



The Impedance Measurement Box is capable of acquiring multipoint impedance spectra in as little as 10 seconds, providing a detailed picture of a battery's condition and state of health.

Impedance Measurement Box

Breakthrough device offers battery state-of-health data in near real time

The dependability of energy storage devices, mainly batteries, is becoming increasingly important to consumers, industry and the military. As battery technology becomes more complex and users' expectations become more pronounced, there is a pressing need for highly accurate assessment techniques that can give state-of-health readings in conditions approaching real time.

Until now, embedded monitoring has relied on passive measurements of voltage, current and temperature, or on impedance methods that can take as long as 10 minutes. Current and former researchers in Idaho National Laboratory's Energy Storage Group have developed the Impedance Measurement

Box (IMB), a device that can generate the necessary data in 10 to 15 seconds.

Winner of an R&D 100 Award in 2011, the IMB provides more than a single-point measurement and can generate data during operation that is more useful for assessing battery

health. It also can be used on batteries prior to installation, confirming health before entering active service or during regular maintenance.

INL researchers developed the invention with help from Montana Tech, Motloch Consulting and Qualtech Systems Inc. and



The Impedance Measurement Box can assess a single battery cell or battery strings, which are commonly used in many consumer applications.

As a combined hardware and control software unit, the Impedance Measurement Box is both easy to use and flexible to apply to different system types.



with support from the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy's Vehicle Technologies Office.

MEETING THE CHALLENGE

Impedance is defined as opposition to the flow of alternating electrical current, and a key performance measurement that correlates with more complex parameters, such as resistance and power capability. Up to this point, standardized impedance measurement techniques required expensive and delicate laboratory equipment, which precluded integrating evaluation of batteries in place. IMB directly measures the wideband

impedance spectrum in seconds during battery operation with no significant impact on service life.

The IMB diagnostic tool uses five key steps to obtain the vital impedance spectrum measurement results. First, it generates an input signal that consists of sinusoids, which are strategically separated by a known frequency spread and summed together. This combined signal is injected into the energy storage device (e.g., battery). The response is then captured by a data acquisition system for the final steps, data processing and analysis, and display.

LICENSING AGREEMENT

IMB is now at the center of a licensing agreement between INL and Dynexus

Technology, a Colorado company that seeks to commercialize the device for use in applications ranging from backup battery power systems to plug-in electric vehicles (PEVs). Automotive manufacturers can implement the functionality of the IMB hardware systems with pre-existing components.

BEYOND AUTOMOTIVE APPLICATIONS

In addition to testing PEV batteries, the IMB diagnostic tool can be used to test batteries for many uses including military, telecommunications and critical infrastructure.

The latest development is a third-generation device, able to assess a 50-volt system, making it applicable for testing on battery modules (which contain multiple cells). The overarching technological purpose of IMB is the development of smarter and better energy storage and management systems that can more accurately detect pending failures, assist with warranty, and enable smarter management for extended battery life. By keeping careful track of the safety and performance of batteries as they age, manufacturers and their engineering teams can make more informed decisions about the state of health and battery life.

FOR MORE INFORMATION

Technical contact

Tanvir Tanim

208-526-5713

tanvir.tanim@inl.gov

General contact

Ryan Bills

208-526-1896

ryan.bills@inl.gov

www.inl.gov

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