Testing Without Batteries

NH Research, Inc.

Introduction

There are many benefits to testing batteries by emulating, or simulating, battery characteristics rather than using a real battery. The emulated battery dramatically reduces testing time, provides highly repeatable test results, and creates a safer test environment. Also, preparation time, operator errors, and result variations due to battery temperature or aging, are eliminated.

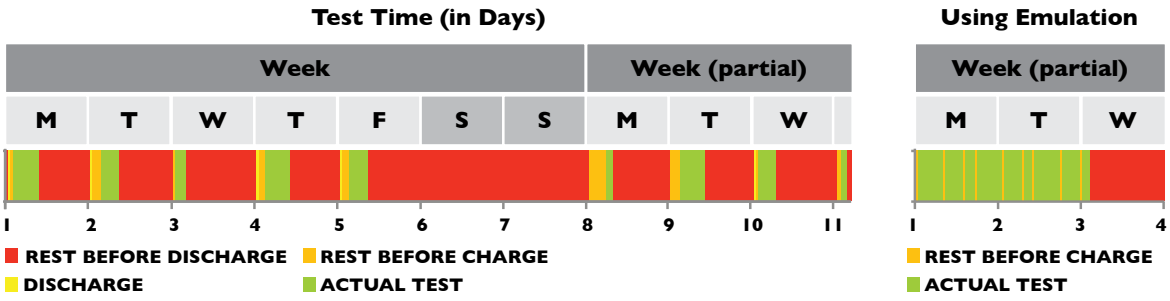

Figure 1 - Testing with Real Battery Versus Using Emulation

Battery Emulation Reduces Testing Time

Testing a real battery often requires operator preparation for each step. Batteries must first be charged, or discharged, then allowed to rest, and finally tested. The significant battery preparation time can be avoided by using an emulated battery.

Figure 1 above shows actual customer data from nine (9) tests conducted with both a real battery and then an emulated battery. Upon comparison between the tests, in these cases, emulation reduces the total test time by more than 70%.

Battery Emulation Provides Repeatable Test Results

Over time, batteries provide inconsistent test results, wear out, and need to be replaced. Battery age, internal temperature, and cycling are all contributing factors to the limited battery life-span. Manual battery operation, including rest time facilitation, can also cause inaccurate test results.

Battery emulation provides consistent and repeatable test results, unlike those from real battery testing, during which battery changes and operator errors cause variations in test results.

Battery Emulation Improves Safety

Although batteries are generally safe when operated within normal operating ranges, they are high energy devices that may pose serious risks upon battery or unit under test (UUT) failure. Such risks include exposure to dangerous gases, fires, explosions, or corrosive chemicals. These concerns have led to safety policies stating that tests must be conducted and monitored during working hours. Furthermore, testing extreme cases of over-discharged or over-charged batteries can pose unpredictable risks and safety hazards.

Battery emulation creates a safe testing environment without any of the concerns that arise when real batteries are used. Also, emulation safely verifies UUT behavior when a battery is outside a normal operating condition.

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Using an Emulated Battery

Batteries can be modeled as a bi-directional voltage source along with a series resistance, as seen in Figure 2. The NH Research 9200 Battery Test System provides an electronically programmable "Battery Emulation" mode, allowing any battery to be simulated at any state of charge. When programmed, the system automatically adjusts the terminal voltage, V_{batt}, based on the amount of current flowing to, or from, the 9200 system.

$$V_{batt} = V_{ocv} + R_s \cdot I_{charge}$$

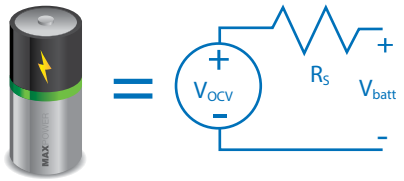

Figure 2 - Equivalent Battery Model

Just like a real battery, the test system will accept or deliver current while maintaining voltage.

Both the voltage and resistance are programmable and can instantly represent any desired state, eliminating battery charging or discharging before testing. Corner case testing of over-charged or over-discharged batteries can be safely and repeatedly simulated, testing how a UUT will react to batteries in these conditions.

9200 Battery Test System

The programmed voltage can be adjusted, or slewed, at a very slow rate, emulating the increase in voltage when a battery charges. Figure 3 shows battery emulation with a charger, and this slow slew rate to emulate the voltage increase while being charged.

In the example shown, the charger periodically checks that the battery is being safely charged by reducing the charge current, indicating a slight decrease in the terminal voltage. Voltage drop is proportional to the amount of current provided by the charger, along with the programmed series resistance term. This method allows both new (low resistance) and old (higher resistance) batteries to be simulated, verifying the charger algorithms.

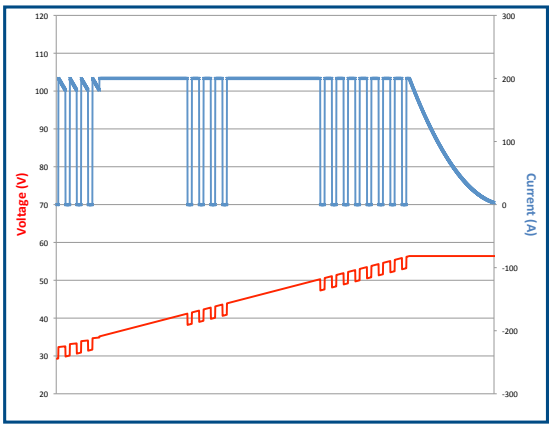

Figure 3 - Series Resistance In Use

Chargers may operate in more than one regulation mode. This example shows the charger transitioning from constant current to constant voltage. The voltage transition is completely charger controlled and does not require reprogramming of the simulated battery.

Using emulation produces test results faster, provides a consistent test, and can safely test power electronic devices that typically require a real battery. Contact NH Research to further discuss how removing real batteries from existing test fixtures will improve both safety and repeatability in testing.

Contact NH Research for more information about how emulating a battery improves your testing.

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