

Testing Lithium-Ion Batteries Using TEMPpoint

Challenge To test 10-cell lithium-ion battery packs using a portable laptop solution; must be capable of measuring at least 10 voltages and 36 thermocouples very accurately and reliably during charge/discharge tests.

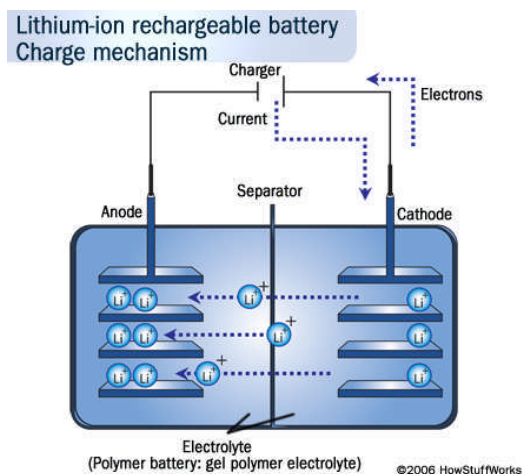
Solution Use Data Translation's high-accuracy TEMPpoint instrument and ready to measure software to measure and analyze temperature and voltage data.

TEMPpoint™

Results

- TEMPpoint increases testing flexibility by measuring both voltages and temperatures simultaneously
- High-accuracy measurements allow precise product characterization to determine product safety and reliability
- Easy-to-use software and easy-access jacks reduce development/testing time

Advances in battery technology have revolutionized the consumer market – powering products such as cell phones and laptops to hybrid cars. Lithium-ion batteries are the predominant power source for these devices because of their ability to store a great deal of energy in a compact, light package. However, lithium-ion batteries do present safety concerns as they have the potential to catch fire when charging mechanisms malfunction or temperature extremes are present. To ensure product safety and reliability, it is critical that manufacturers accurately test the charge/discharge cycle of these batteries to characterize their behavior and predict their performance.

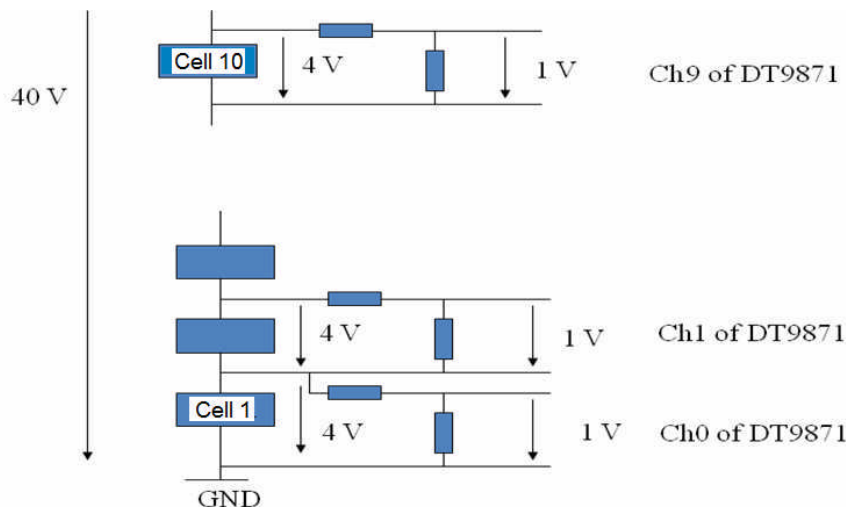


Challenge

A world-leader in industrial tools needed to test the charge/discharge cycle of lithium-ion battery packs used in their electronic gardening tools. Each battery pack consisted of 10 cells; each cell provided 4 V. The customer wanted to measure the charge of each cell, the heat that was generated by each cell, and the temperature at various test points on the tool during the charge/discharge cycle.

To determine the charge of each cell, the customer needed to measure 10 voltages; a 4:1 voltage divider was used to step down the voltage to the ± 1.25 V input range of the TEMPpoint instrument. To measure the temperature of each cell and at various test points, the customer needed to measure the values of 36 thermocouples.

In addition, the customer wanted to trigger the start of other devices in the test stand based on the data that was collected during this test.



A 4:1 voltage divider steps down the voltage to the ± 1.25 V input range of the TEMPpoint instrument.

Solution

The TEMPpoint instrument proved to be an excellent solution for this application for the following keys reasons:

- **Flexibility** - The TEMPpoint instrument accepts up to 48 inputs. You can mix and match B, E, J, K, N, R, S, and/or T thermocouples as well as voltage inputs, which connect to the TEMPpoint instrument using easy-access jacks.

To monitor and control external equipment, the TEMPpoint instrument also provides 8 opto-isolated digital inputs and 8 opto-isolated digital output lines, which are galvanically isolated to 250 V.

- **Accuracy** - The TEMPpoint instrument provides a dedicated 24-bit Delta-Sigma A/D for each thermocouple and voltage input channel. This ensures the highest resolution measurements (1 part in 16 million). Further, the Delta-Sigma converters provide an antialiasing filter to reject 50 Hz and 60 Hz power line frequency components. Software selectable filters are also available to further reduce any noise in the measurements.

Each A/D channel also has a dedicated CJC circuit to make TEMPpoint more accurate and more immune to temperature variations both inside and outside the instrument.

The voltage measurement circuit is a very precise device supporting an input range of 0 to ± 1.25 V full-scale and providing an accuracy of ± 0.0000004 V. The TEMPpoint instrument automatically linearizes measurements based on the input type selected.

TEMPpoint features a very high common-mode voltage of ± 500 V on the inputs. This allows the customer to measure each of the 10 cells at every level between 0 V and 40 V.

And, because noise and high voltage inherent in industrial machinery can adversely affect a temperature measuring instrument, the TEMPpoint instrument provides 1000 V of galvanic isolation. Galvanic isolation improves system accuracy by eliminating the unwanted effects of voltage transients and protects the PC against the damaging effects of high voltages.

- **Ease of Use** - TEMPpoint ships with a ready-to-run executable. Using the TEMPpoint application, customers can acquire temperature measurements from up to 48 thermocouple or voltage input channels, display the data on the screen, and log data to disk for analysis – without writing code! For more advanced analysis, data can be exported to other applications, like Measure Foundry, Microsoft Excel, and MATLAB. And, since source code is also provided, customers can customize this application to suit their needs using Measure Foundry.

Results

- **Portable battery testing system increases testing flexibility.** The high-accuracy TEMPpoint instrument met the customer's requirement by simultaneously measuring 10 voltage and 36 thermocouple inputs.
- **High accuracy measurements allow precise product characterization.** Since each TEMPpoint channel has a 24-bit Delta-Sigma converter and CJC, +/-500 V of common-mode voltage, and 1000 V of galvanic isolation, the customer was able to precisely characterize the performance of all 10 cells of the lithium-ion batteries to determine product safety and reliability.
- **Easy-to-use software and easy-access jacks reduce development/testing time.** The ready-to-measure TEMPpoint application allowed the customer to quickly acquire and analyze all 46 channels simultaneously without writing code. In addition, the easy-access jacks provided easy test connections and setup.

Products Used

DT9871 USB TEMPpoint instrument

Ready-to-Measure TEMPpoint application

