Typhoon HIL®

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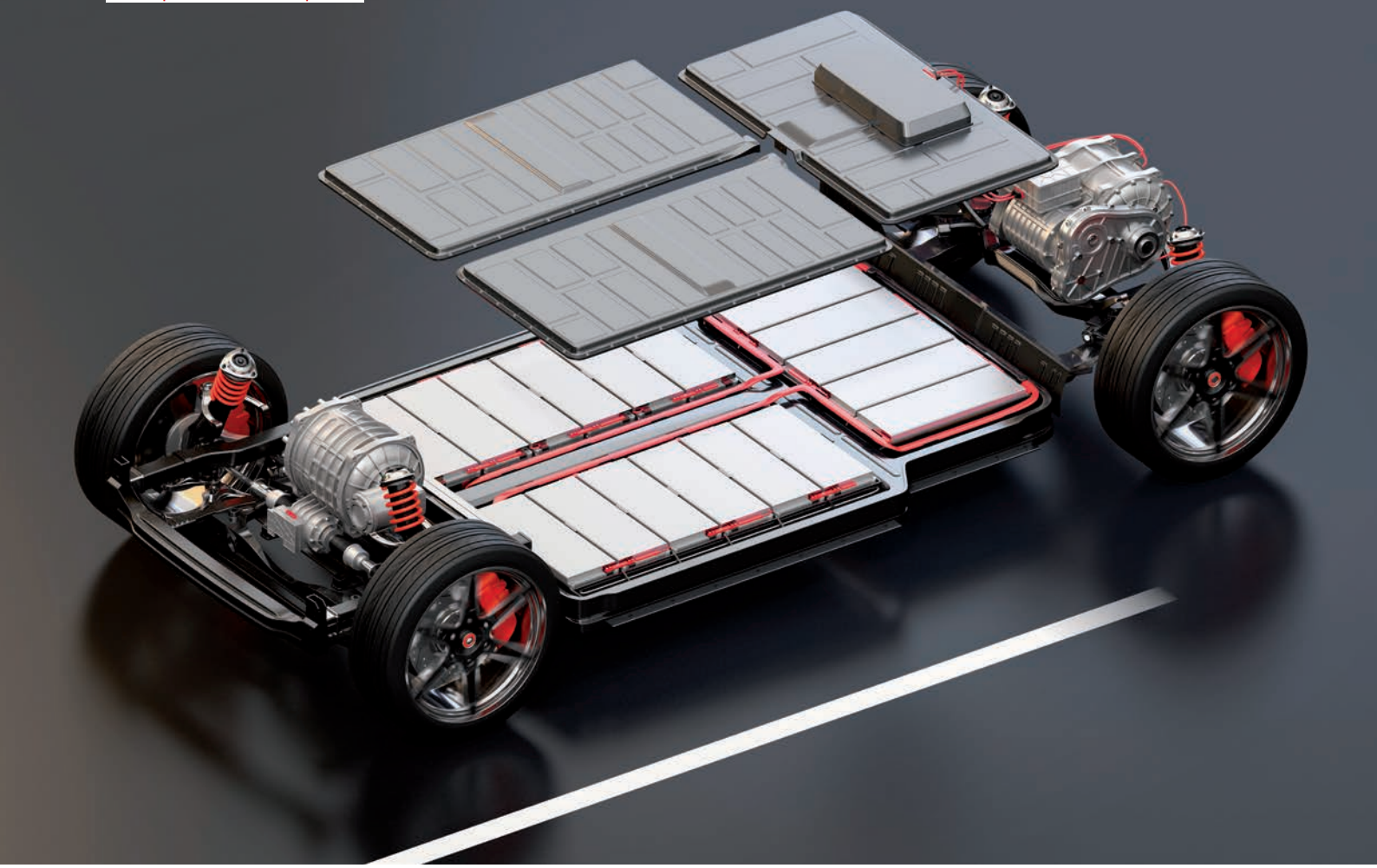


BMS HIL Testing Solutions

Design and Test Cutting-Edge Battery Systems with Typhoon HIL Solutions

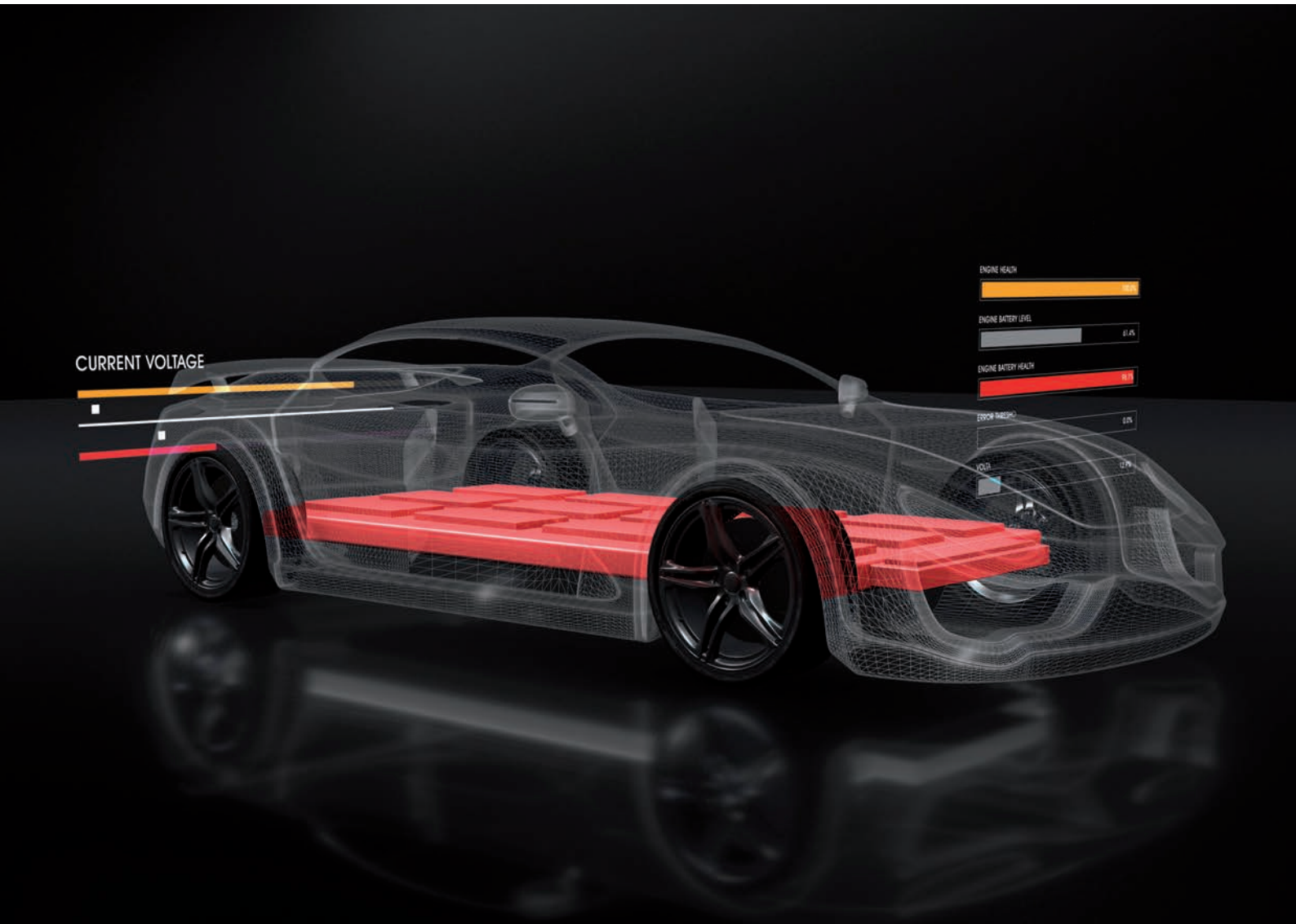
www.typhoon-hil.com

Lead the Charge

Elevate BMS verification and validation with Typhoon HIL Solutions

In the rapidly evolving landscape of electric vehicles, the accuracy and reliability of battery management systems (BMS) are crucial for safety, efficiency, and longevity. Verifying and validating these systems is challenging due to their complexity and safety requirements. Therefore, thorough testing is essential for optimal performance and compliance.

Typhoon HIL's BMS solutions emerge as an essential tool for engineers focused on elevating and optimizing battery management. With our integrated testbed and high-fidelity models, you can confidently navigate the complexities of electrified transportation.



BMS HIL Testbed: features and benefits

Typhoon's BMS HIL Testbed offers a comprehensive suite of features designed to streamline and enhance the testing of battery management systems.

- Scalable Smart Cell Emulators with detailed and nuanced cell models, providing flexibility and adaptability to diverse testing requirements
- Seamless integration allows for precise emulation of battery cells under various conditions, ensuring thorough validation of BMS functionalities
- Turnkey solution that offers all the essential signals and communication protocols, such as DC Pack Voltage, Shunt Emulation, Thermistor Emulation, and CAN/CAN-FD
- Scalable architecture that supports battery systems ranging from 60 V to 800 V, ensuring versatility across different vehicle models

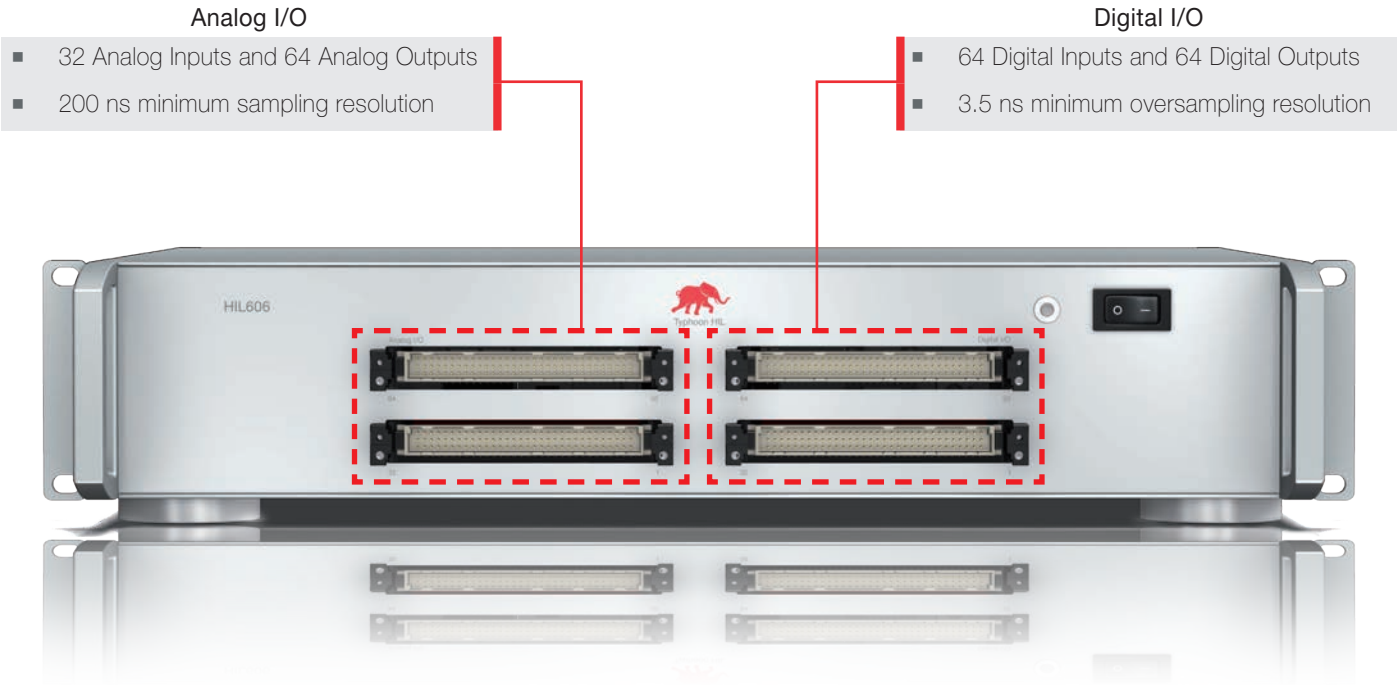
Empower Battery Systems Testing

Advanced real-time simulation

At the core of the BMS HIL Testbed is the latest generation HIL606 real-time simulator, providing a robust and reliable foundation for all testing activities:

- **Reliable performance with HIL606:** With the speed of our latest 4th-generation devices and the power of our 6-series, 8-core processors, you can control more high-fidelity models than ever before. Additionally, you can take advantage of unique connectivity options, such as USB 3.0, 4x Ethernet, 2x EtherCat, 2x CAN FD, 2x QSFP, General Purpose IO (GPIO), and more.

- **Accurate simulations of extreme scenarios:** The HIL606 can perform highly accurate real-time simulations designed to replicate and validate various scenarios and extreme cases, such as failure conditions. It enhances test reliability by allowing engineers to validate BMS responses to critical events and ensure compliance with safety standards.



Smart Cell Emulator

The Smart Cell Emulator provides detailed exploration of cell behaviors, enabling critical insights for enhanced testing and analysis. With precision on the order of 0.05% full-scale accuracy, it ensures that the emulated signals closely match real-world conditions.

It includes sophisticated fault insertion features that allow for comprehensive testing of the BMS's fault detection and response mechanisms. This is crucial for uncovering potential system vulnerabilities and ensuring the robustness of the BMS under abnormal conditions.

Technical highlights

Channels: Up to 256 (32 x 8 cards)

Channel isolation: Up to 1kV

Communication: CAN FD or CAN

Calibration: Automatic

Fault insertion: Short, open, reverse polarity

Operation mode: CV or CC

Output Voltage Characteristics:

- Range: ± 8V
- Accuracy: < ± 0.5mV ± 0.05% FS

Output Current Characteristics:

- High current range: ± 1A
- Accuracy: < ± 0.2mA ± 0.05% FS
- Low current range: ± 10mA
- Accuracy: < ± 5µA ± 0.05% FS

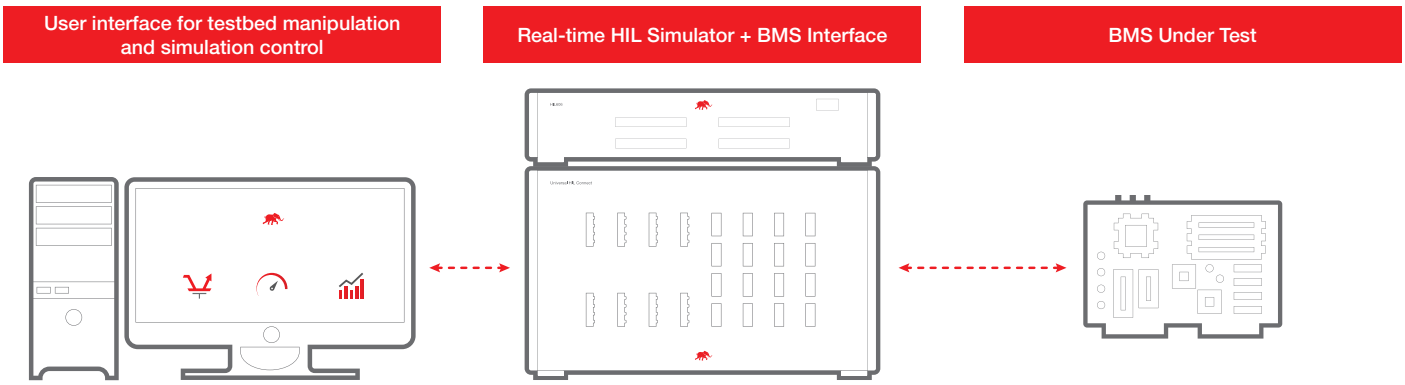
Temperature Measurement:

- Using off-board PT1000
- Accuracy: ± 0.5ºC ± 0.25%

Cutting-Edge BMS Solutions

BMS HIL Testbed specifications

Component	Specifications
Real-Time HIL Simulator	HIL606
Smart Cell Emulators	Up to **256 channels** (32 x 8 cards) Isolation: Up to **1kV**
Thermistor Emulators	Up to **96 channels**, **10kΩ NTC** Accuracy: **0.1%**
Isolation Resistance Emulator	**2 channels**, up to **65MΩ** Accuracy: **1%**
Shunt Emulator	Voltage range: **± 250mV** Accuracy: **± 0.25mV ± 0.1% FS**
HVIL Interface	Resistance range: **0Ω to 420 Ω** in steps of **60Ω** **Open Wire Fault** capability
Protocols Supported	**CAN**, **CAN FD**, **LIN**, **SENT**, **SPI**
Pack Voltage Emulation	Up to **1kV**
Fault Insertion Unit	Supports **open circuit**, **short circuit**, and **reverse polarity** fault insertion
Controllable Power Supplies	Provides adjustable power supply outputs for various testing requirements
Industrial PC	Integrated **industrial-grade PC** for robust operation and control



Ensuring reliability and compliance

Integration of isolation resistance emulation

Ensures systems remain robust and reliable under varied conditions. This feature allows for testing the BMS's ability to detect and respond to insulation faults, essential for maintaining safety in high-voltage battery systems.

Main Power Control Unit (MPCU)

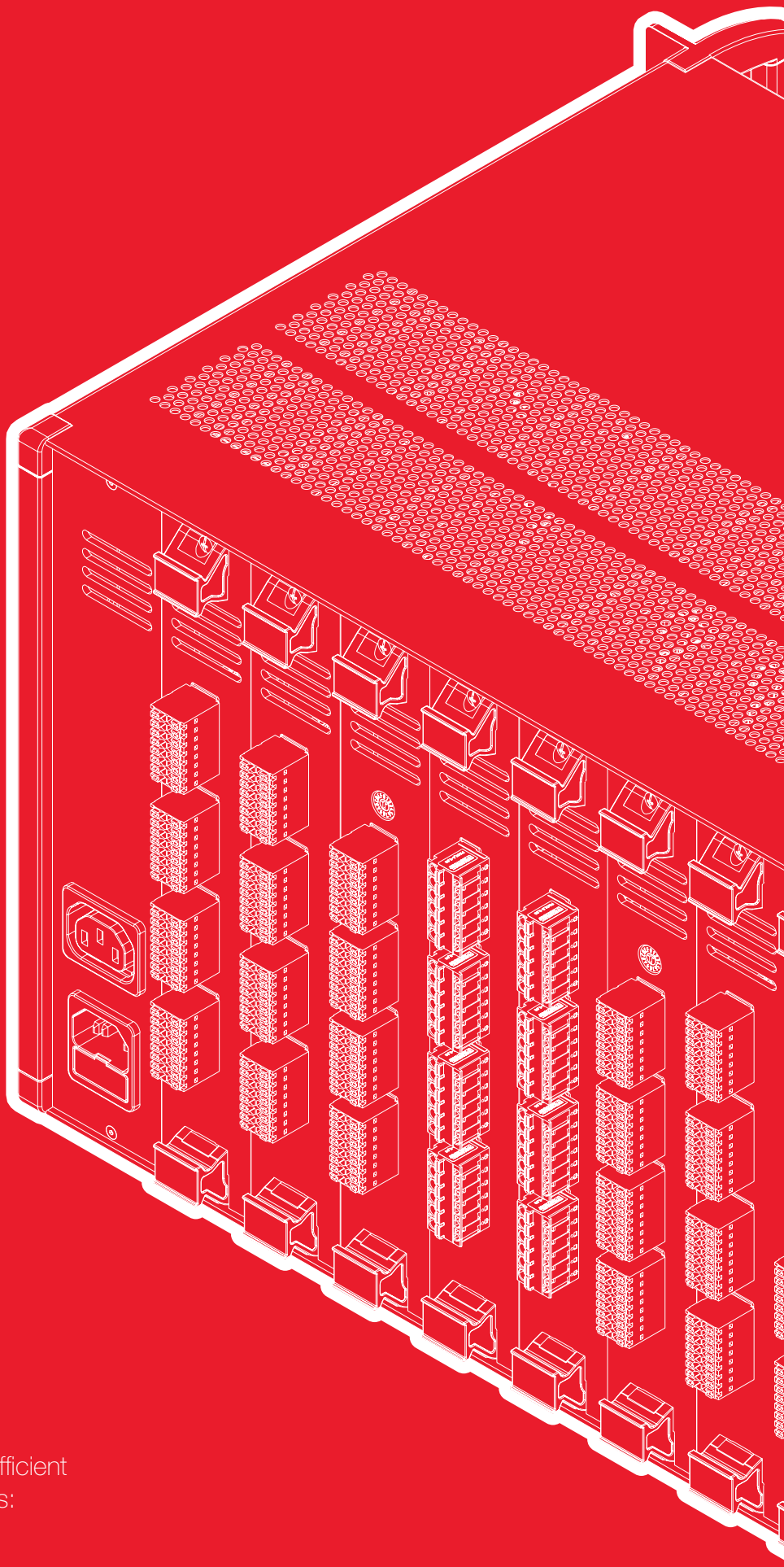
Operates the bench power and provides safety for the operator. Equipped with automatic disconnect capability and an emergency switch.

DC PSU

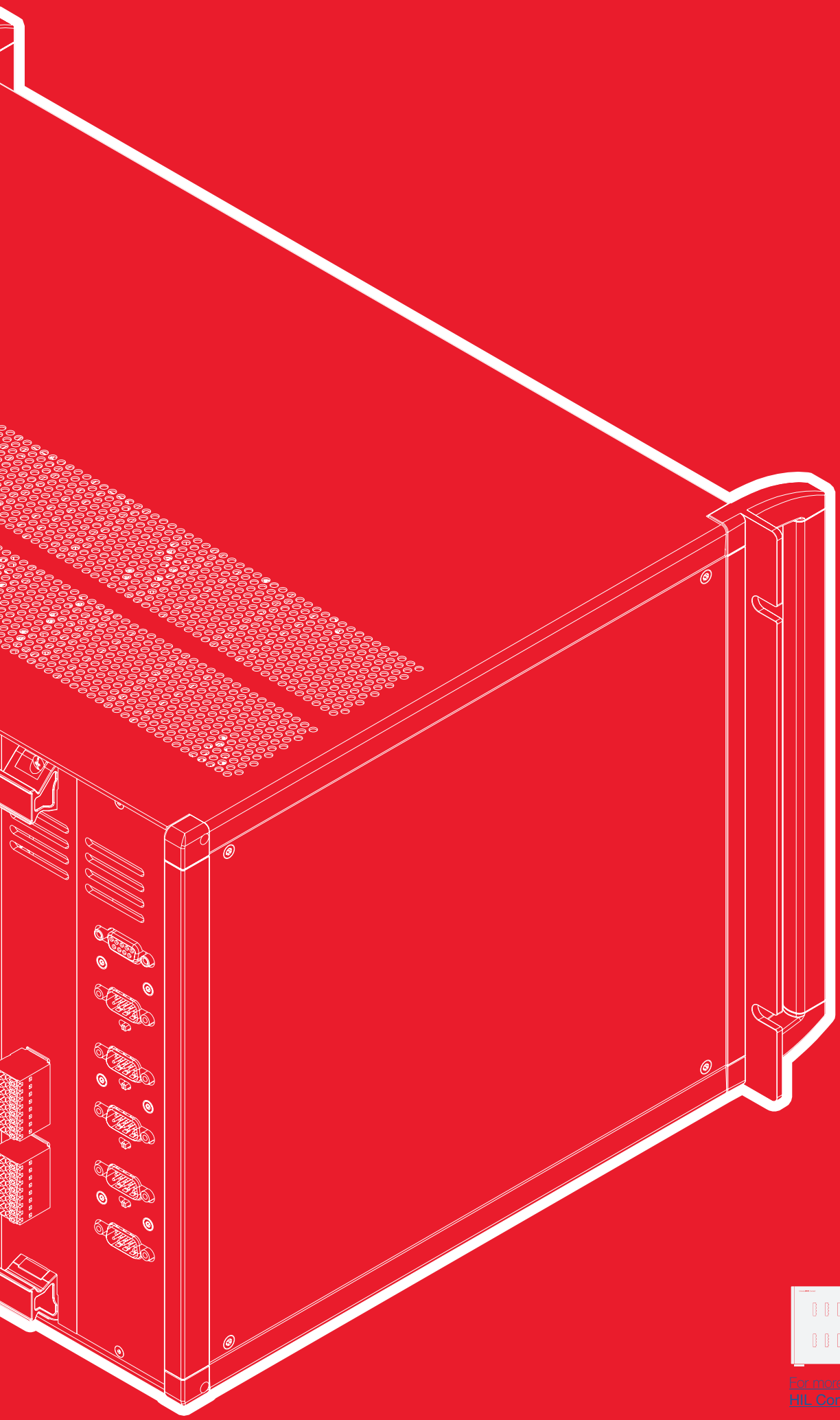
Multi-Channel DC Power Supply used for battery (KL15, KL30) simulation and board power.

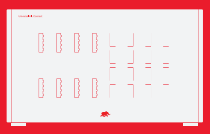
HIL Connect

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



BMS Interface configuration enables efficient testing of all key BMS functions, such as: accuracy of cell voltage measurements, balancing algorithm verification, and cell temperature and battery current measurement. All these are key parameters for accurate estimation of battery SOC, SOP, and SOH.





For more information on available
HIL Connect interface cards.

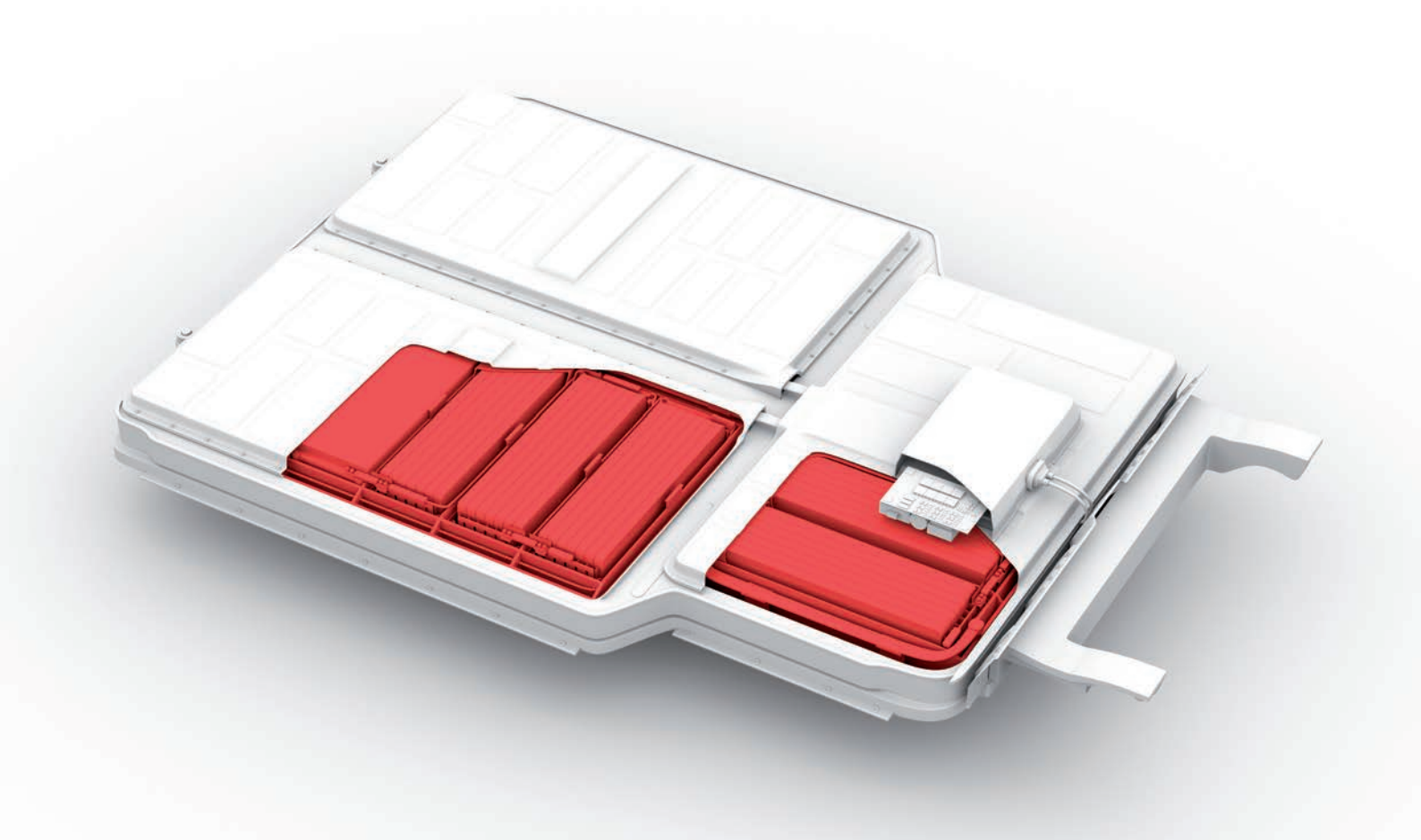
Next-Gen Software Modeling and Real-Time Monitoring

Modeling capabilities

The Typhoon HIL Control Center (THCC) is our flagship software package, serving as the central hub for our tools used to configure, control, and monitor HIL simulations and experiments

The Typhoon HIL Schematic Editor is a powerful tool that allows you to create detailed models of battery systems, power electronics, and control algorithms, facilitating advanced insights into system behaviors

The simulation capabilities of Typhoon HIL Solutions cover a wide range of battery chemistries, including lithium-ion, nickel-metal hydride, and more. This versatility enables adaptable explorations and testing across different battery technologies



SCADA model interface functionalities

Interface with customizable widgets

Tailor the interface to your specific needs with Typhoon HIL's highly intuitive graphical interface augmented with customizable widgets. It offers unmatched control over monitoring processes.

Dynamic visualization of simulation data

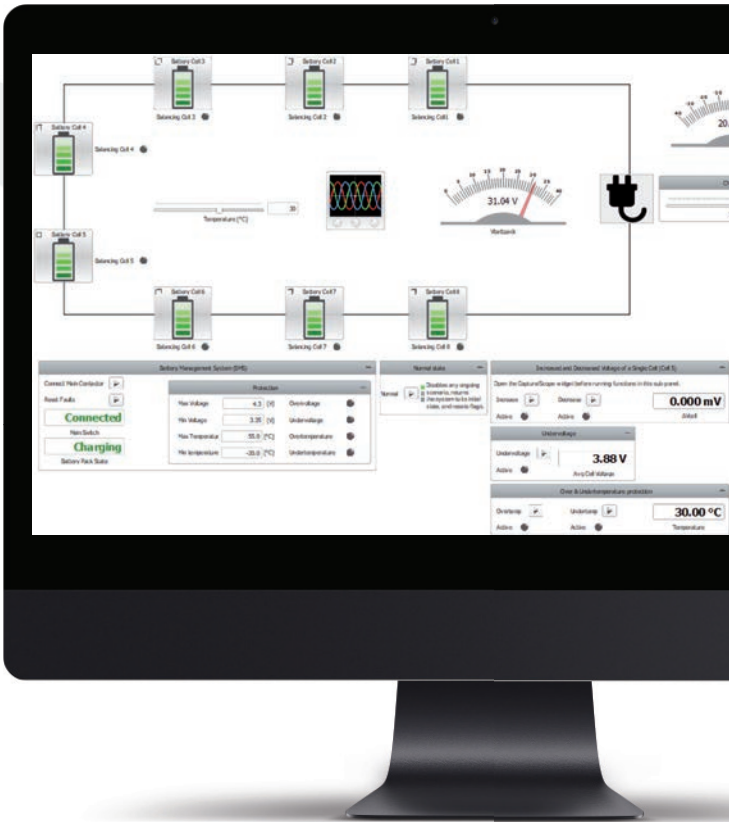
The dynamic visualization of all simulation data and results ensures that users can make informed, data-driven decisions based on real-time insights into system performance.

Automation for complex procedures

TyphoonTest is our signature testing framework that helps you speed up test automation using the Typhoon API based on Pytest, a widely used open-source framework for Python. It streamlines the process of creating test scenarios, capturing signals, applying transformations, and analyzing your data.

Comprehensive control and monitoring

The HIL SCADA enables comprehensive control and monitoring of all testbed operations, ensuring no detail is overlooked. This maximizes operational efficiency and provides real-time feedback during testing.



Streamlined Implementation and Operation Processes

Take advantage of a comprehensive solution

Integration with TyphoonTest

TyphoonTest facilitates efficient test execution, eliminating redundancies and enhancing performance. It provides a unified environment for test development, execution, and analysis.

Remote bench operations

The BMS HIL Testbed enhances remote bench operations through industrial PCs to ensure scalability and remote accessibility. It allows you to conduct testing and monitoring from various locations.

Dedicated slots for DUT integration

Typhoon HIL BMS Solutions provides dedicated slots specifically for devices under test (DUT) integration. This maximizes efficiency and accuracy in testing, facilitating easy connection and disconnection of DUT.

Alignment with DevOps processes

The alignment of Typhoon HIL Solutions with DevOps processes ensures that development and operational workflows remain streamlined and efficient. This enables continuous integration and deployment practices, enhancing collaboration and productivity.

> Our BMS HIL Testbed is more than just a collection of advanced tools; it's a comprehensive solution designed to simplify and elevate the entire BMS validation process. With our seamless integration of cutting-edge hardware and real-time simulation, we're empowering engineers to push the boundaries of electrified transportation.

Igor Pintaric
BMS Product Manager
Typhoon HIL

Wiring and connectivity configurations

ODU Connector provides a robust and reliable DUT-side connection, simplifying the changes on or between DUTs.

Comprehensive multi-channel DC power supply facilitates extensive LV battery emulation across systems. Allows for independent control of multiple voltage channels, simulating various battery configurations and conditions.

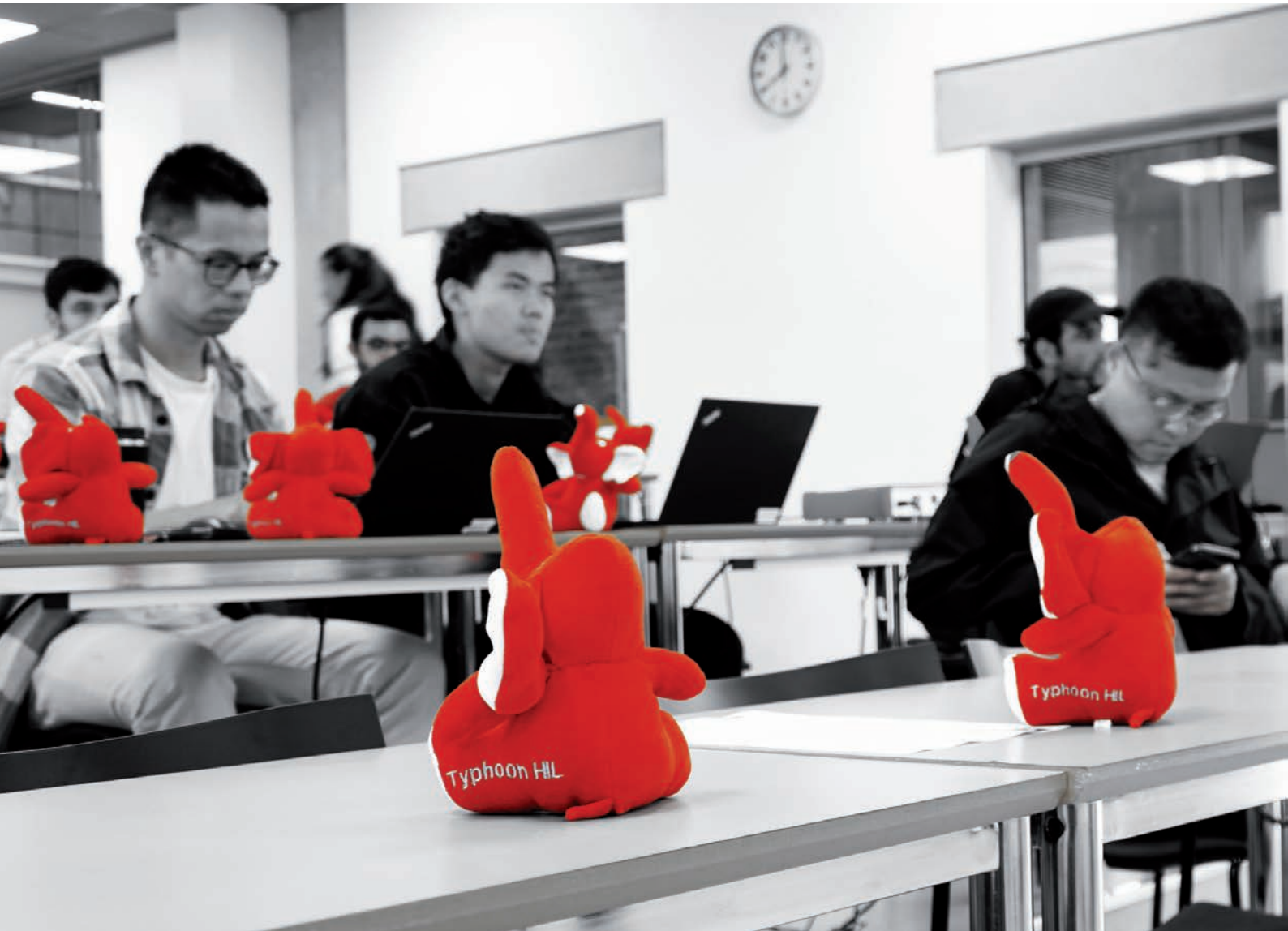
Shielded cabling for noise-sensitive signals to ensure signal integrity and mitigate potential interference, preserving data accuracy, enhancing the reliability of test results.

Empowering Users by Training and Support

HIL Academy

Typhoon HIL provides free access to the HIL Academy, designed for professional skill enhancement and the development of technical expertise. It offers a range of courses and resources that help you develop proficiency in HIL testing and modeling.

With the HIL Academy you have access to tailored training sessions that focus on your specific needs. These personalized training programs offer guidance and support to help you get the most of our solutions and address unique challenges in your projects.



Technical support and consulting services

Typhoon HIL provides ongoing technical support and consulting services, ensuring that you are never without expert assistance. This dedicated support helps you overcome roadblocks and optimize HIL verification and validation.

For more information about support services.

Complementing personalized support, **Typhoon HIL offers a comprehensive knowledge center and a wealth of online resources**. These include application notes, hardware and software manuals, blog articles, videos, and webinars, all readily available to users.

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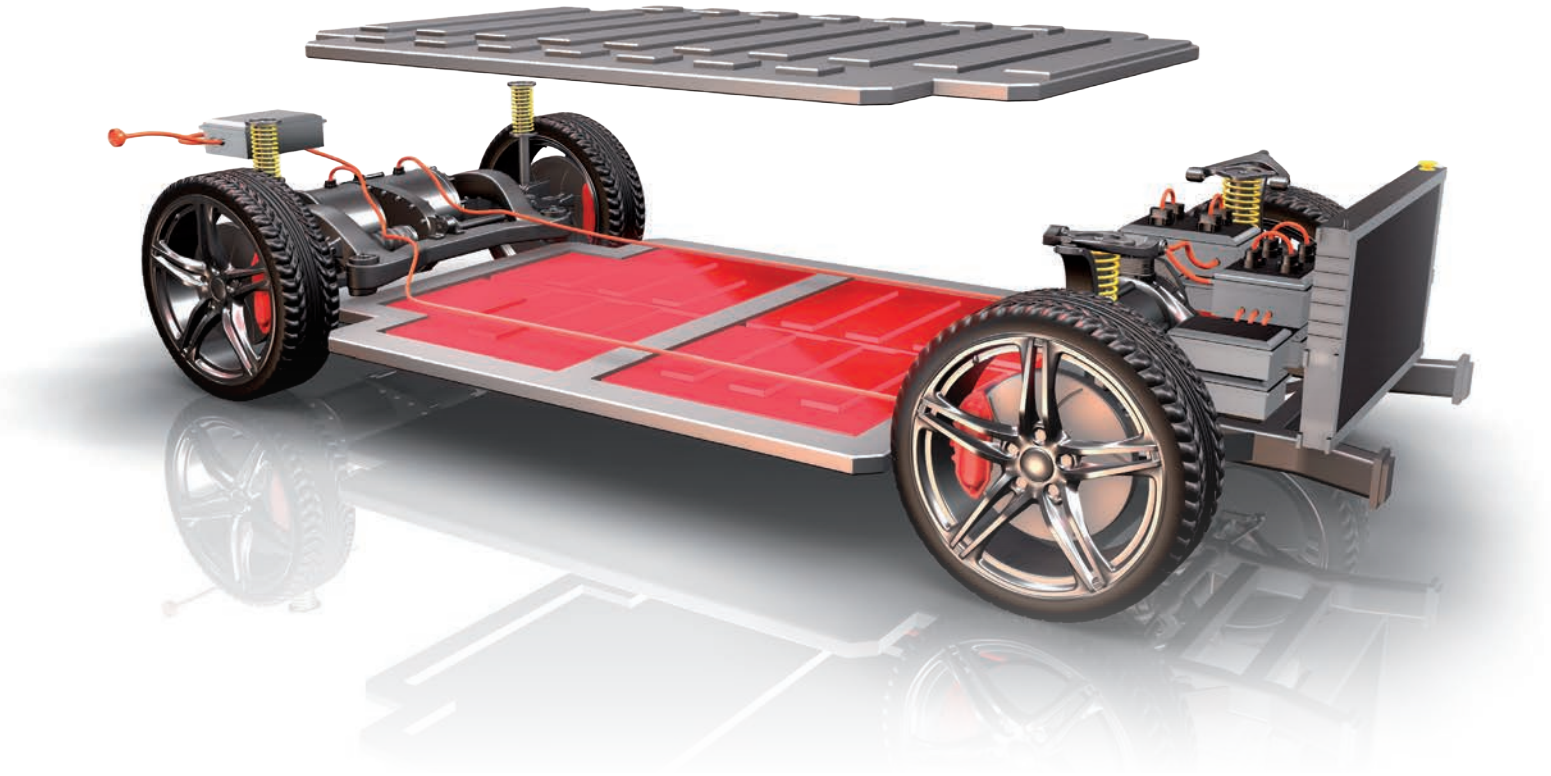

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