Microgrid Testbed.

Rein in microgrid complexity. With ease.

Typhoon HIL

Outsmart the microgrid.

Microgrid Testbed

Ultimate test solution for microgrid control system verification

What is a microgrid?

Microgrid is a collection of distributed energy resources (DER) that insure high power quality and can also be seamlessly connected to a wider distribution system.

What is Microgrid Testbed?

Microgrid Testbed is a collection of HIL devices from Typhoon HIL with integrated DER controllers, protection relays and microgrid controllers.

What is the purpose of Microgrid Testbed?

The main purpose of the Microgrid Testbed is to comprehensively test controller's hardware, firmware, software and communications under all operating conditions including faults in both the island and grid-connected mode.

To help our customers reach a high level of test productivity, the Microgrid Testbed performs all its tests and generates test reports automatically.

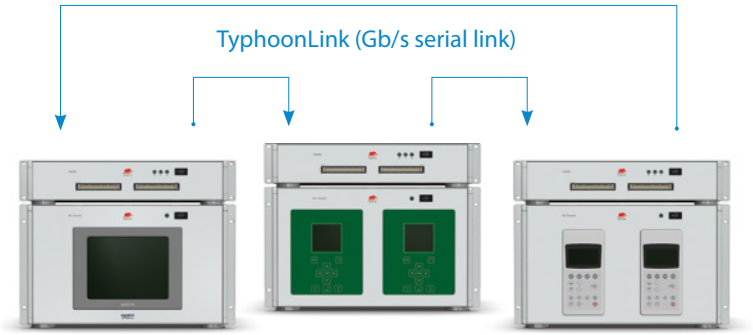
How does Microgrid Testbed work?

DER and distribution system hardware models comprising smart inverter hardware, PV panels, batteries, transformers, generators, switches, cables, active and passive loads etc. are running inside a HIL device with a 1 µs time step. Smart inverter controllers control the operation of smart inverter models. Relays control the protective switches and microgrid controllers provide the overall supervisory control.

In other words the Microgrid Testbed has identical control system as a real microgrid, only the power hardware is digitized.

Modular by design.

Test the microgrid components first.
Then test the whole microgrid.



Distributed HIL for distributed energy resources testing

The future grid comprising a distributed and decentralized collection of microgrids requires a fast, powerful, high-performance decentralized HIL system where one HIL device models one microgrid island while the Microgrid Testbed models a collection of islands, i.e. the distribution grid.

This is precisely the scalability inherent in desktop HIL devices from Typhoon HIL.

Smart inverter control testing

Undoubtedly, the smart inverter is one of the key enabling technologies for microgrid development. The smart inverter is the interface between the DER and the microgrid distribution system and to a large extent comprises the intelligence behind the DER. Additionally, smart inverters are in charge of active and reactive power regulation, voltage and frequency regulation as well as mitigation of the harmonics in the grid.

Effective testing of the smart inverter controller is the foundation for the effective testing of the microgrid and that is where Typhoon HIL truly shines.

Test the relay protection and SCADA

Add the relays into your Microgrid Testbed and then put your microgrid/distribution grid through its paces: short circuits, phase losses, overvoltages, low voltage ride throughs and component failures.

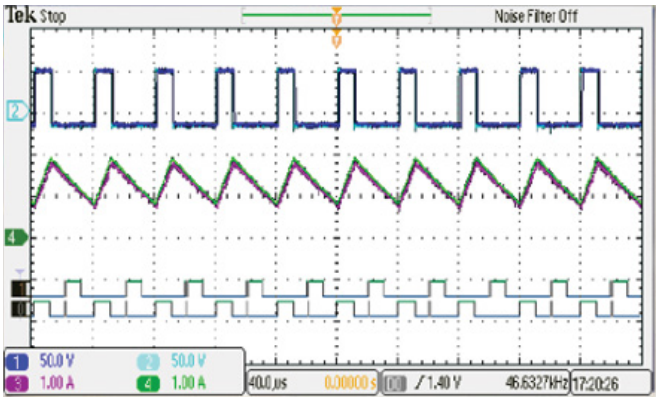
Finally, top it all with the whole network sensitivity analysis.

With all other control components being real, it is only natural to use a real SCADA with all its functions and communication infrastructure.

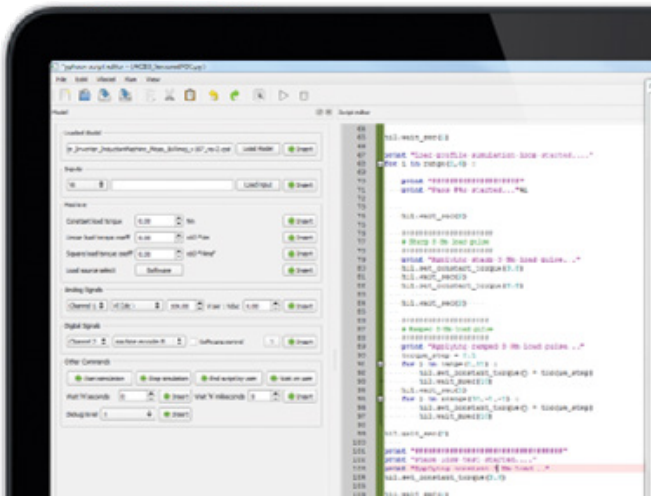
Microgrid Testbed highlights.

Test your smart inverter controller with a 20 ns time resolution.

A 20 ns PWM resolution combined with 0.5 µs simulation time step enables the most realistic, and most comprehensive smart inverter controller tests. From DC to 200 kHz switching frequency, the extreme time resolution of Typhoon HIL devices simply shines.



Real boost MPPT converter current; HIL boost current; Real boost inductor voltage; HIL inductor voltage.



Automate testing with Python scripts to comprehensively and reproducibly test and qualify all your controllers.

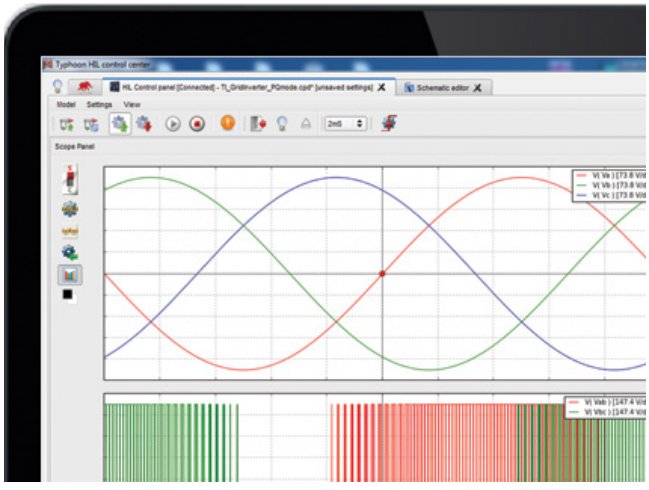
Automate testing with Python: the ultimate ease of use.

Automate controller testing processes with Python scripting. Discover the most comprehensive power electronics control software testing environment where fault injection, such as grid disturbances, short and open circuits, are just one Python command away.

Use Python scripting and rich mathematical function library to quantify system performance in a broad spectrum of operating conditions, under standard operating conditions as well as under fault conditions (internal and external).

Zoom in voltages and currents with Typhoon HIL Scope Function's microsecond "microscope".

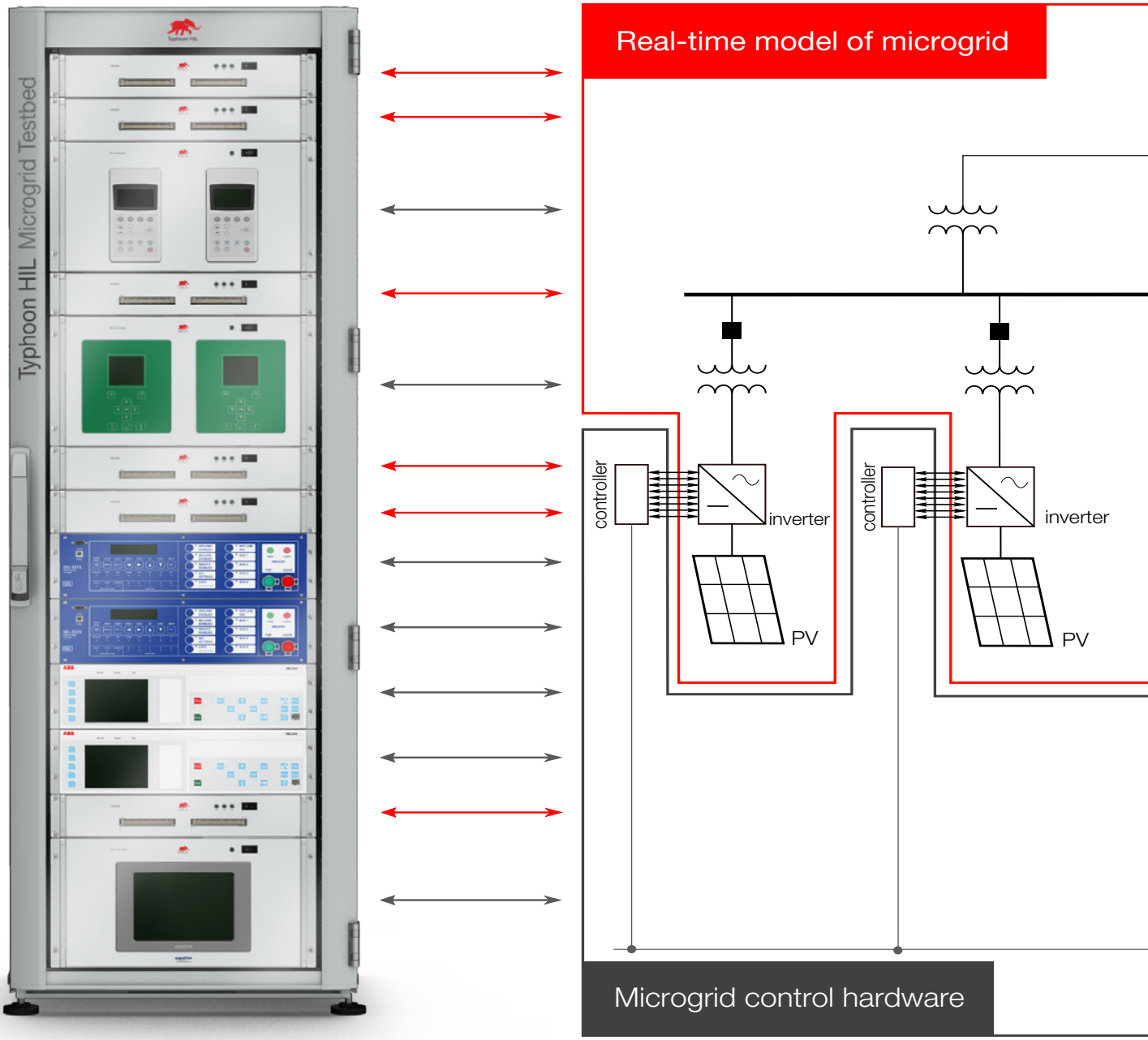
Quickly debug control code with deep memory scope/capture function. Trigger on fault injection events and quantify the converter system response. With 1 megapoint capture record length, on all 32 analog channels, and 1 MHz sample rate even tiny glitches in modulator algorithm are quickly identified. Capture HIL signals to quickly detect, debug, and characterize your controller performance.

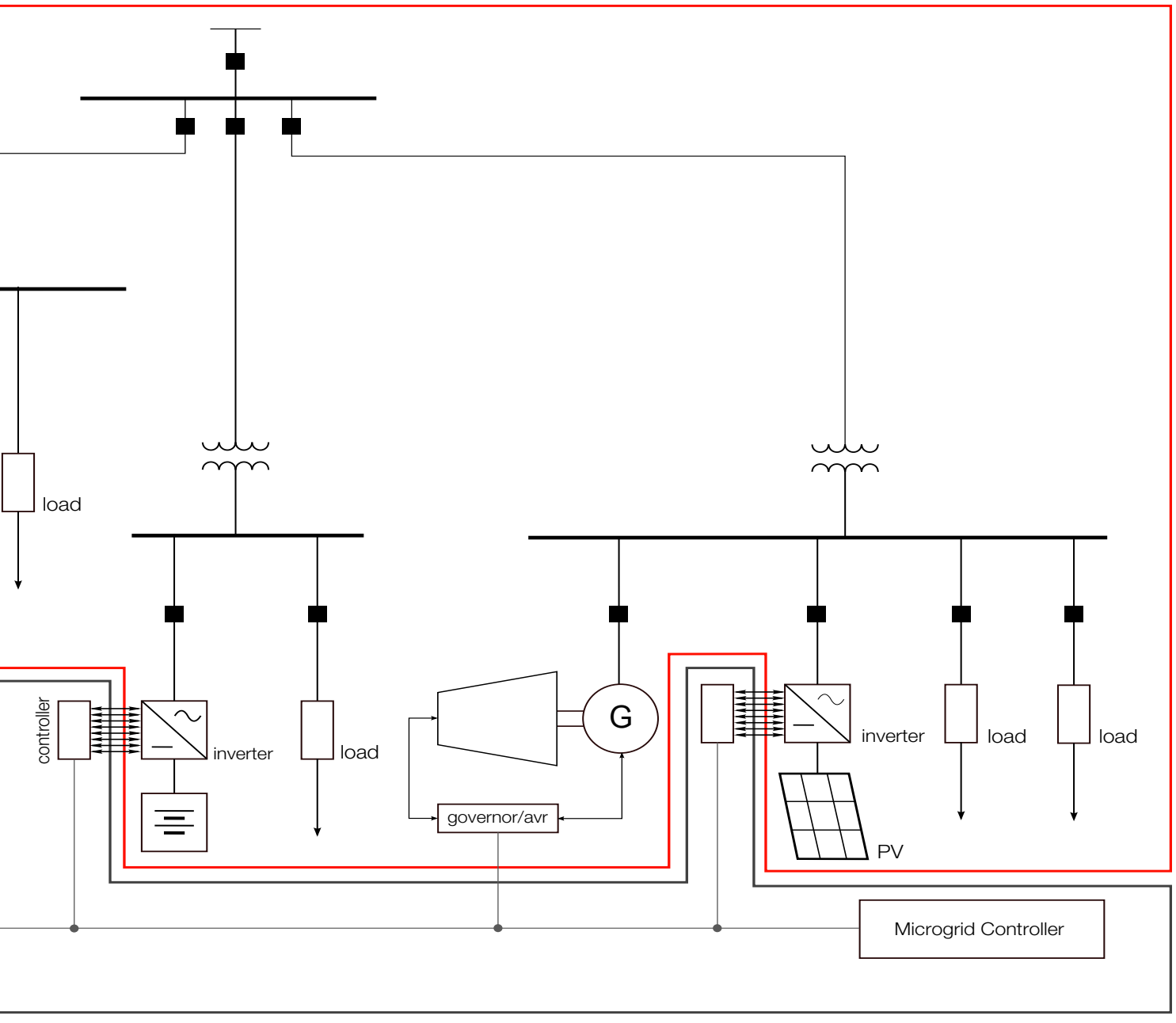


Capture HIL signals to quickly detect, debug, and characterize your controller performance.

The ultimate microgrid Testbed.

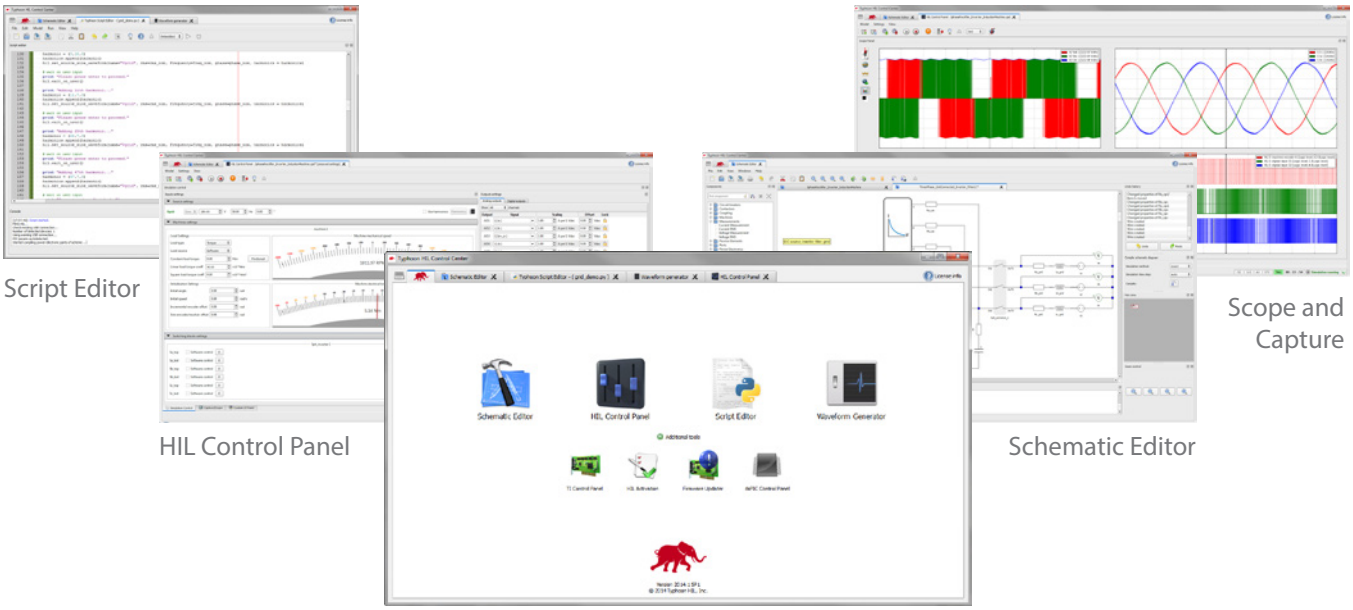
Use the ultra-high fidelity Microgrid Testbed
for the most comprehensive microgrid controller test,
verification, and precertification.




load
controller
inverter
load
G
governor/avr
inverter
load
load
PV
Microgrid Controller

Unified Software Environment.

Experience integrated HIL software with automated testing.
Intuitive and easy to master, our software provides a unified environment for microgrid design, test automation and quality assurance.



Script Editor

HIL Control Panel

Scope and Capture

Schematic Editor

HIL Control Center

Unified experience.

Model smart converters with our simple to use schematic editor with a rich library of passive elements, converters, sources and machines. With only one click, rapidly compile the circuit into real-time executable machine code for our HIL hardware.

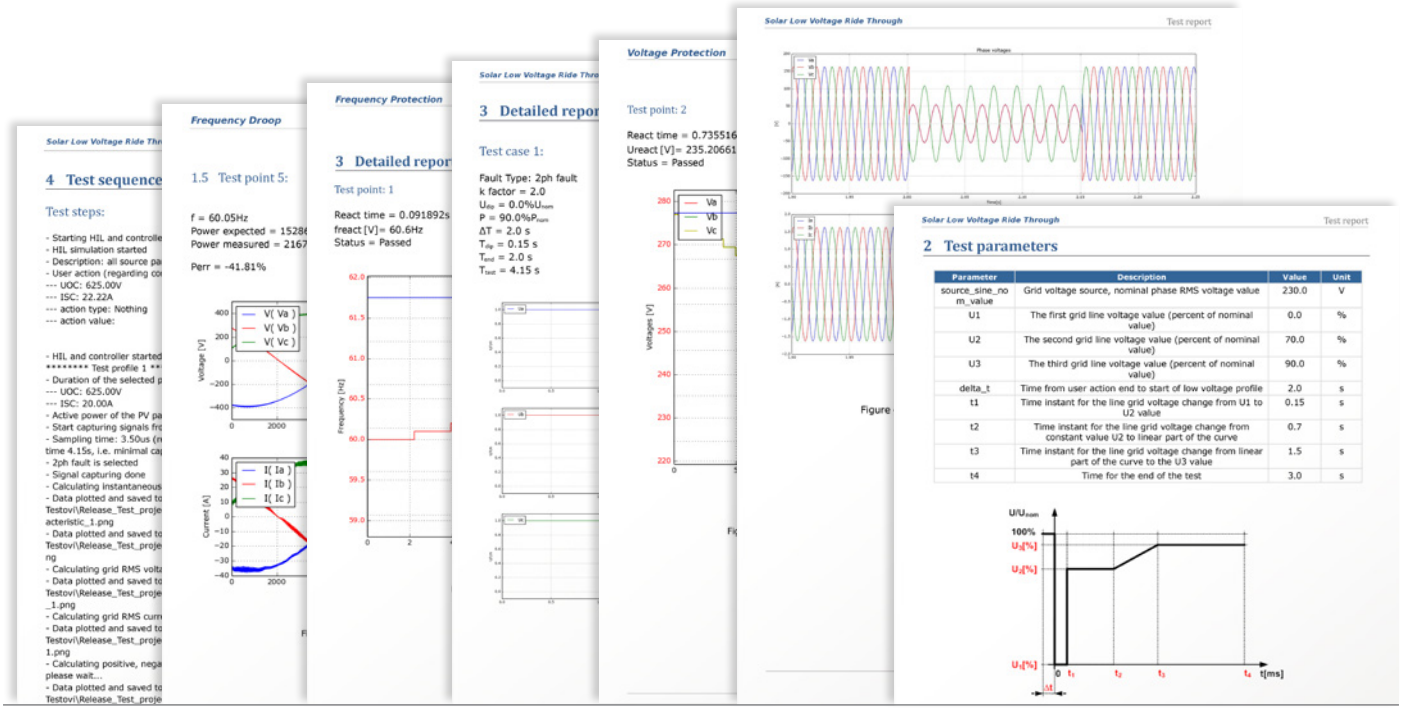
Open the HIL control panel to load the compiled model onto the hardware and launch the real-time simulation. Select signals you want to see on the scope and change sources and parameters for a fully interactive experience. With a built-in Python script editor, automate your test processes and generate test reports, automatically.

Discover simplicity.

- Schematic editor with vector graphics.
- Library of power electronics circuit elements.
- One click circuit compilation.
- Interactive control of real-time emulation.
- Waveform editor for source definition.
- Software control of digital inputs.
- Automatic testing via Python scripts.
- Library of test scripts for testing grid complance, protection etc.
- Python API.
- Automatically generated HTML test reports.

Pre-certify your microgrid. In-house.

First of a kind Microgrid Testbed optimized for grid-code pre-certification.



Microgrid testing reinvented

The new Precertification Toolbox from Typhoon HIL, verified by the AIT Austrian Institute of Technology, allows you to exhaustively test your inverter control software in- house against national and international grid codes. Moreover, you will do it at a fraction of the time and cost.

Even the highly demanding Low Voltage Ride Through and Frequency Droop test procedures can be completed with just few clicks thanks to the Typhoon HIL built-in test libraries.

Streamlined certification

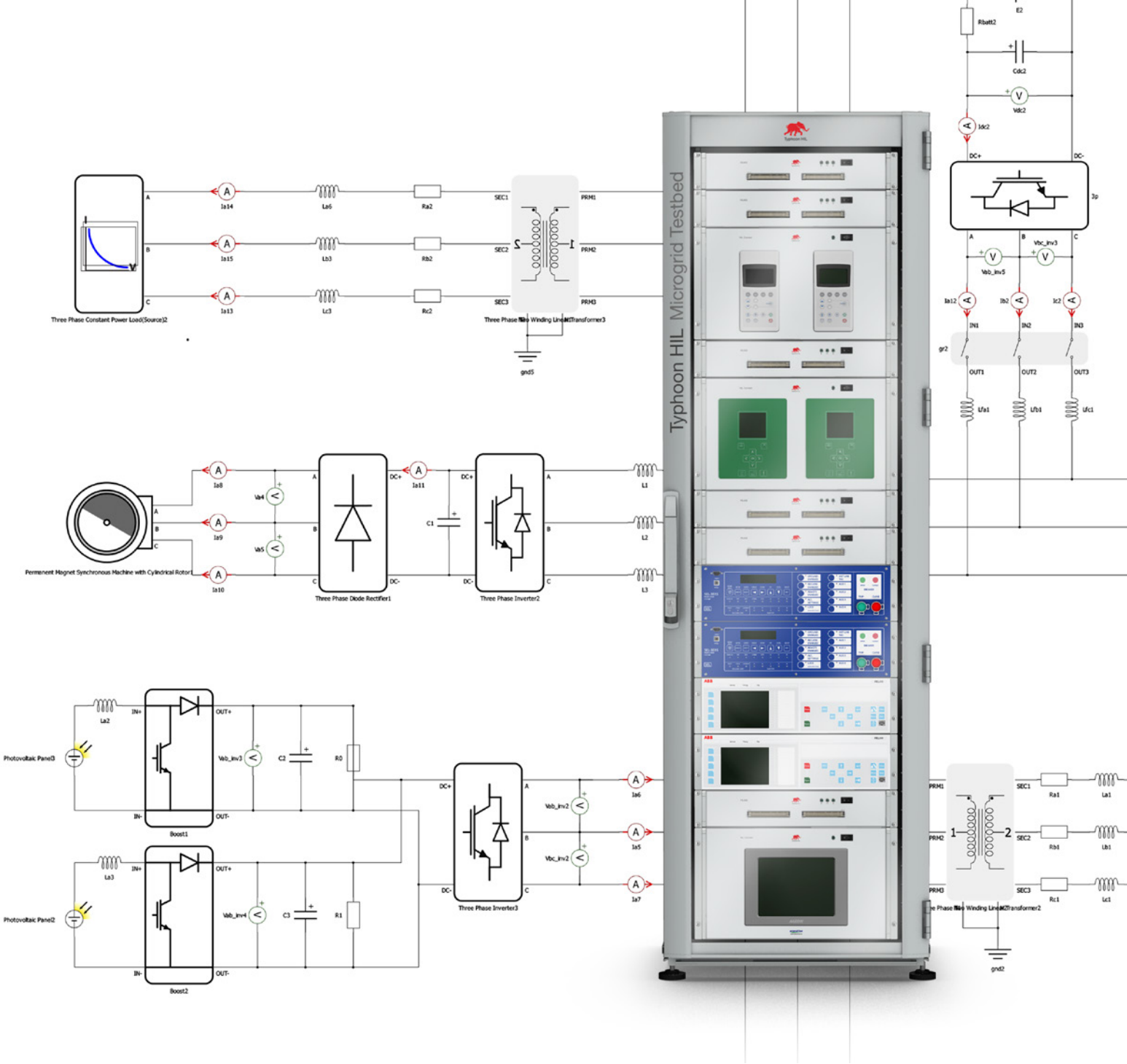
Our Microgrid Testbed enables repeatable, formalized control system testing for a wide selection of operating conditions that are often impossible or impractical to test with real hardware. Digitizing the power components inside our HIL opens a world of possibilities to verify smart inverter grid compliance in-house by driving it through a wide range of standard-defined operating points. All with a simple push of a button.

Typhoon HIL Microgrid Testbed will automatically generate highly-detailed reports for all test operations with all test-relevant data captured in high-resolution.

Microgrid Testbed technical details

Performance	Simulation capacity	1 µs timestep simulation of up to 40 multilevel converters (720 switches) for HIL applications with DER controllers 10 µs time step simulation of large distribution systems with up to 500 buses
Analog I/O	Channels (fully selectable)	up to 500 channels
	Resolution	16 bit
	Accuracy	1 %
	Voltage outputs (user defined)	Range ± 10 V LV, ± 350 V HV (four quadrant) Compliance range ± 10 mA Bandwidth > 50 kHz LV, ~ 10 kHz HV
	Current outputs (user defined)	Range ± 50 mA LC, ± 500 mA MC, ± 3 A HC (four quadrant) Compliance range ± 10 V, ± 1.5 V HC Bandwidth ~ 10 kHz
	Analog inputs range	User defined
	Analog inputs impedance	User defined
	Sample rate	1 MSPS
	Protection	ESD and overvoltage protection
	Connector types	User defined
Digital I/O	Channels (fully selectable)	up to 500 channels
	Resolution	20 ns
	Voltage inputs	Levels 3.3 V, 5 V, 15 V, 24 V Impedance > 10 k
	Voltage outputs	Levels 3.3 V, 5 V, 15 V, 24 V Impedance 1 k (3.3 V, 5 V), 10 k (15 V, 24V)
	Optical IO	Coupling 1 mm POF Data rate 5 MBd max
Connectivity	Supported protocols	Ethernet / IP Modbus IEC 61850 SunSpec Custom protocols
Power supply outputs	Output voltage	User defined
	Output power	User defined
Host interface	HIL Control Center	Vertically integrated toolchain Drag&Drop model library (Power system, power electronics and signal processing libraries)
	Data acquisition	HIL Scada Built in multi-channel oscilloscope up to 240 Mpoints data buffer
	Host connectivity	USB, Ethernet

Outsmart the microgrid.



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