OPAL-RT TECHNOLOGIES

OPAL-RT Accelerates the Development of New Generation of Modular UPS for Schneider Electric

Schneider Electric

Application

- Uninterruptible Power Supply (UPS)

Related Products

- eHS| FPGA-Based Power Electronics Toolbox
- OP4512
- OPAL-RT Premium maintenance

Type of Simulation

- Hardware-in-the-Loop (HIL)
- Automated testing

SUCCESS STORY

INTRODUCTION

From 2021 to 2023, OPAL-RT China (Beijing OPAL-RT Technologies Co., Ltd.) has not only provided Schneider Electric Shanghai's Uninterruptible Power Supply (UPS) team with several sets of high performance Hardware-In-the-Loop (HIL) test platforms, but also with high-quality customized technical support services to help the UPS team efficiently perform iterative testing of software and hardware during the new product development phase.

Based on the deep understanding of users' needs, Schneider Electric released a new generation of modular UPS Galaxy PX in early 2023. Benefiting from modular design, integration of digital control technologies and power electronics technologies, Galaxy PX guarantees high-quality power supply for small and medium power consumption environment, and digitally improves service efficiency, so as to help optimize the performance of user's IT asset and to create high returns.

Galaxy PX

Galaxy PX 3-phase uninterruptible power supply delivers robust power protection and high availability and scalability in a cost-optimized, 100-250 kW N+1 400V package ideal for small and medium data centers and other business-critical applications.

The Galaxy PX UPS is simple to select, quote, stock, install, scale, and maintain. It features a modular design with Live Swap in a compact, one-cabinet footprint. Its scalability enables you to pay-as-you grow, optimizing capital investment with competitive acquisition costs. The modular design also enables N+1 internal redundancy, which increases the system's availability with no extra footprint.

Smart Power Test (SPoT) Mode lowers the cost of site acceptance testing by eliminating the need for an expensive load bank. Galaxy PX is EcoStruxure™-connected to give you peace of mind anytime, anywhere, and start-up service is included to optimize your system's performance, quality, and safety.

CHALLENGE

For UPS, new products need to go through numerous reliability tests and extreme condition tests during the R&D phase. Traditional testing often involves a large number of real prototypes. However, these kind of "prototypes" may burn during the tests under extreme conditions. Remaking a prototype will cost extra time and money, and test efficiency will thus be affected. In addition, the "cracking" of capacitors accompanied with the "burning" high-voltage prototype will also cause certain psychological impact to the testers.

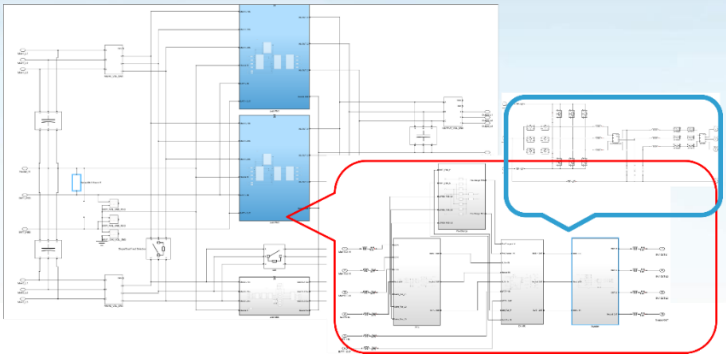
The limitations of traditional tests in the UPS development are:

1. Low test efficiency;
2. Difficulties to measure internal faults;
3. Limited extreme conditions and external circuit settings;
4. Slow response to hardware changes.

SOLUTIONS

For developing the new generation of Galaxy PX UPS products, Schneider Electric (Shanghai) UPS built up several digital and automatic test benchesusing the OPAL-RT real-time simulators to replace the real prototypes in the test.

With OPAL-RT's **eHS| FPGA-Based Power Electronics Toolbox**, it is possible to build highly customized power electronics topology models using a minimum time step in the nanosecond range, which can handle high switching frequencies (0-200 kHZ and above).



eHS Gen5: Unveiling the new solver of the fastest FPGA- Based Power Electronics Toolbox in the industry

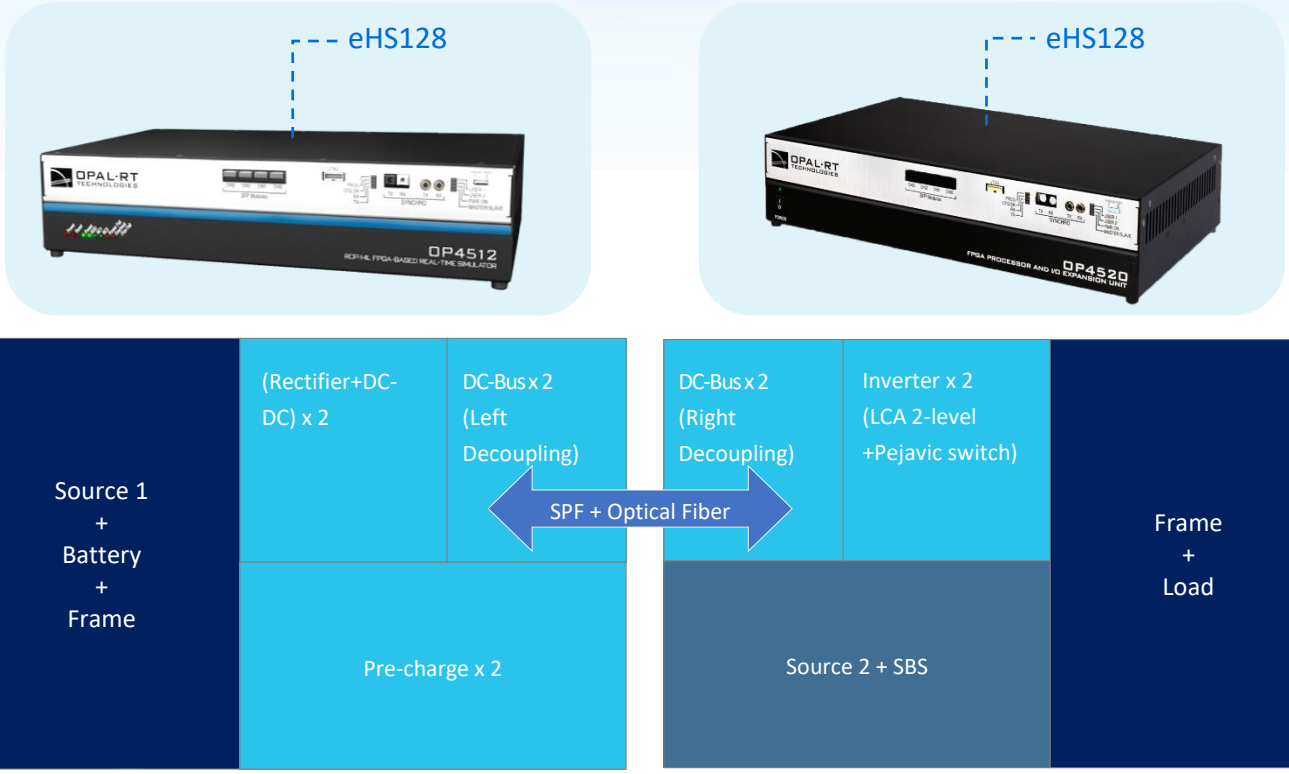
As the world electrifies, researchers are pushing the limits of power electronics requirements in terms of efficiency and power density. OPAL-RT has been at the **forefront of FPGA simulation for over 20 years** and continues to innovate to meet the demands of the power electronics industry.

eHS Gen5 offers outstanding simulation speed and accuracy, for a wide range of high-frequency converter applications. Its **90ns time step and 625ps gate pulse sampling resolution** make it ideal for real-time simulation of user-defined resonant converter topologies.

eHS simplifies FPGA usage for HIL simulation, without the need for coding or mathematical modeling. It's the perfect tool for transitioning from circuit design to FPGA implementation.

SOLUTIONS

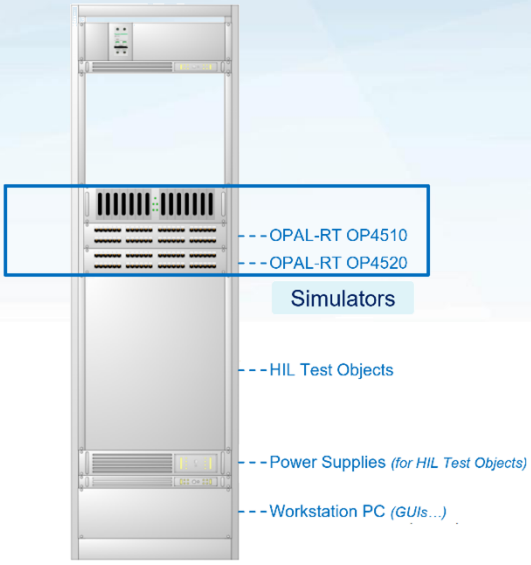
In terms of hardware, a combination of OPAL-RT OP4510 HILBOX simulator and OP4520 IO expansion unit is adopted. They are both equipped with a Kintex™ 7 410T FPGA, which can simulate the power factor controller (PFC) and the inverter separately, while coupling of the DC bus is done using the Aurora communication protocol via an optic fiber cable.

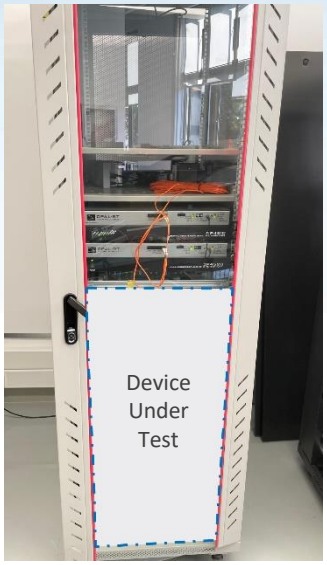


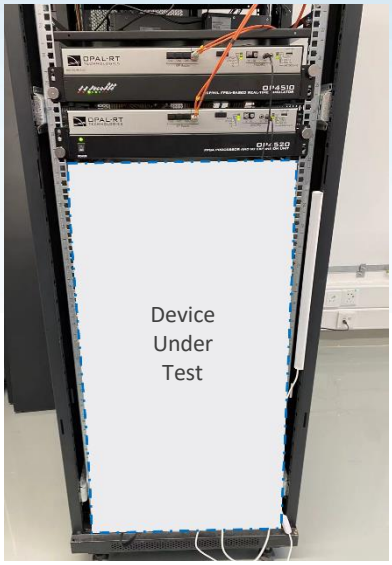
*Together with OPAL-RT China, we introduced a new automated simulation testing platform for the R&D of new Galaxy PX UPS: **OPAL-RT Hardware-In-the-Loop digital simulation platform**. This HIL platform is customized by our testing team according to hardware design of the product and specifically to meet software development and testing requirements.*

—— Ricky Zhang , Chief Firmware Test Specialist
Secure Power Division Energy Management Business
Schneider Electric (Shanghai)

SOLUTIONS







A Comprehensive Range of Scalable Hardware

Backed by decades of expertise in the development of innovative hardware solutions, OPAL-RT's unique approach integrates parallel, distributed computing with commercial-off-the-shelf technologies, offering an unmatched combination of performance, openness and affordability.

OPAL-RT offers a wide range of simulator platforms to meet all current industry needs and forthcoming challenges. All simulators are based on a modular and flexible design, and are fully customizable and expandable for specific I/O requirements.

Learn more

RESULTS

How does Schneider overcome technical challenges to achieve fast and high-quality delivery of new products in just one year? Compared with the traditional UPS testing tools, OPAL-RT Hardware-In-the-Loop digital simulation platform has the following advantages:

- No need to worry about high cost of hardware and complex modifications for test, the simulation of various components, faults (short circuit, open circuit, low resistance, high resistance) and internal destructive experiments can be realized in a digital way to accurately validate the protection algorithm.
- It is allowed to configure and then simulate extreme test conditions with all the internal data and waveforms exposed directly to the user in a very easy way.

- No need to frequently modify the configuration of the hardware in the test platform. Benefiting from the digital connection between UPS power loop and itstest framework, no hardware issues (such as poor contact, aging, damage,etc.) will occur, which ensures long-term running stability of automated testing and more reliable product quality.
- With just a mouse and a keyboard, the test bench can be synchronized with hardware design. Testing will keep pace with project schedule to expedite production.

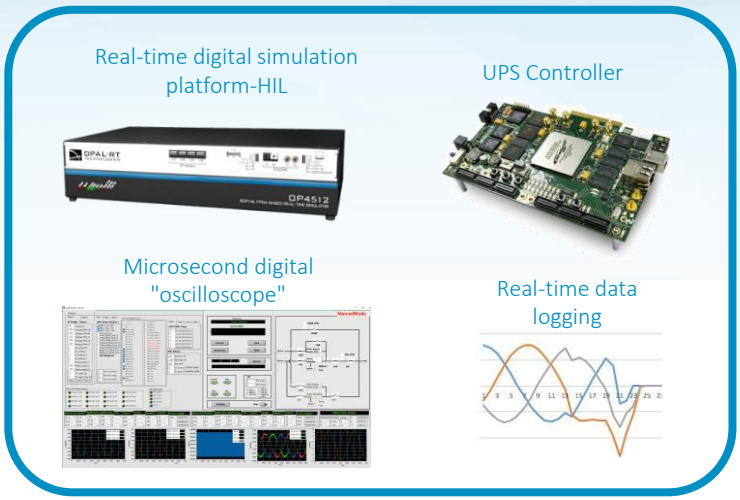
- No need to struggle with how to fully capture or monitor the test data results. After setting certain test conditions, it is fully possible to operate the test remotely, all complex details will be displayed in your screen, which enables faster support service.

- Digital test platform will not produce much energy consumption, so allow the team to enjoy energy saving, high efficiency and environment friendly R&D process.

RESULTS

Upgrade From traditional test to Hardware-In-the-Loop test, driving efficiency across the board.

- 700+ test cases with 10~15 rounds
- Covering 80% of the automated testing
- Easy implementation of destructive tests *(**b**us short circuit; sampling error; inductance damage)*
- Fast and accurate reproduction of complex scenes *(harmonic injection; sudden change of network; external short circuit)*
- Easily configured simulations for testing under extreme conditions
- Immediate response to hardware changes
- High efficiency, environment friendly & energy saving



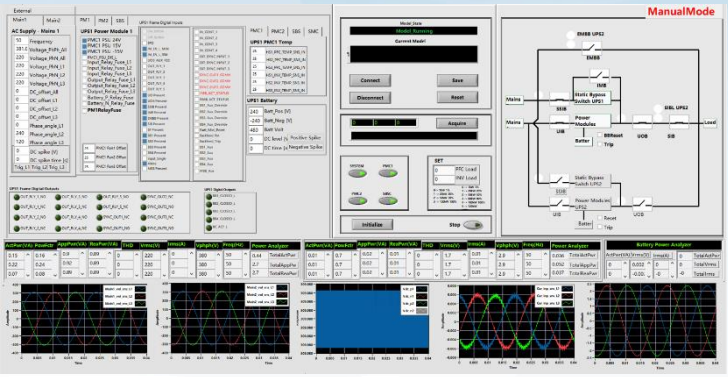
EXPEDITE development process

More **RELIABLE** product quality

FASTER service support

- 600+ test cases with 3~4 rounds
- Covering 50% of the automated testing
- Difficult to test internal faults
- Difficult to reproduce complex scenes
- Extreme conditions limited by testing equipment
- Complex and laborious to build platform
- Slow response to hardware changes

RESULTS



▲ LabVIEW automated test panel

The feature "Scenario" in eHS makes it easy to test UPS under different load conditions and even extreme conditions without resetting the simulation.

At the same time, it can also introduce fault state simulation, which is difficult to realize efficiently when using real prototype for the test.

Furthermore, with the help of open LabVIEW API and Python API interface in OPAL-RT RT-LAB, technical specialists who are familiar with LabVIEW in Schneider Electric technical team were able to build a LabVIEW panel for auto-test. Instead of learning to use RT-LAB and Matlab, test specialists or software developers can easily complete automated testing by simply configuring the parameters on this customized LabVIEW panel. Thanks to such efficient automation test scripts, the simulators can run non-stop automated tests for a week without supervision of any staff , which improves test efficiency and speeds up product validation.

"Over the past two years, OPAL-RT China's local technical support team has been providing us with professional and customized support services (Premium Maintenance Plan), they not only answered our technical questions in time, but also completed developing some customized firmware, when the HIL platform needs to be adapted to our own control program to meet the test conditions. Their excellent services saved considerable learning time for us and allows testers to focus on product testing."

—— *Ricky Zhang*

Thanks to Schneider Electric (Shanghai) UPS team for their trust and support to OPAL-RT, and we look forward to the long-term cooperation in more fields in the future!