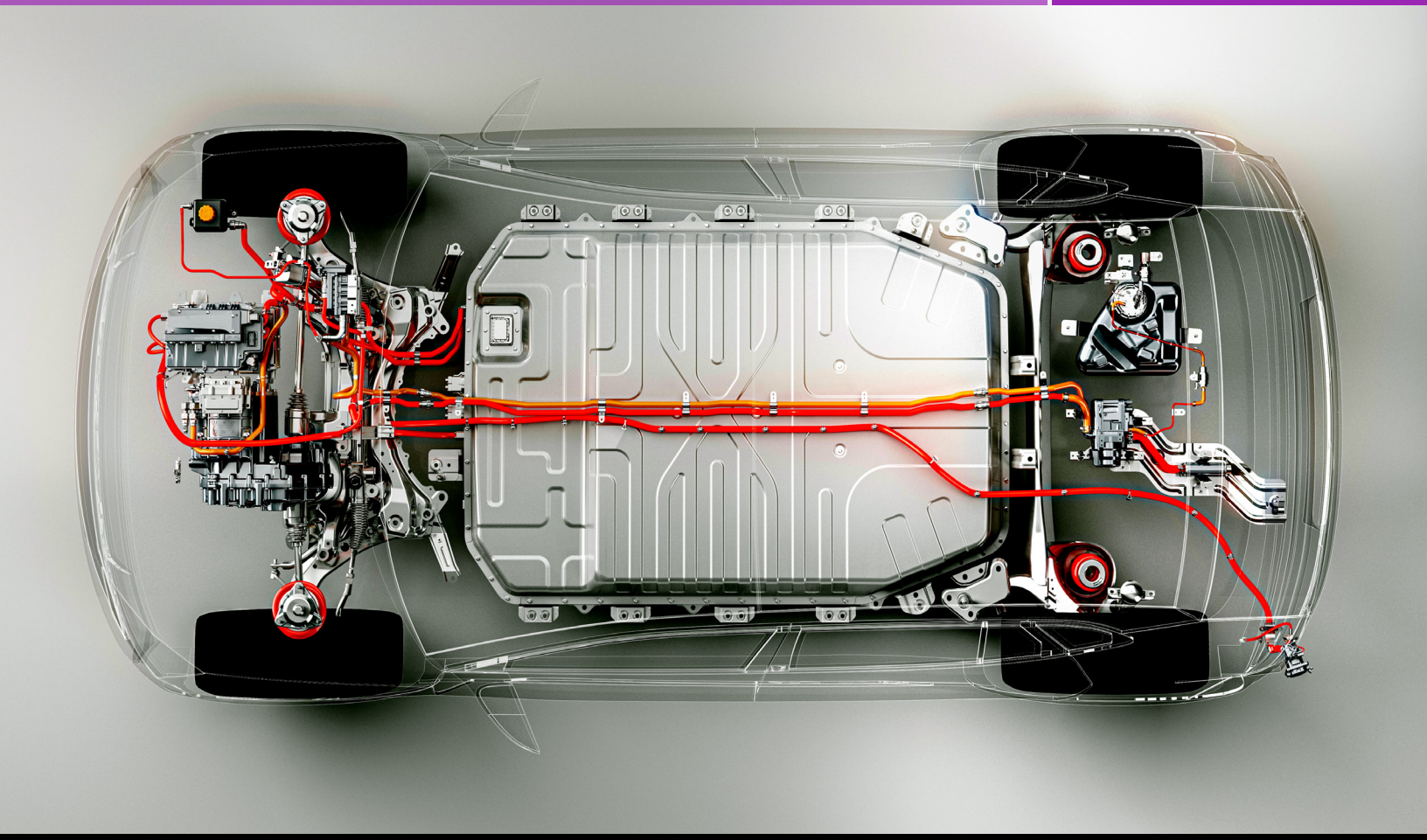
WHITE PAPER



Investing in EV Battery Testing — Benefits for EV Battery Designers

KEYSIGHT

Battery Design — The Epicenter of the EV Ecosystem

Phasing out gas-powered internal combustion engines (ICE) and moving towards clean energy electric vehicles (EVs) brings substantial technology investments to deliver EVs to the mainstream market.

Government legislation to eliminate or limit the production of ICEs by 2035 is creating a surge in demand for the EV ecosystem. This in turn, is driving demand for more efficient ways of EV battery testing.

Meeting product performance and market demands

At the epicenter of this increase in market demand is the battery — the subsystem of EVs that makes a sustainable electrified transportation system possible.

The objective is to develop batteries that improve durability, power density, and operational safety using a fast, cost-effective, and energy-efficient process.

One important aspect of battery design is performance testing. It is a critical process that includes the design, production, and system integration phases to ensure that all batteries entering the open market are of the highest quality for safety and operational performance.

EV battery testing can be an expensive, time-consuming task without the latest systems and methodologies. Using both best practices and state-of-the-art technologies throughout the battery design process can help you resolve battery design challenges quickly and easily.

This whitepaper explores the importance of investing in an end-to-end EV battery test system. It also discusses how investing in cutting-edge technologies can improve the quality and performance of EV battery designs to help battery designers meet the following key market drivers without compromising range performance, power density, and safety:

- Improve time to market.
- Decrease operational costs.
- Reduce energy consumption.

Best Practices

The testing and verification of EV batteries is an integral part of ensuring performance and safety when a product enters the marketplace. Thorough testing during the research and development (R&D) phase can also improve time to market, cost efficiencies, and reduce energy consumption. The following are three areas to consider when focusing on battery testing to improve time-to-market for the EV battery supply chain.

Example of Battery Test Lab

1. Perform in-house testing

Test houses are busier than ever, so wait times are longer, and designers are experiencing delays. Relying on external test facilities can add weeks to your development time frame, putting you at a disadvantage against the competition.

Purchasing in-house test equipment can keep testing wait times to a minimum. Scheduling in-house test appointments will reduce the time it takes to receive a complete set of performance data for your latest prototype.

While the capital investment requirements for such equipment may seem prohibitive, the time savings can deliver a substantial return on investment at a time when competition is increasing.

2. Identify performance and safety issues

It is important to consider the impact of poor performance. Omitting non-compulsory testing can lead to performance or safety issues that go undiscovered. The process of recalling a product further down the production process is costly. The time it takes to rectify the issue significantly affects the time it takes to bring a fully operational version to market. In a market evolving at such a quick pace, these delays are not justifiable.

Omitting testing from the earlier design and production stages may feel like a shortcut to saving time. However, in reality, it is a high-risk strategy that could result in extensive time-to-market delays if an issue remains undetected.

3. Focus on testing to lower operational costs

A well-designed test laboratory can drive tangible operational cost savings for those working in the EV battery R&D sector.

Some high-performance, state-of-the-art battery test systems provide up to 96 percent energy efficiency. The remaining four percent of the available energy returns to the grid for other uses.

The technology minimizes the operational costs of a busy R&D lab — both upfront by optimizing the installation of cooling infrastructure, and on an ongoing basis, via a notable reduction in energy costs.

Identifying the testing requirements of cell designers

Modularity and flexibility operations for cell designers, R&D studios, and small start-ups are key to formulating lean processes and designing high-quality battery cells quickly.

In the upstream design stage, the investment shows in the quality of the end product. Cost-effectiveness is critical to sustaining a successful R&D facility — correcting design flaws must be fast, cost-efficient, and accurate. Test systems such as charge/discharge platforms and lifetime cell cycling equipment must evaluate and verify designs quickly to deliver complete data sets so designers can move to the next set of changes.

Ideally, test equipment should have a compact footprint and the ability to deploy different channel configurations as cell requirements change and capacities grow.

In addition to the individual challenges EV battery designers face, there are also macro challenges that the industry must face together.

Macro Testing

EV sales are increasing, with 6.75 million units sold in 2021, 108 percent more than in 2020. This increasing volume equates to thousands of hours of testing that ties up vast quantities of test equipment for substantial periods. As the market moves at a fast pace to fuel growth, these vast and lengthy testing procedures can create design bottlenecks and time-to-market delays.

Such an increase in testing creates a need to manage and evaluate vast amounts of data efficiently. Choosing lab operations software that offers data integrity and traceability functionality is one way of managing high volumes of test data. Keysight's PathWave lab operations software for battery tests is one example of such a solution. This software offers easy-to-use, highly accurate data analysis tools alongside workflow management functions that streamline your test lab for optimal efficiency.

Testing and validation during the design phase

As batteries become more technologically advanced, the level of testing and validation during the design phase increases – a positive step for checking faults in the design before moving to production. These additional test requirements indirectly affect external test facilities that cannot meet demand.

The solution for many design laboratories is to invest in highly accurate, in-house test equipment so that prototypes are validated quickly. This process supports the EV ecosystem in bringing to market the latest battery technologies as quickly as possible.

Complex system testing

In addition to power electronics, there are many other test scenarios to consider, including using a battery management system and a temperature/climate chamber to test prototypes under different climate conditions.

The dynamic control of these variables enables test engineers to set and change values without user intervention. Data from these additional sources must undergo evaluation during the test sequence without post-processing. The test system must display the data clearly during the test so the users can gauge whether the test is working well or whether test termination is necessary.

Consequently, it must be possible to synchronize control of all components in the test environment while also recording measured values and their use as a variable during the remainder of the test sequence.

Keysight's SL1091A Scienlab Energy Storage Discover (ESD) software is an intuitive software package that enables users to conduct tests that deliver accurate, stable, and reproducible results.

This state-of-the-art solution enables time synchronous control of all battery test systems for cells, modules, and packs, including test environment components. It offers maximum transparency, a range of self-explanatory test programming functions, and targeted evaluation.

Test scenarios include:

- function, aging, environment, and performance tests
- standard and standard-compliant tests (ISO, DIN, EN, SAE)
- resistance (internal), charge, energy, capacity, efficiency, cyclic, calendrical durability, temperature behavior, and mechanical resistance
- analyze durability, range, and efficiency
- electrochemical impedance measurement and cyclic voltammetry

Summary

Emulating realistic test environments is essential for early defect removal during the EV battery design process. The Keysight SL1700A Series Scienlab battery test system — pack level enables the emulation of future battery pack applications so that design engineers can test high-power battery packs comprehensively.

The performance and safety testing and verification of cells are essential during the early stages of EV battery development. Keysight's SL113XA | SL100XA Series Scienlab battery test system – cell level provides reliable test systems for precise and reproducible measurement results.

Learn More

You can discover more about Keysight solutions by visiting us at:

- Battery Test Systems
- HEV / EV / Grid Emulators and Test Systems
- PathWave Lab Operations for Battery Test

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