HIL Connect Interface System.

Interface your power electronics controllers directly to HIL602 via customized HIL Connect.

Typhoon HIL

HIL made for Power Electronics Engineers.

HIL Connect Interface System

Directly interface your industrial controller to
Typhoon HIL real-time emulator without any modifications to
the controller hardware or software or firmware.

Applications

Typhoon *HIL Connect Interface System* enables
seamless interfacing of any power electronics
controller system to the Typhoon HIL family of
real-time emulators. Its modular signal condi-
tioning architecture enables our engineers to
rapidly customize it to match your industrial
controller I/O interfaces such as: current sen-
sors, voltage sensors, fiber optic transceivers,
contactors, and temperature sensors.

Ease of interfacing with HIL

Our ultra-high fidelity real-time emulators
enable comprehensive test and verification of
control systems in *Hardware-in-the-Loop (HIL)*
configuration where real controller is "in the
loop" with the emulator. However, to conclu-
sively test, verify, and finally certify power elec-
tronics controller system in HIL configuration it
is critical that the controller (Device Under Test)
is not modified in any way. Our HIL Connect is
designed to support all types of power elec-
tronics controller interfaces.

Measurement subsystem emulation

Flexible input/output current, voltage, and optical transducers
seamlessly interface with all the controller IO signals
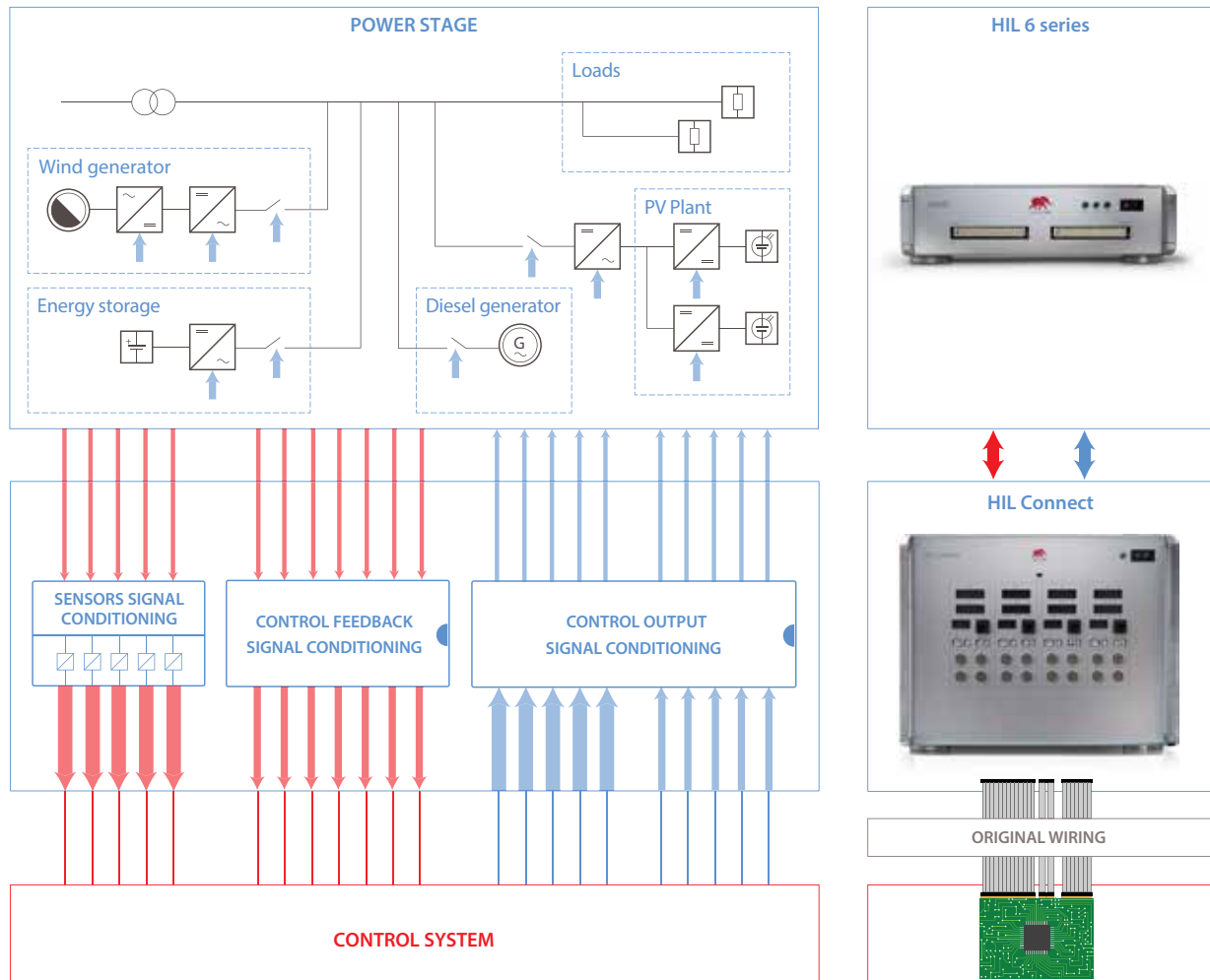
Benefits

HIL Connect solution is designed to faithfully emulate your power stage and sensor/conditioning stage. The power stage is modeled in our HIL emulator, which communicates with the outside world via low voltage IO (5V). To enable direct connection of unaltered controller IO signals to the emulator, the HIL Connect device conditions and transduces IO signals (i.e. shifts voltage, converts voltage to current, voltages to light etc.). Indeed, whether you are testing your algorithm on a rapid control prototyping platform or testing an industrial controller, HIL Connect makes your HIL device the ultimate Plug and Play gateway to complete control test automation.

Emulation capability

HIL Connect interface solution enables realistic emulation of current/voltage transducers and IO signal conditioning:

- LEM sensors, current transformers

- voltage sensors

- relays and contactors

- temperature and other low-power sensors

- input/output impedance matching

- batteries

Microgrid test bench reinvented

Test your microgrid controller with a HIL test bench comprising multiple real inverter controllers directly interfaced to HIL via a single HIL Connect box.
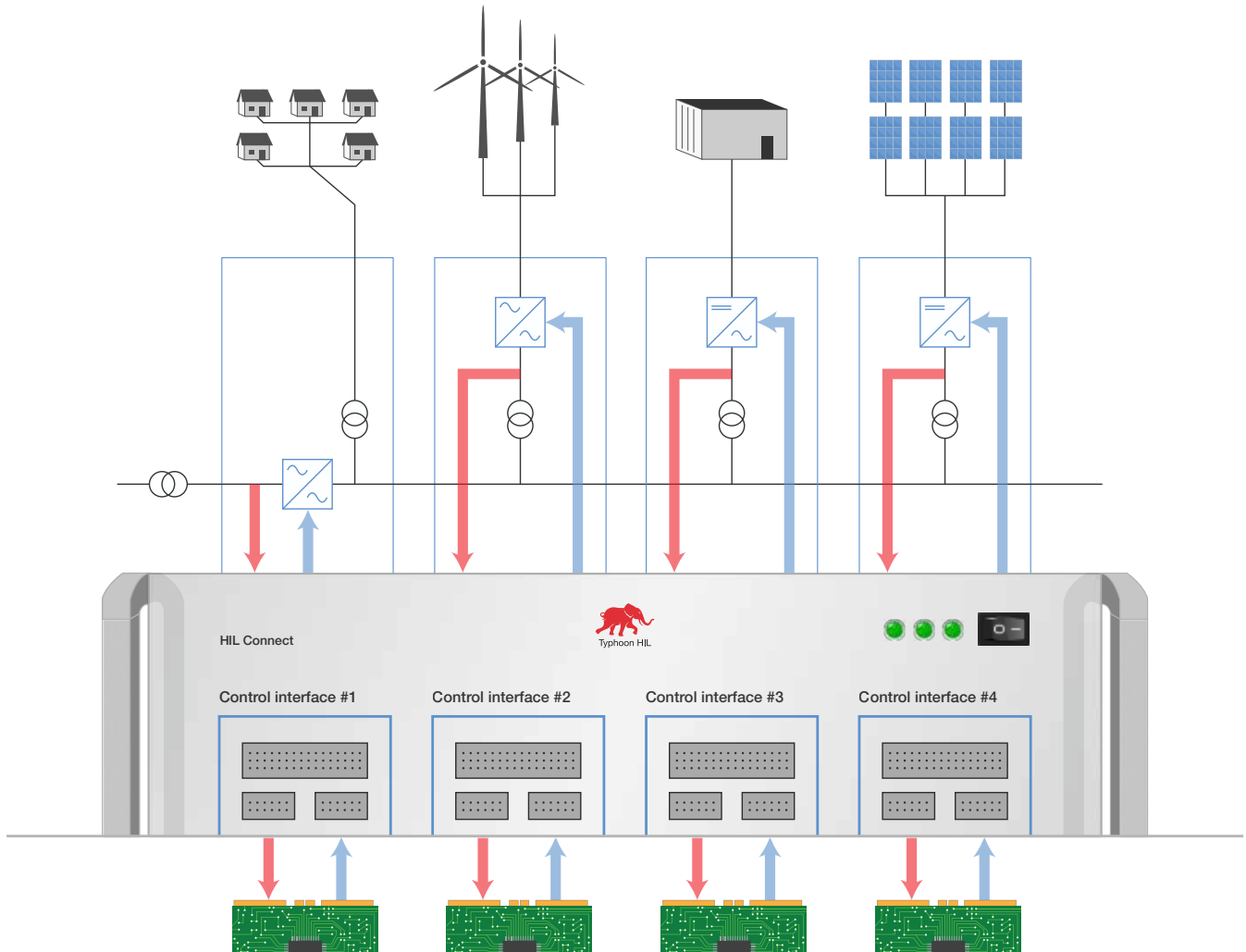
Multiple inverter controllers

With single HIL Connect you can interface multiple controllers to our real-time HIL simulators. For even more complex systems, i.e. microgrids, you can connect multiple HIL Connects in parallel to build a HIL cluster. This makes the HIL Connect a must have for interfacing multiple inverter controllers. This is a unique test bench with multiple smart-inverter controllers, that can be controlled by i.e. high-level microgrid controller.

Test your high-level microgrid controller with highest fidelity HIL models without the need to worry about hardware interfaces.
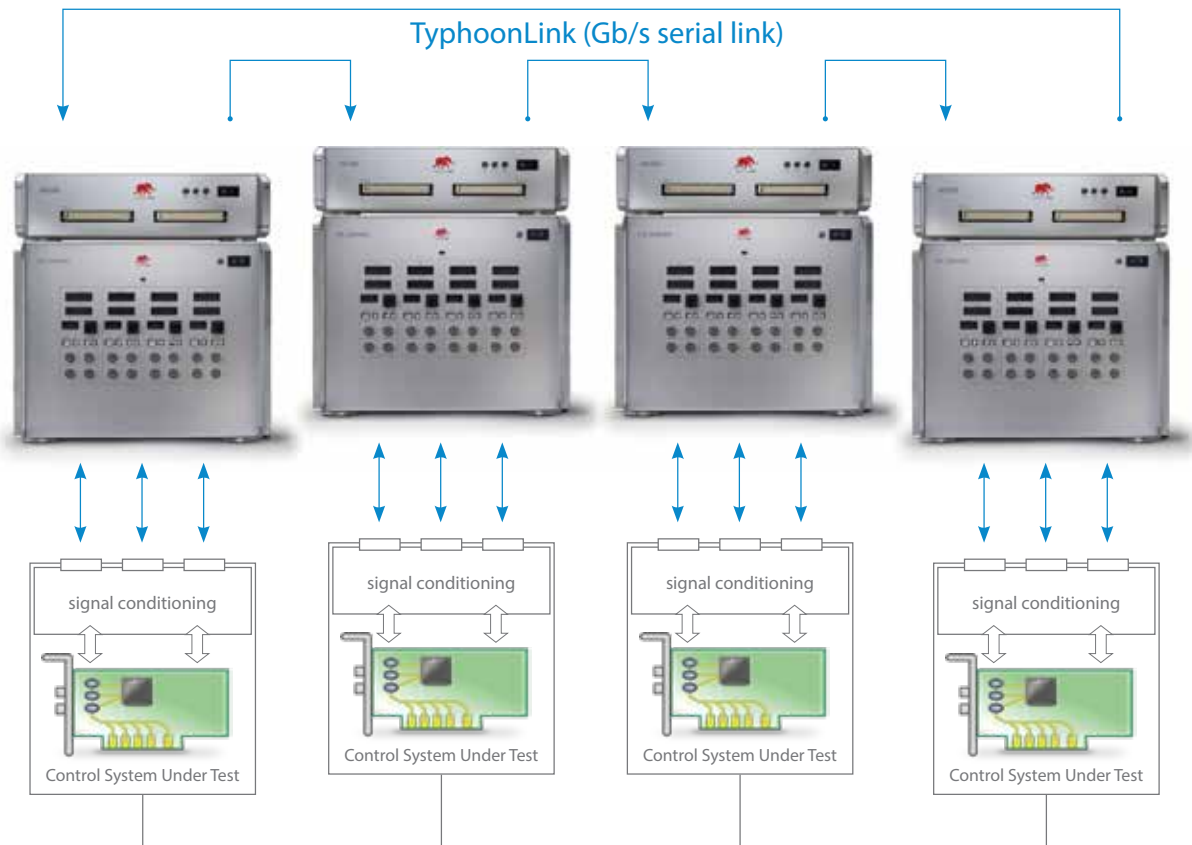
System controller test platform

HIL test instrumentation, comprising HIL real-time emulators and HIL Connect, streamlines controller software and firmware life-cycle management. The lifecycle management includes stages from control algorithm development, through control hardware and software test and verification, all the way to in-house pre-certification.

Use HIL test platform to test system integration issues before even one unit leaves for field testing and commissioning. Use HIL test platform to test, optimize, and verify entire control system, including the communications, against a spectrum of operating regimes and without high-power lab.

Typhoon HIL micro-grid solution

Complete HIL solution for micro-grid control system development, testing, and pre-certification.

TyphoonLink (Gb/s serial link)

signal conditioning

Control System Under Test

signal conditioning

Control System Under Test

signal conditioning

Control System Under Test

signal conditioning

Control System Under Test

MicroGrid HIL solution.

HIL602 with HIL Connect provides a comprehensive environment for design and testing of control systems for micro-grid power electronics converters. *TyphoonLink*-Gigabit per second serial link-enables seamless connection of multiple HIL602 units into one unified HIL system that can simulate 16 or more converters.

   Whether you are testing a single converter control or multiple converter control (centralized or decentralized) HIL602 in the cluster configuration provides a unified environment that is as easy to use as if you were working with single HIL unit. Compile schematic diagram from the *Schematic Editor;* control the real-time emulation process via *HIL Control Panel*; quickly access all simulated signals via the *Scope/Capture* function-the same way as if you were using a single HIL. Finally, automate testing with Python scripts via Typhoon API.

Features and Benefits

• Connect 4 or more *HIL602* units in *HILCluster* configuration.

• Deploy 24 real-time computational cores as one unified HIL real-time emulation fabric.

• Test one or multiple controllers in micro-grid environment for both centralized and decentralized micro-grid control configurations.

• Test both lower level and application/micro-grid level control layers.

• Interface seamlessly your industrial controllers to multiple HIL units via *HILConnect.*

• Automate test and pre-certification processes with Python scripts via Typhoon API.

HIL Connect use case

Battery storage DC/DC converter for PV application
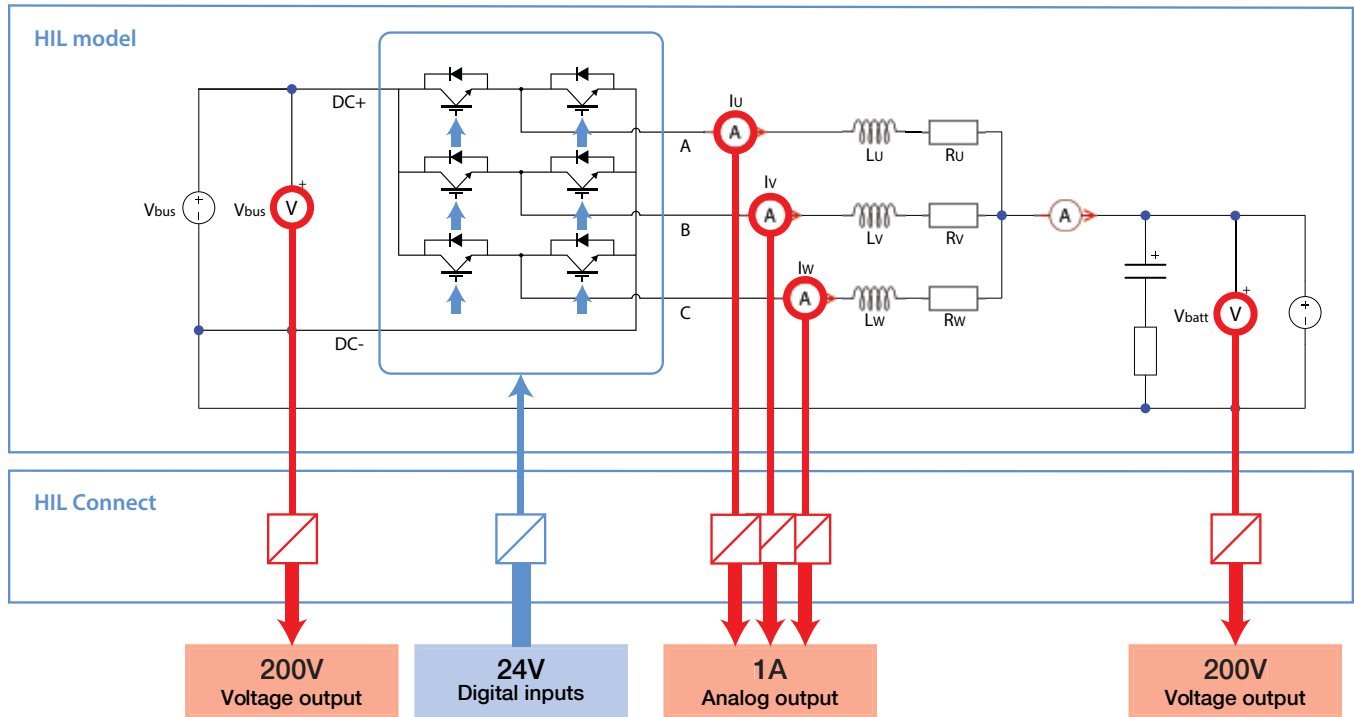
Control development

All the fast controller functions—such as PWM modulation, current and voltage control loops, maximum power point tracking, as well as protection functions and high-level control functions (i.e. dynamic grid support) can be tested and characterized on integrated testing solution comprised of Typhoon's ULL HIL and custom built HIL Connect. Original control software for PV plant battery storage control system, can be developed, tested and verified with real control feedback signal levels.

After the controller code verification, HIL Connect becomes perfect platform for fast interfacing and in-production control testing and verification, thanks to its plug and play connectivity, prior to the product shipping and commissioning.

Highlights

- Direct measurement of emulated voltages and currents by controller sensor conditioning board.

- High voltage and high current outputs on HIL Connect AO for controller feedback.

- Integrated power amplifiers for sensor emulation.

- Interface for 24V gate drive signals.

- High power battery emulation capability.

- Custom defined I/O connector layout.

- Parallel controller configuration enabled.

HIL Connect example systems

Current, voltage, optical transducers and amplifiers with minimal customization interface with all the controller IO signals. True Plug and Play HIL.

Typhoon engineering will customize analog I/O voltage and current levels, digital I/O voltage levels, I/O connectors and power supplies. Our engineers refine their immense customer support experience into HIL Connect interface system design to support all power electronics controller I/O interfaces.

+/- 10 V voltage output	0 - 5 V voltage outputs	+/- 10 V analog outputs
+/- 175 mA current outputs	+/- 5 V voltage outputs	+/- 180 V voltage outputs
72 V @ 1 A battery emulators	+/- 100 mA current outputs	+/- 1.736V analog inputs
thermistor emulators	5 V digital inputs	+/- 3 A current outputs
5 V digital outputs	3.3 V and 24 V digital outputs	24 V digital IO

HIL Connect customization steps

Customized connectors, voltage/current I/O levels, and
power supplies according to your controller IO specification.

Step 1: IO Specification

Our team of experts works with your engineers
to specify all electrical, mechanical, and
modeling customization tasks for your new *HIL
Connect* system. Once the spec is approved we
move to the prototyping phase.

Step 2: Customization

Following the specification steps our
engineering team designs and manufactures
your new HIL Connect system. Series of IO tests
ensure the performance of the interface system.

In addition, we customize HIL Connect's front
panel connectors so that you can use the exact
same cables/connectors to connect controller
to the HIL Connect, as you use for connecting
controller to the real power stage in your
product.

HIL Connect front plate is designed from ground
up to simplify connectivity and enable parallel
controller connections.

Step 3: Commissioning

After extensive testing, HIL Connect is delivered
to your site, and with the assistance from
our specialists, the on-site commissioning is
performed.

HIL Connect IO specification

Analog current outputs	Low current outputs	Medium current outputs	High current outputs
Channels	32	8	8
Output range	+/- 50mA	+/- 500mA	+/- 3A
Compliance range	+/- 10V	+/- 10V	+/- 1.5V
Bandwidth	~ 10 kHz	~ 10 kHz	~ 10 kHz

Analog voltage outputs	Low voltage outputs	High voltage outputs
Channels	32	8
Output range	+/- 10V	+/- 350V or 0/+700V
Compliance range	+/- 10mA	+/- 10mA
Bandwidth	> 50 kHz	~ 10 kHz

Analog inputs	Current inputs	Voltage inputs
Channels	16	16
Input range	user defined	user defined
Input impedance	user defined	user defined

Analog IO accuracy	1%	

Digital voltage IO	Voltage inputs	Voltage outputs
Channels	32	32
Levels	3.3V, 5V, 15V or 24V	3.3V, 5V, 15V or 24V
Impedance	>10k	1k (3.3V / 5V outputs) 10k (15V / 24V outputs)

Optical IO	Optical inputs	Optical outputs
Channels	16	16
Coupling	1mm POF	1mm POF
Data rate	5 MBd max	5 MBd max

Power	HIL Connect PSU		Additional PSU
Rails / Output current	+/- 12V / 0.5A	+/- 5VA, 3.3VD, 5VD / 1A	user defined

Mechanical	Size A	Size B
Format	19"	19"
Height	3U	6U
Width / Depth	320 x 245 [mm]	320 x 245 [mm]

Notes: This table outlines a default HIL Connect configuration. For a custom configuration, please contact us directly at **info@typhoon-hil.ch**.
Total number of channels depends on connected HIL emulator. Short circuit/overvoltage protection on all IO.

HIL made for Power Electronics Engineers.

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