HORIBA
Explore the future

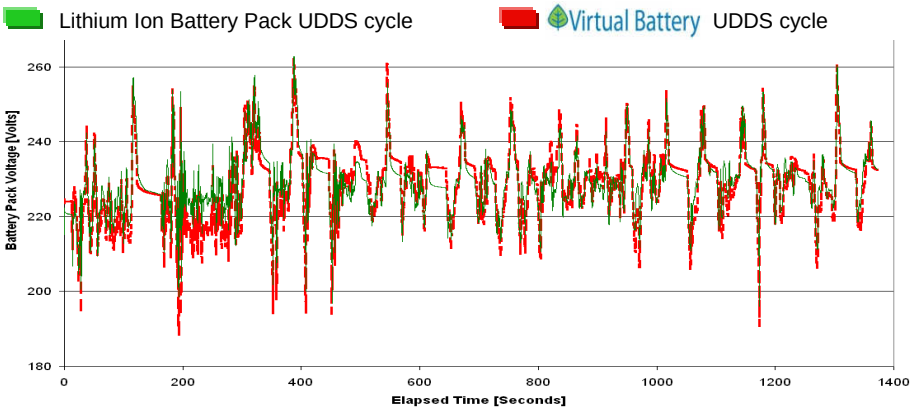
Virtual Battery

Another HORIBA Hybrid Team Solution

Advanced Battery Simulation for Development and Validation of PHEV, HEV, and Extended Range EV

HORIBA's Virtual Battery provides the most accurate, cost-effective, and convenient battery pack simulation solution available today for developing, calibrating, validating, and optimizing your hybrid product. Virtual Battery makes possible:

- Parallel development of engine, transmission, electronics, auxiliaries, and battery packs
- Verification of "what-if scenarios" on the test stand *without* actual battery specimen
- Simulation of stress and extreme environmental conditions *without* damaging or destroying batteries
- Battery pack development



Virtual Battery Closely Replicates Actual In-Vehicle Battery Performance – RMS Voltage Difference of <1%

Save Time and Money

Virtual Battery shortens development cycles and reduces cost:

•Accurately replicates real-world in-vehicle battery performance

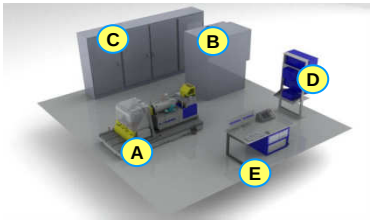
•Enables parallel development of power trains and battery packs

•Eliminates need for multiple battery pack prototype builds

•Allows critical evaluation of and feedback into battery design process

Accurate and Reliable

- Side-by-side tests show excellent correlation between the per-formance of the physical vehicle battery pack and Virtual Battery (<1% RMS error on voltage)
- Provides fast, accurate control
- Designed to withstand harsh electrical environments



HORIBA E-Motor Test Stand (EMTS) with Virtual Battery

- A AC Dynamometer, Headstand, and Bedplate
- B Fluid Conditioning Unit
- C Variable Frequency Drive with Virtual Battery
- D Hybrid Power Interface & Safety Lockout Enclosure
- E STARS Test Automation System

Flexible, Easy to Use

- Battery packs are built-up from cell level with predefined or custom chemistries
- Model parameters and battery controls can be changed even while a test is in progress
- Intuitive GUI interface is available to any networked computer using a web browser.

3 Ways to Implement HORIBA Virtual Battery

1 Include Virtual Battery in your existing or greenfield test stand

Advanced Battery Pack simulation is provided with a combination of high quality DC Power Supply and SPARC Virtual Battery Controller. This system can be integrated into an existing or new drivetrain or vehicle test stand. HORIBA can also supply HEV/EV test components such as an automation system, dynamometers, thermal management, power interface, and other accessories that best fit your application needs.

2 Upgrade existing simulation system with Virtual Battery

HORIBA's SPARC Virtual Battery Controller is engineered for quick, easy integration with nearly any customer-supplied programmable DC power supply.

3 Add Virtual Battery software to existing HORIBA SPARC Controller

If your test system already has a HORIBA SPARC controller, Virtual Battery can be added to provide the lowest cost of implementation.

HybridTeam

www.HORIBA.com - 800.346.7422

Virtual Battery

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Comprehensive, Flexible, and Cost-Effective Battery Simulation Solution

The Battery Pack Model

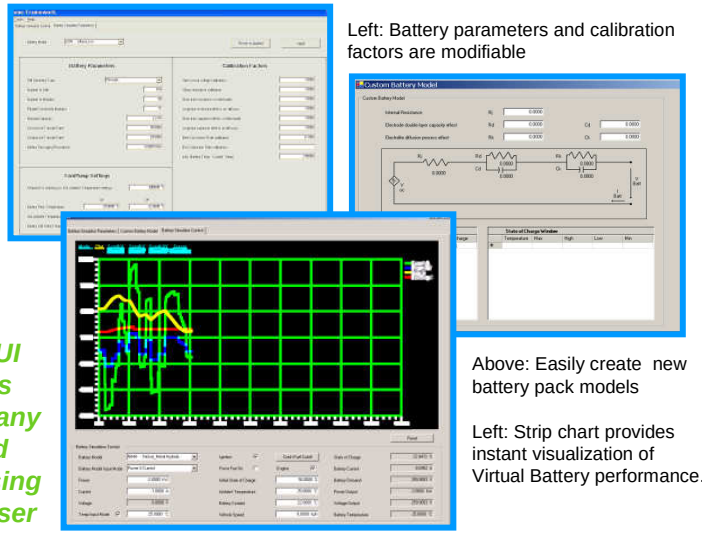
Built-In Chemistry Parameterizations:
- Lithium Ion
- LiFePO4
- NiMH
- Pb-acid

Ultra Capacitor modeling provides three time sequence phases to reflect short, medium, and long term effects.

Model parameters and battery controls can be changed and optimized even while a test is in progress

Flexibility to create customized battery packs by identifying parameter values for:

- Open Circuit Voltage
- Battery Cell Capacity
- Ohmic Resistance, Resistance and Conductance of Short/Long Time Effect
- Maximum Available Current
- Discharge and Charge Power Limit
- Operating Pack Temperature Limit
- Cell Geometry (cylindrical/prismatic)
- Numbers of Parallel / Series Connections



Left: Battery parameters and calibration factors are modifiable

Above: Easily create new battery pack models

Left: Strip chart provides instant visualization of Virtual Battery performance.

Intuitive GUI Interface is available to any networked computer using a Web browser

Control Parameters

High-speed access and control of:

- Power Limits (Amp / V / W)
- State of Charge (SOC)
- Depth of Discharge (DOD)
- Thermal Control
- Slew Rate
- Cell Numbers

Test Conditions

- Driving cycles from automation system via CANbus, Ethernet, Analog or other
- Environmental conditions
- Stress (maximum performance)
- Battery age
- Battery pack thermal management

External Influences

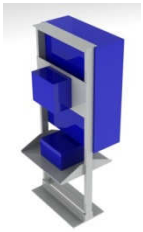
Real-time (1 kHz) interface to external Simulators and automation system for simulation of:

- Accessory Power demand
- Current or Power demand from E-motor
- Ambient Temperature
- Cabin Temperature
- SOC Windows
- Vehicle CANbus residual bus simulation

Supporting Hardware Options

Safety and Convenience

Hybrid Power Interface and Safety Lockout Enclosure



- Convenient in-cell power connection for up to two E-Motors with access to signals for measurement devices.
- Easy switch between battery pack and DC power supply without E Motor disconnection.
- Voltage indicators for power on/off indication
- Isolation monitoring device to detect ground fault
- E-Stop tie-in offers safe removal of power and PLC communication to TAS for proper shut down
- PLC communication to a test automation system for proper shut down

High Quality Power Source

DC Power Supply

- Very low ripple and fast response (10 ms) assures accuracy during transient modes
- True voltage symmetry -> protects electronics from unrealistic voltage to reference ground
- Voltage matching start-up -> prevents damaging current rush
- Power circuit health and safety monitoring

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