff Switch

Measurement

V1
V2
V3
V4
L4
L5
L6

B1
A2
B3
1: SPM-NPC

D1
C2
D2
2: SPM-NPC

IGBT Switches | 2kW @ 5 kHz | 1000 V DC-Link
Please refer to power modules datasheet for more information at www.taraztechnologies.com

Power Modules

F1
E2
F2
F3
3: SPM-NPC

H1
G2
H2
H3
4: SPM-NPC

IGBT Switches | 2kW @ 5 kHz | 1000 V DC-Link
Please refer to power modules datasheet for more information at www.taraztechnologies.com

Power Modules

I1 J1 K1   Relay 1   P1 L1
I2 J2 K2   EMC Filter   P2 L2
I3 J3 K3   P3 L3
E3 G3   N   L4
                          Relay 2

2.5mH | 10A RMS
20A Saturation

Lcm : 2mH
Ldm : 20µH
Cx : 1µF
Cy : 0.15µF
10A RMS

LC Filter | EMC Filter | Relays

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01. Prototype your Control System Directly from your Favourite Simulation Software or Using Industry Standard C Language

MATLAB®   PSIM   plecs

OR
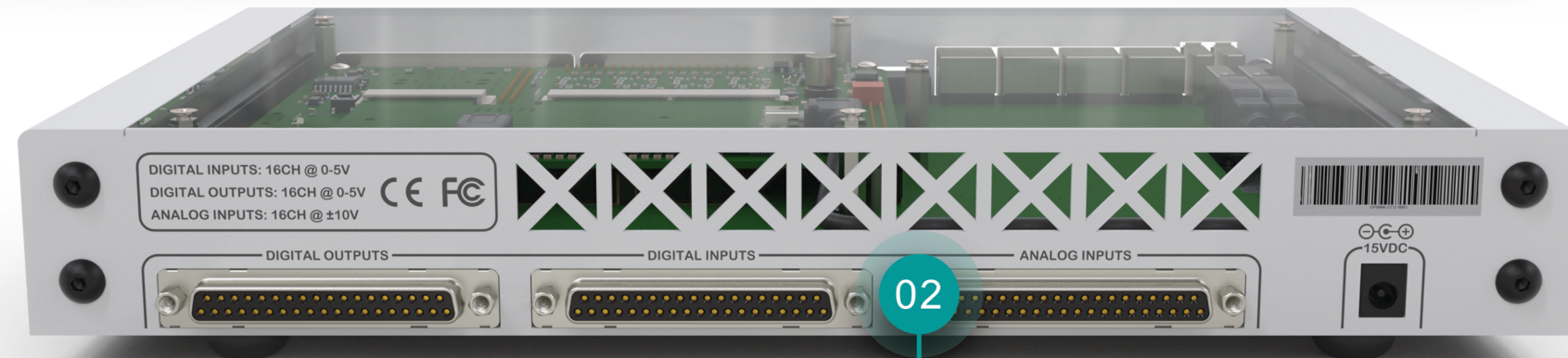
PE-RCP Box

TI C2000 F28379D Based RCP Controller
Dual-Core | 200MHz

TI C2000 F28379D BASED CONTROLLER

PE-RCP BOX

DIGITAL INPUTS: 16CH @ 0-5V
DIGITAL OUTPUTS: 16CH @ 0-5V
ANALOG INPUTS: 16CH @ ±10V

DIGITAL OUTPUTS   DIGITAL INPUTS   ANALOG INPUTS   15VDC

02. HIL Real-Time Simulator Interface

OPAL-RT TECHNOLOGIES

03. Power Electronics Interface
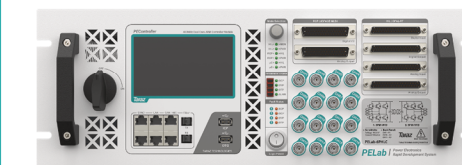
PELab

PELab to Typhoon HIL Interface Module Applications

✓ Interface PELab to Typhoon HIL Real-Time Simulators

✓ Interface PEController/PE-RCP to Typhoon HIL Real-Time Simulators

✓ Interface PE-RCP Box to Typhoon HIL Real-Time Simulators

PELab Models	Module Topology (Notes)	Leg Current (RMS)	DC-Link	Switches Type (Cost per Module)	Inductors (Cost per Inductor)	EMC Filters (Cost per Filter)	Measurements	Controller & DAQ Software	Base
PELab-6PH	**3 Phase 2 Level Inverter** *Maximum 2 Inverters per PELab* *Maximum 6 Inductors per PELab* *Maximum 2 EMC Filters per PELab*	8A	470uF @ 800V	IGBT (800$) / SiC (1100$)	1mH (250$) 2.5mH (350$)	350$	3 Voltages & 3 Currents (600$) 6 Voltages & 6 Currents (1200$) 8 Voltages & 8 Currents (1800$)	PEController (1650$) PEController + intelliSENS (2400$) PE-RCP (1950$) PE-RCP + intelliSENS (3200$)	5500$ FPGA Based Multiplexed Controllers & HIL Interface Enclosure, Wiring & Integration Auxiliary Power Supplies
		16A	470uF @ 800V 1500uF @ 400V 2700uF @ 200V	IGBT (1200$) / SiC (1500$)	1mH (350$) 2.5mH (500$)	450$			
		30A	260uF @ 800V Film Caps	IGBT (2800$) / SiC (3400$)	1mH (650$) 2.5mH (1100$)	650$			
		50A	260uF @ 800V Film Caps	IGBT (2800$) / SiC (4200$)	1mH (1100$)	1200$			
PELab-MMC	**Full Bridge Inverter** *Maximum 4 Modules per PELab* *Maximum 8 Inductors per PELab* *Maximum 2 EMC Filters per PELab*	8A	470uF @ 800V	IGBT (600$) / SiC (800$)	1mH (250$) 2.5mH (350$)	350$			
		16A	470uF @ 800V 1500uF @ 400V 2700uF @ 200V	IGBT (800$) / SiC (1000$)	1mH (350$) 2.5mH (500$)	450$			
		30A	130uF @ 800V Film Caps	IGBT (1800$) / SiC (2200$)	1mH (650$) 2.5mH (1100$)	650$			
		50A	130uF @ 800V Film Caps	IGBT (1800$) / SiC (2800$)	1mH (1100$)	1200$			
PELab-TNPC	**TNPC Leg** *Maximum 4 Modules per PELab* *Maximum 4 Inductors per PELab* *Maximum 2 EMC Filters per PELab*	8A	470uF @ 800V	IGBT (600$) / SiC (800$)	1mH (250$) 2.5mH (350$)	350$			
		16A	470uF @ 800V 1500uF @ 400V 2700uF @ 200V	IGBT (800$) / SiC (1000$)	1mH (350$) 2.5mH (500$)	450$			
PELab-NPC	**NPC Leg** *Maximum 4 Modules per PELab* *Maximum 4 Inductors per PELab* *Maximum 2 EMC Filters per PELab*	8A	117.5uF @ 1000V	IGBT (600$) / SiC (800$)	1mH (250$) 2.5mH (350$)	350$			
		16A	375uF @ 800V 675uF @ 400V	IGBT (800$) / SiC (1000$)	1mH (450$) 2.5mH (500$)	450$			

Note:

Disconnection & Pre-charge Relays are Part of the EMC Filter, Availability in the PELab-MMC/TNPC/NPC is Conditional to Digital Inputs Availability.

Looking for something else?

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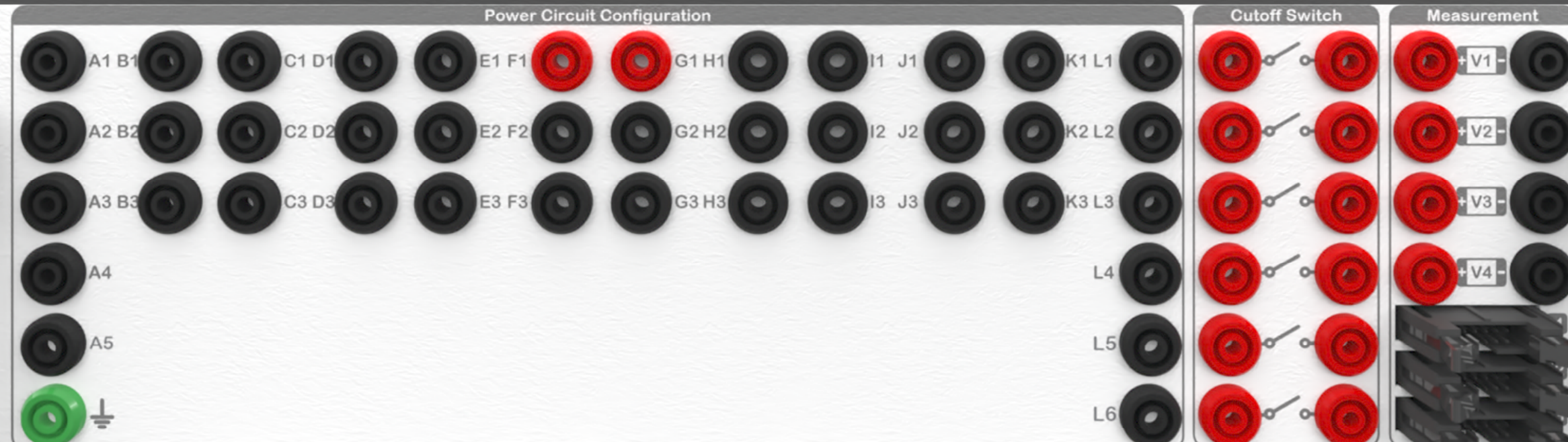
- Available Examples:
  - ✓ V/f Control of AC Induction Motor
  - ✓ Three-Phase Grid-Tie Inverter with Boost Converter

- Embedded Libraries, Framework & Application Examples

  https://github.com/Taraz-Technologies/PEControllerBSP

- Getting Started & Application Guides

  https://www.taraztechnologies.com/help/

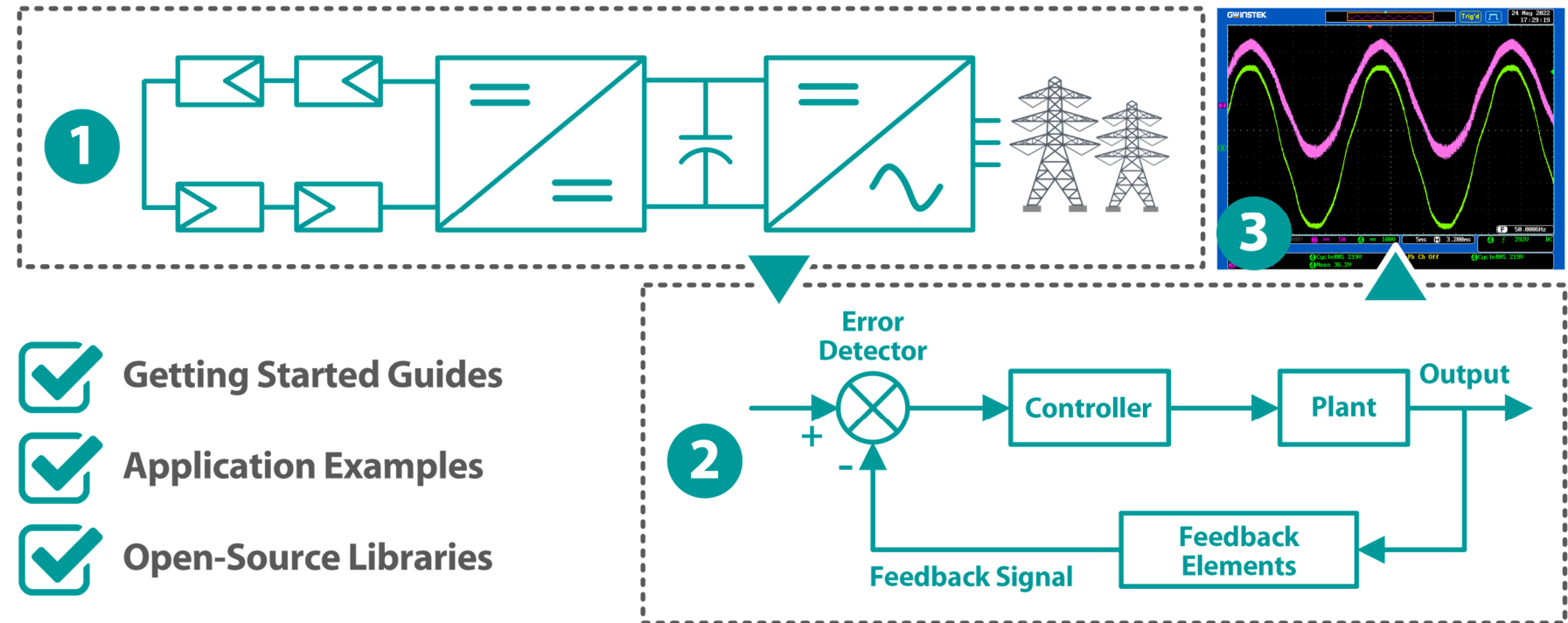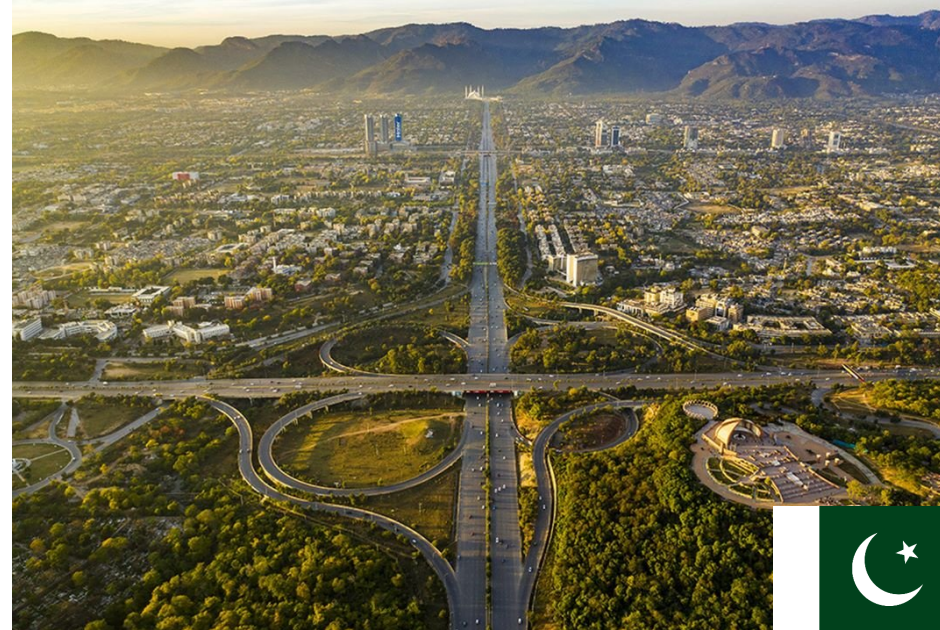Taraz Technologies has been providing research-oriented power electronics solutions to customers in more than 30 countries. Our products include DC/DC Converters, Gate Drivers, Power Modules, Embedded Controllers, Isolated Sensors, Smart Probes, Data Acquisition devices as well as fully integrated Power Electronics Systems. Our product design philosophy focuses on easy-to-use, research-friendly, and modular solutions that can accelerate the research and development cycle while providing maximum versatility for research. Furthermore, our finished product portfolio includes Programmable Power Supplies and Solar Inverters for the domestic market.

Founded in 2012, Taraz was nominated among the top most innovative technology startups in Pakistan. Our research and manufacturing facility is located in Islamabad, the green capital city of Pakistan.

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100+ Customers

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PELab | Power Electronics
Rapid Developement System

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- **Real Time Simulator:** *A device that can model and simulate hardware digitally and solve the equations in same time step as real world. Therefore, it can replace actual hardware with simulated one.*

- **RCP:** *Rapid Control Prototyping is a design methodology that aims at accelerating control software development cycles. The methodology seeks to rapidly address experimental activities in order to quickly identify and correct potential issues. If necessary, design iterations can be made involving system simulations. RCP mainly focuses on control system development and may be complementary with other techniques, such as HIL.*

- **C-HIL Validation:** *Controller-Hardware-in-the-loop simulation, is a technique that is used in the development and testing of complex real-time embedded systems (Controller). Real time simulator is used to simulate the hardware, the Controller under test interacts with this hardware simulation to verify control system performance and dynamic response.*