ACCURATE AND FLEXIBLE BATTERY TESTING

How to perform battery testing effectively using the EX1401 isolated thermocouple and voltage measurement instrument

// CHRIS GIBSON

Today, advanced batteries are widely used in transportation, commercial industries, aerospace and defense industries, as well as in portable electronic devices. Battery manufacturing companies put a lot of effort into maximizing the batteries' life and performance so that electronic devices keep operating as long as possible before running out of battery power.

Batteries can be dangerous because they can store high amounts of energy and can explode, potentially causing serious accidents or injuries. However, we all use them every day. For example, lithium-ion batteries are used in clean-air and energy storage applications such as portable chargers. Nickel-based batteries are used in air and rail transportation, standby power applications and emergency lighting. Batteries need to be robust, reliable and capable of being used in extreme conditions to ensure that they cause no harm to humans under any circumstances. Therefore, batteries must be tested with high accuracy to ensure their proper operation.

COMMON MODE NOISE

In battery life cycle testing, multiple cells are linked and tested at once to increase the test throughput. Initially, the voltage of each individual cell can be as low as a few volts. However, after stringing together cells in series, the total voltage becomes much higher. During the test, a voltage DAQ instrument is used to take a voltage measurement from each battery. However, a high common mode voltage is generated, along with so-called common mode noise, causing the acquired data to become very unreliable. Because the common mode voltage is high relative to the actual voltage of the batteries, it is difficult to distinguish between the noise and the actual signal in the acquired data. As a result, data analysis becomes nearly impossible or the test results become very inaccurate.

The EX1401 Isolated Thermocouple and Voltage Measurement Instrument provides up to 500V of channel-to-ground isolation to safeguard against high common mode noise. Each individual channel of the EX1401 is isolated and has exceptional input protection across a wide range of operating conditions. Not only can it ensure measurement integrity, but it protects the instrument from harmful voltages. Without the common mode noise, the acquired data reflects the true signal data. Data analysis can be performed and test results become much more reliable and accurate.

VOLTAGE MEASUREMENT

"BATTERIES MUST BE TESTED WITH HIGH ACCURACY TO ENSURE THEIR PROPER OPERATION"

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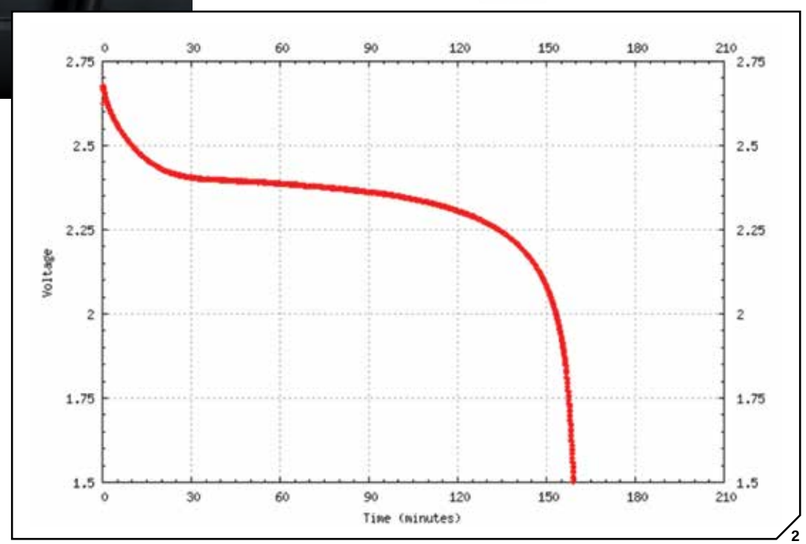
1 // The EX1401 provides up to 500V of channel-to-ground isolation to safeguard against high common mode noise

2 // A typical battery discharge curve



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HIGH SAMPLING RATE WITH TEMPERATURE MEASUREMENT

The performance of a battery depends on its slew rate. The batteries under test are often charged and discharged repeatedly while a voltage DAQ instrument continuously monitors the voltage of the batteries. During the test, the slew rates of the battery are monitored. As a result, a battery discharge curve can be obtained, the battery life can be calculated and the number of recharge cycles can be determined based on the analysis of the slew rates.

In order to obtain a perfect battery discharge curve to characterize a battery, a high amount of voltage data is acquired at a high data sampling rate over a long period of time. The DAQ instrument is required to capture the changes in this voltage at the millisecond level. At least 1000 data points per second are required, so the DAQ instrument has to support a sampling rate of at least 1k Sa/s. Furthermore, the temperature of the battery must be monitored in the meantime to ensure the batteries do not overheat and cause damage when an aggressive current is applied. Along with

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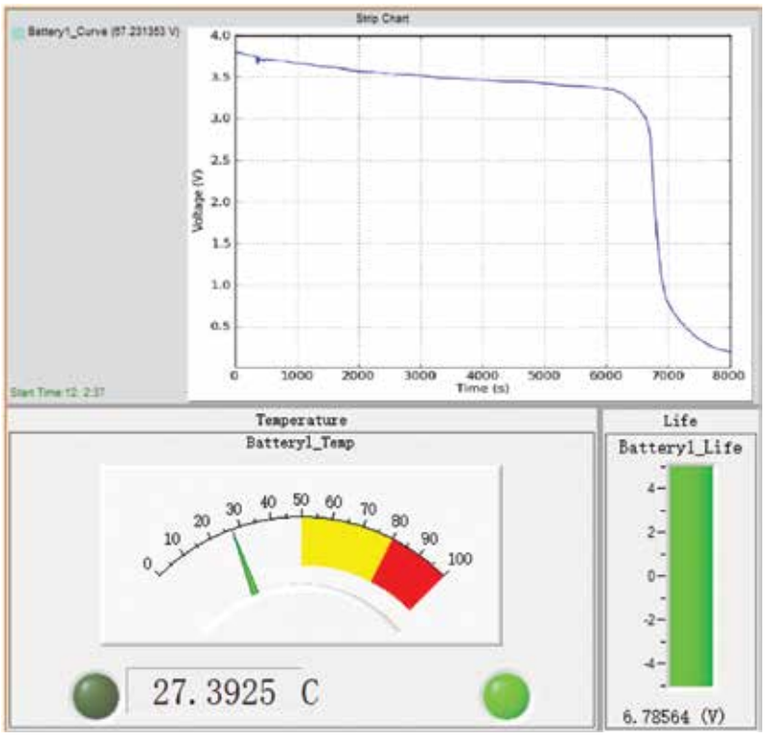

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3 // The display shows the discharge curve, battery life and battery temperature in different formats

the temperature data, the maximum charge and discharge rate can also be specified. However, temperature instruments generally do not support high voltage ranges and high sampling speed. The voltage and temperature instruments have to be set up separately.

The EX1401 supports sampling rates up to 20 kSa/s (thousand samples per second), so capturing the voltage changes at the millisecond level can be done very easily and the batteries' slew rates can be calculated with high accurately. Each channel of the EX1401 is independent and software configurable. Each of the 16 channels can be configured to measure voltage on different ranges or temperature independently. It allows the engineer to use the same instrument to measure both required measurement types. As a result, it can increase the flexibility of the test, reduce the total cost of ownership of the whole system and save storage space. Furthermore, each channel is equipped with an individual 24-bit ADC. During the data acquisition process, data from all channels are synchronized. The EX1401 allows the engineer to connect and test multiple batteries at the same time, increasing the test throughput.

SOFTWARE

The EX1401 supports a completely free of charge turn-key software application called EXLab Express. It can be downloaded from the VTI Instruments website and installed on any PC with a Windows operating system in minutes. EXLab Express provides a Microsoft Excel-like channel configuration table. The user can easily configure any channel to take voltage measurements on different ranges or temperature measurements with different thermocouple types, all on the same page. Once the channels are set up and the data acquisition process begins, the data can be monitored in various intuitive ways.

Eventually, the acquired data can be played back using EXLab Express software or exported to another software application for further data analysis.

The EX1401 is a perfect instrument for battery testing. It provides 500V isolation to safeguard against common mode noise. It supports sampling rates up to 20 kSa/s to capture batteries' voltage changes on the millisecond level. It is also a flexible instrument that supports 16 software-configurable voltage and temperature channels, increasing the flexibility and throughput of battery testing, as well as decreasing total cost and storage requirements. When combined with the free EXLab Express software, which provides intuitive graphical user interfaces for configuring channels, monitoring and recording data, the EX1401 offers everything needed for battery testing. \\

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BETTER STRAIN AND BRIDGE MEASUREMENTS

Recently launched by Ametek VTI Instruments, the EX1403 Precision Bridge and Strain Gauge Instrument sets a new standard for strain and bridge measurements, delivering the highest performance measurements possible while controlling overall test hardware costs. Sixteen channels of strain or voltage, independent 24-bit ADCs per channel, extensive software-selectable filtering, and independent signal conditioning paths deliver exceptional accuracy and reliability. Built-in signal conditioning, programmable excitation, and selectable bridge completion, all integrated into the instrument and configurable on a per-channel basis, greatly simplify setup and configuration. With unmatched performance, accuracy and reliability, the EX1403 is the "goto" solution for the most complex structural test applications worldwide.

A single system that can provide high-quality static or highspeed strain measurements in applications such as airframe structural and fatigue test, rocket and satellite structural test, wind tunnel flight load test, general purpose bridge measurements and load frame materials testing

Manufacturing and test environments of today are dynamic, dictating minimal downtime of test systems in order to meet increasing product throughput demands. Ensuring that acquired data is reliable and that instrument calibration can be turned around quickly are keys to the success of any production team. VTI embeds intelligence into the EX1403 to facilitate maximum system "uptime" and increase manufacturing efficiency. Built-in self-test can be invoked under software control prior to each critical test. A simple pass-fail result will be returned after completing system health diagnostics, including temperature and voltage level measurements of the on-board processor; this result can be used to prevent a test from running in the event of a failure.