Typhoon HIL

HIL Connect

Effortlessly Validate your Power Electronics Controllers, No Modifications Needed.

www.typhoon-hil.com

Interfacing Made Simple

Streamlining Controller Interfacing

Comprehensive signal conditioning integrated with Hardware-in-the-Loop (HIL) solutions allows for rapid and thorough validation of power electronics controllers. Utilizing HIL reduces delays, risks, and costs associated with traditional hardware testing. Typhoon HIL Connect acts as an essential intermediary between the HIL Simulator and controller, ensuring seamless compatibility and reliable performance.

HIL Connect is tailored to support a variety of controller interfaces, accommodating different signal types expected by the Device Under Test (DUT). With its modular architecture, HIL Connect enables rapid customization of I/O interfaces, ensuring seamless connection between the HIL Simulator and the DUT. All current, voltage, and optical I/O interfaces will convincingly mimic real power stage signals for the DUT to operate as if it's part of an actual system.

Introducing the HIL Connect

HIL Connect is a card-based, 19-inch rack-mount signal-conditioning device capable of conditioning one row of HIL I/O (up to 32 x AO, 16 x AI, 32 x DO, 32 x DI). With eight card slots, it offers versatile configurations to meet various project requirements, with different cards offering different interfacing options. Cards are expansion modules that extend HIL capabilities through analog, digital, or communication I/O channels, adjusting voltage and current levels as required by the application.

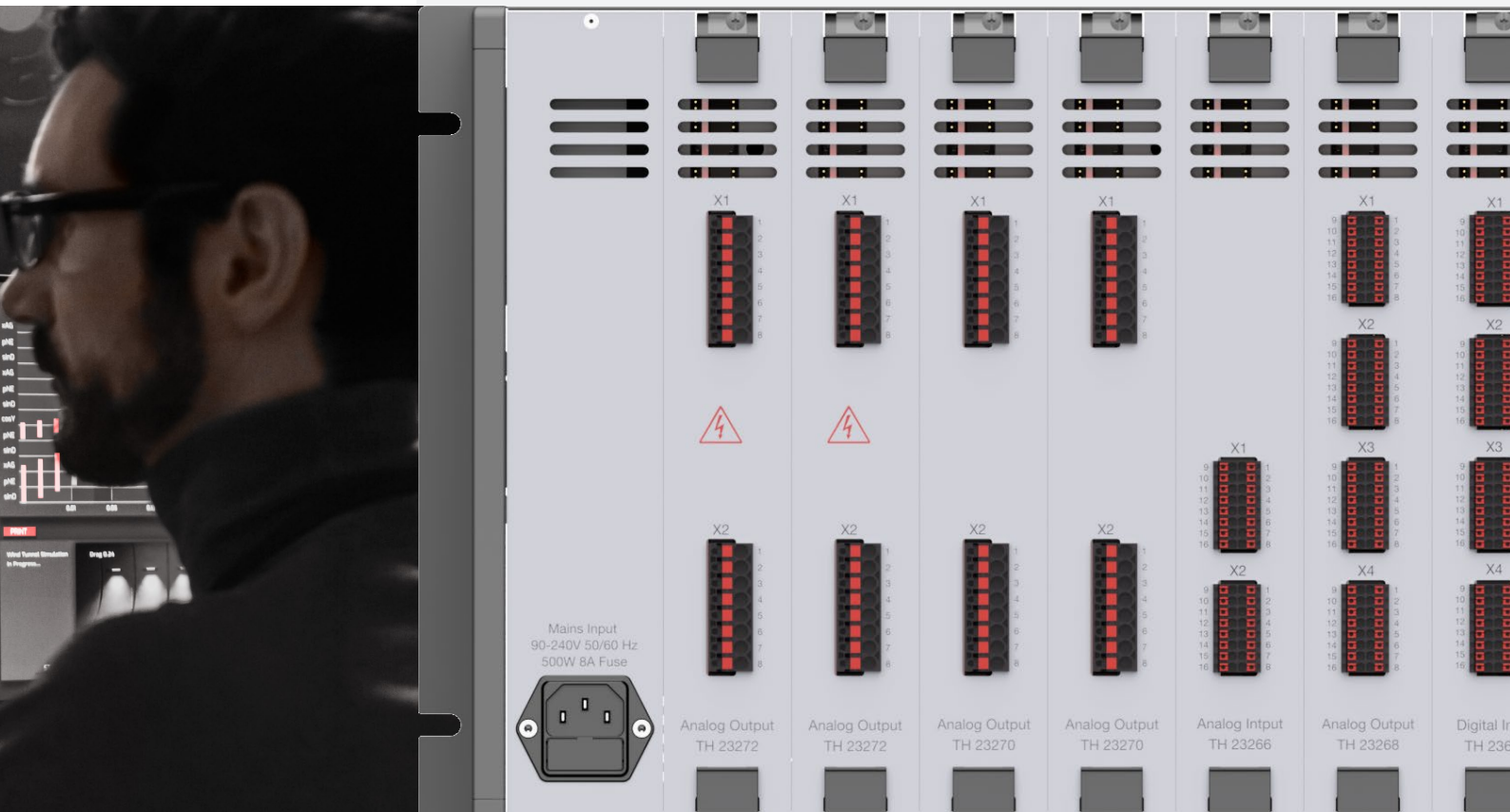
HIL Connect guarantees that the control signals and sensor measurements obtained from the simulation align with the expectations of the DUT in real-world scenarios.

A true plug-and-play device

HIL Connect offers a plug-and-play architecture with connector headers commonly used in real-world applications, including terminal blocks, BNC connectors, and custom connectors. This compatibility allows users to quickly connect the system to production-grade controllers, facilitating rapid testing and reducing certification risks.

Emulation capability

- Current sensors
- Voltage sensors
- Fiber optic transceivers
- Relays and contactors
- Temperature sensors
- Battery cells



Technical Specifications

HIL Connect offers a diverse array of inputs and outputs, encompassing analog voltage and current signals, digital signals, power, and optical signals. Its extensive range of voltage and current values ensures suitability for a wide spectrum of applications and products, from microgrids to electric vehicles. Additionally, all I/O ports feature short-circuit and overvoltage protection.

Analog current outputs	**Low current outputs**	**2A RMS current outputs**	**5A RMS current outputs**
Channels per slot	32	8	4
Output range	±20 mA	±2.82 A	±7.071 A
Compliance range	±10 V	±1.5 V	±1.5 V
Bandwidth	100 kHz	50 kHz	50 kHz

Analog voltage outputs	**Low voltage outputs**	**High voltage outputs**
Channels per slot	32	8
Output range	±10 V	±183.3 V
Compliance range	±40 mA	±1 mA
Bandwidth	100 kHz	10 kHz

Analog inputs	**Low current inputs**	**Mains current inputs**	**Mains voltage inputs**	**Low voltage inputs**
Channels per slot	16	8	8	16
Input range	±40 mA	±20 A	±600 V	±10 V
Input resistance	~16.5 Ω	~2 mΩ	1.2 MΩ	100 kΩ
Bandwidth	100 kHz	20 kHz	20 kHz	100 kHz

Analog I/O accuracy	**Low voltage inputs and outputs**	**Low current inputs and outputs**	**2A RMS current outputs**	**5A RMS current outputs**
	<1 mV ±0.1% FS	<0.1 mA ±0.1% FS	<10 mA ±0.5% FS	<20 mA ±0.8% FS

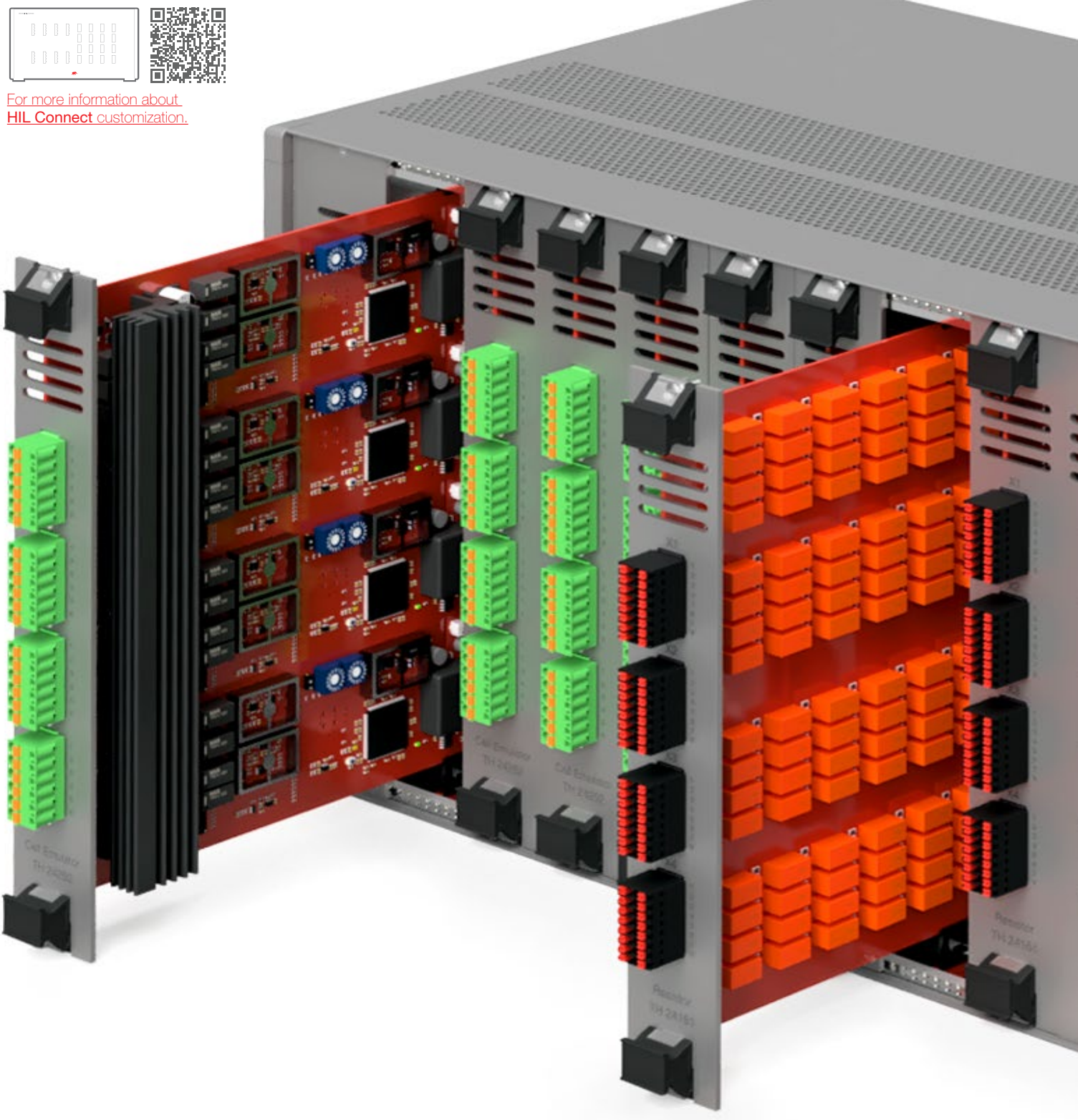
Digital voltage I/O	**Voltage digital inputs**	**Voltage digital outputs**
Channels per slot	32	32
Logic levels	3.3 V - 24 V (Universal Inputs)	3.3 V, 5 V, 15 V, 24 V (Selectable)
Resistance	100 kΩ (VI < 5.1 V), 1 kΩ (VI > 5.1 V)	~20 Ω

Optical I/O	**Optical inputs**	**Optical outputs**
Channels per slot	16	16
Coupling	1mm POF	1mm POF
Data rate	50 MBd/s Receiver	50 MBd/s Transmitter

Power	90-240 VAC, 50/60 Hz

Selecting the best cards for your application

When designing the interface between your DUT and the HIL Simulator, Typhoon HIL provides a variety of off-the-shelf cards. Our highly experienced engineers are available to assist you in selecting the optimal interface cards for your HIL Connect configuration, tailored to your application's needs. You can ensure comprehensive coverage based on the system requirements, such as analog and digital I/O, signal types, voltage and current levels, connectors, and power supplies. Subsequently, your HIL Connect will be equipped with the necessary cards, connector headers, and cables to align with your device's I/O specifications.



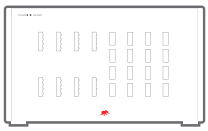
For more information about **HIL Connect** customization.

Interface Cards

A variety of HIL Connect cards are at your fingertips

The HIL Connect device has eight slots that allow you to integrate cards with specific interface capabilities. Each HIL Connect card has a corresponding Typhoon HIL Control Center (THCC) software component that simplifies the configuration process, enabling you to run the card smoothly with your model. Moreover, some cards can be configured on a hardware level by toggling internal DIP switches.

Our standard HIL Connect card portfolio includes cards suitable for **industrial, grid, e-Mobility, and BMS applications.**



For more information on available HIL Connect interface cards.

Available HIL Connect interface cards

Analog input and output cards

In the analog input card, each input can be configured for voltage or current mode, with an input signal range of ±10 V or ±40 mA and an output signal level of ±10 V, with an input resistance of 100 kΩ / ~16.5 Ω. Meanwhile, in the analog output card, each output can be configured for voltage or current mode, showing an input range of ±10 V and an output range of ±10 V or ±20 mA, with a load range of >500 Ω to voltage mode or <500 Ω to current mode. Additionally, they have an accuracy of 1 mV ± 0.1% FS in voltage mode or 0.1 mA ± 0.1% FS in current mode and bandwidth (-3dB) ranging from DC signals to 100 kHz.

Digital input and output cards

The digital input card is versatile and can support high and low-bandwidth applications. It has an input range of 3.3 V to 24 V and an output range of 5 V. On the other hand, the digital output card has an input range of 5 V and an output range of 3.3 V, 5 V, 15 V, or 24 V. Which can be selected using switches on board in groups of 8 channels.

Resistor emulator card

Emulates varying resistance in a system using a ladder resistor networks. It has eight isolated channels. The resistors are controlled from a HIL device via CAN, with the update rate down to 1 ms.

Fault insertion card

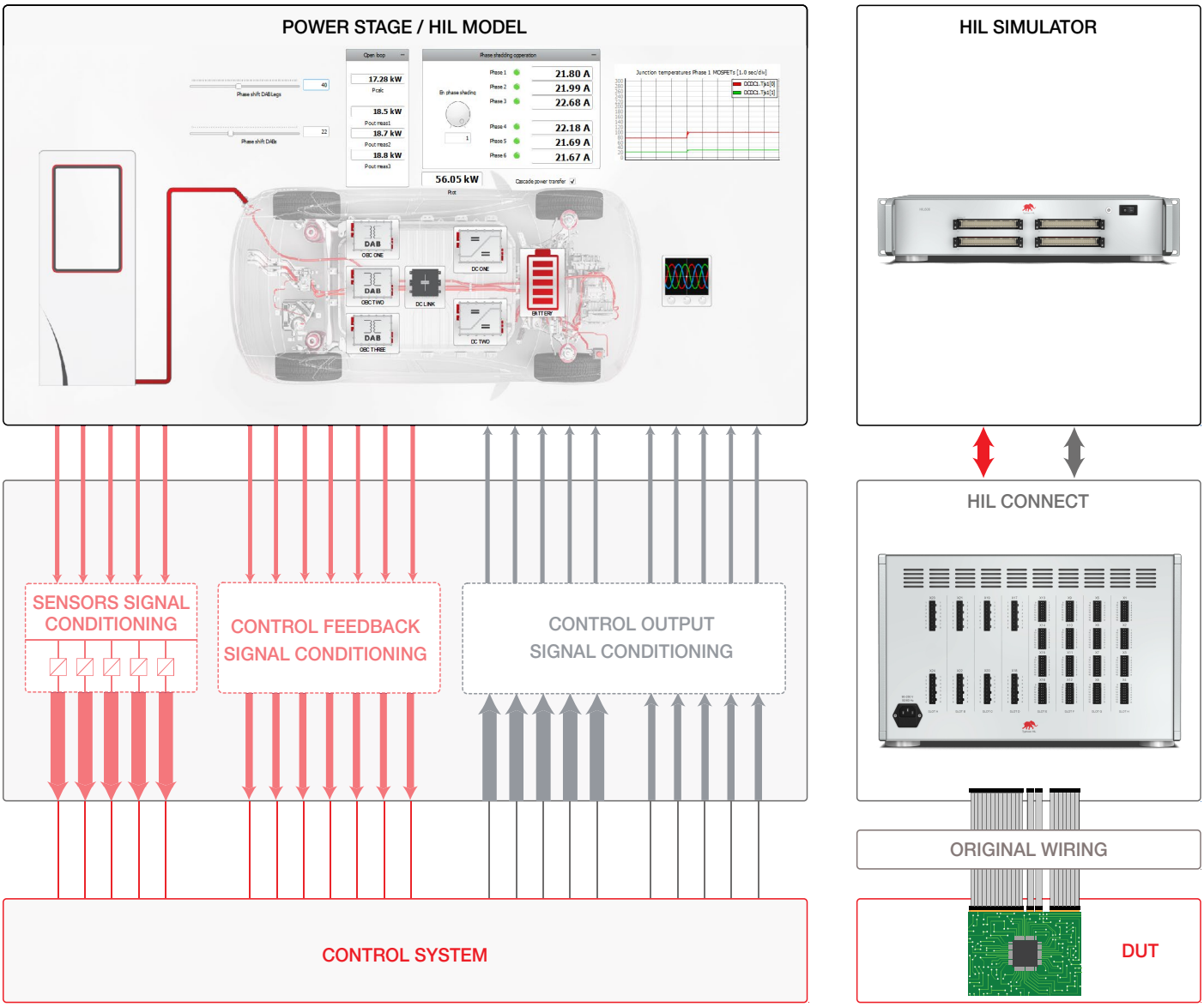
This card simulates fault conditions in a system through a relay network. It features 12 channels, each with four signal terminals and one fault terminal. Each channel can handle up to 100V and 5 A and simulates a range of faults, including open circuits, short circuits between in terminals or out terminals, and short circuits to an external signal fed to the fault terminal. The relays can be controlled from a HIL device via CAN, with the update rate down to 1 ms.

Card name	I/O type	# of channels	Input rating	Output rating	User-available hardware settings
High Voltage	Analog output	8	±10 V	±183.3 V	Drive channel selection, in groups of 8
Current Output	Current output	8	±10 V	±2.82 A	Drive channel selection, in groups of 8
Analog Input	Analog input	16	±10 V or ±40 mA	±10 V	Voltage or current mode selection
Analog Output	Analog output	32	±10 V	±10 V / ±20 mA	Voltage or current mode selection
Digital Input	Digital input	32	universal 3.3 V to 24 V	5 V	-
Digital Output	Digital output	32	5 V	3.3 V, 5 V, 15 V, or 24 V	Output voltage selection (Revision 2.6 and up)
Cell Emulator	Cell emulator	4	±10 V	±5 V, ±1 A	Drive channel selection, in groups of 4
BMS Digital	Digital I/O	16x optically isolated voltage input, 16x relay output	3 - 100 V	5 A relay contact	-
BMS Analog Output	Analog output, PSU	16 x AO, 2 x PSU	±10 V	±10 V analog output; 24 V and 5 V PSU	-
CAN Resistor Emulator	Resistor emulator	8	CAN message	0 - 655 kΩ	CAN ID selection
CAN Relay DO	Digital output	32	CAN message	0 - 100V, 5A	CAN ID selection

Standard Configuration

Specific resistances must be used to calculate the motor's temperature so that the electric vehicle can receive appropriate signals. Moreover, it is essential to ensure that the DUT is properly powered and receiving all connections and that fortified communication is established.

Empowering e-Mobility testing



Standard e-Mobility configurations for your solutions

e-Drive

The e-Drive configuration for HIL Connect covers a diversity of signal types and ranges involved in the e-Drive and charging. Additionally, it features an interface for 24V gate drive signals.
The **e-Drive HIL Connect** comes equipped with:

- **Slot A |** Analog Input Card (16ch, ±24V)
- **Slot B |** Analog Output Card (32ch, ±24V)
- **Slot C |** Digital Input Card (32ch, universal 3.3 V to 24 V)
- **Slot D |** Digital Output Card (32ch, 3.3 V, 5 V, 15 V, or 24 V)
- **Slot E |** Resistor Emulator Card (8ch, 0-655kOhm)
- **Slot F |** Relay DO Card (32ch, 100V 5A rated)

BMS

The **BMS configuration** brings together the essential cards required for battery management, standard configuration:

- **Slot A-D |** Cell Emulator Card (4ch each, ±5 V, ±1 A)
- **Slot E |** BMS Analog Output Card (16ch AO, ±10V; 2ch PSU 24V and 5V)
- **Slot F |** BMS Digital IO Card (16ch DI, optically isolated; 16ch relay DO, 100V 5A rated)
- **Slot G |** Resistor Emulator Card (8ch, 0-655kOhm)
- **Slot H |** Shunt Emulator Card (2ch, ±250mV)

With the BMS configuration, you have a controlled voltage output, current measurement input, and

“

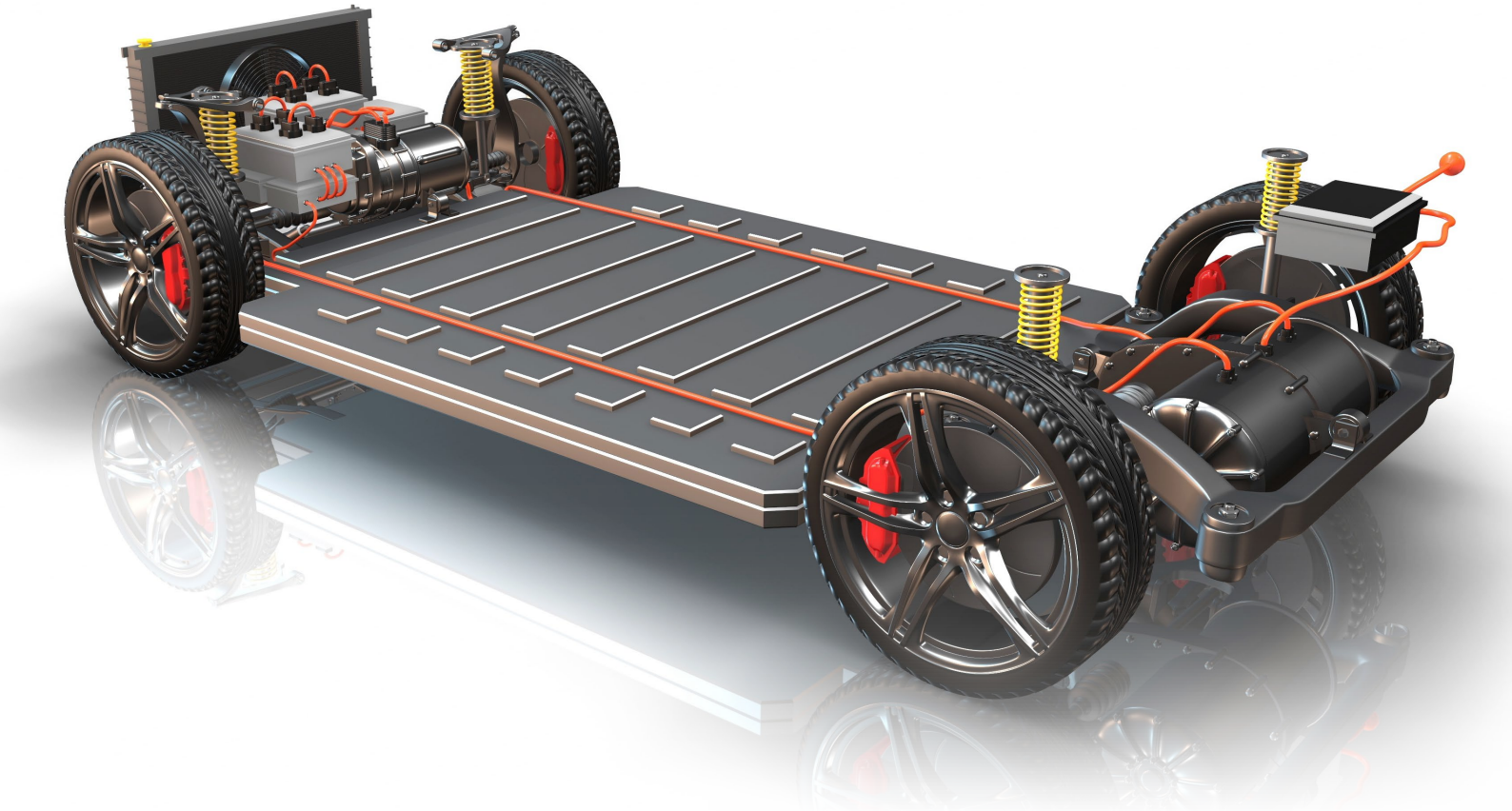
For the PANDA EU Funded project, the HIL Connect was optimized for the automotive industry and interconnection with other automotive testing solutions.

Typhoon HIL testbeds were used to emulate the full electric vehicle model in real-time and confirm that the battery system performed within the required specifications.

Read more:

Dr. Ronan German
Associate Professor and Control Team
at Université de Lille and Member at L2EP

Typhoon HIL



Typhoon HIL, Inc.
15 Ward Street, 2nd Floor
Somerville, MA 02143
USA

Phone: +1 800-766-3181

Typhoon HIL GmbH.
Seminarstrasse 85
CH-5430 Wettingen
Aargau, Switzerland

Phone: +41 (0)56 521 00 25

Tajfun HIL d.o.o.
Bajci Zilinskog bb
21000 Novi Sad
Republic of Serbia

Phone: +381 21 3010 476

www.typhoon-hil.com
e-mail: info@typhoon-hil.com