

Satellite Battery Testing in Aerospace and Defense

Secure Mission-Grade Satellite Battery Testing

The Challenge: Satellite Battery Testing Is Mission-Critical and Hard to Scale

Aerospace and defense satellites rely on batteries to maintain payload operations, telemetry, and critical subsystems during eclipse or power-limited phases. Validating battery performance and its interaction with the power conditioning unit (PCU) under diverse mission conditions is critical, but traditional test methods fall short for several reasons:

- Battery behavior must be validated across a wide range of conditions such as varying state of charge (SoC), temperature extremes, and rapid sun-to-eclipse transitions.
- Edge cases, including over- and under-voltage events, fast bus transients, and thermal cycling must be recreated with high fidelity and measured with sub-millisecond accuracy.
- Long-duration, high-power tests using real batteries generate excess heat, drive up energy costs, and extend testing schedules due to safety and cycling limitations.

Legacy battery testing methods increase mission risk, delay integration, and undermine confidence in satellite launch readiness.

The Solution: A Purpose-Built Platform for Satellite Battery Validation

Keysight high-power ATE system power supplies close the gap in satellite battery testing by combining a high-density regenerative power supply with automation-ready software. This unified platform enables you to safely emulate batteries, reproduce mission-critical events such as sun-to-eclipse transitions, and conduct extended validation with enterprise-grade data integrity.

The solution reduces the need for physical batteries during integration, shortens test cycles, expands coverage of extreme conditions, and lowers lab energy and cooling costs — all without compromising the precision and fidelity demanded by satellite missions.

Solution Highlights

Emulate satellite batteries with precision and scale

Replace physical flight batteries with a 2-quadrant regenerative power supply to emulate charge, discharge, and cycling behavior safely. Create custom battery profiles from captured mission data or use predefined chemistries to replicate SoC and temperature conditions during sun-to-eclipse transitions.

Inject mission-critical faults and edge cases

Programmatically reproduce over- and under-voltage events, fast bus transients, and thermal excursions to validate the PCU and bus protection behavior under controlled, repeatable conditions.

Automate long-duration, mission-profile tests

Execute full orbital cycles, eclipse handovers, and extended battery endurance tests with high-resolution logging (voltage, current, power, and energy). Run unattended for days or weeks with automated reporting and pass / fail thresholds.

Reduce energy waste and lab overhead

Regenerative hardware returns discharged energy to the grid, reducing heat generation, cooling requirements, and operating costs, all of which are critical for extended satellite testing.

Maintain secure, traceable workflows

Support for secure data isolation (removable storage), enterprise software development life cycle practices, and KeysightCare services are included to meet classified and regulated program requirements.

Example Use Case: Aerospace Satellite Battery Validation

Satellite integrators need to validate the battery system within the PCU that supports payloads, communications, and bus operations during eclipse phases. Using Keysight high-power ATE system power supplies, you can emulate the onboard battery at different SoC and temperature profiles, then apply dynamic charge and discharge cycles to mirror mission transitions such as sun-to-eclipse handovers and peak payload power draws. Programmed edge cases, including over- and under-voltage events and rapid bus transients, can be injected to ensure the PCU and battery system respond within specification. All data, including ripple, recovery time, and efficiency, can be logged and analyzed using the automated software power suite, while regenerative operation returns discharge energy to the facility grid, reducing both cooling requirements and test energy costs.

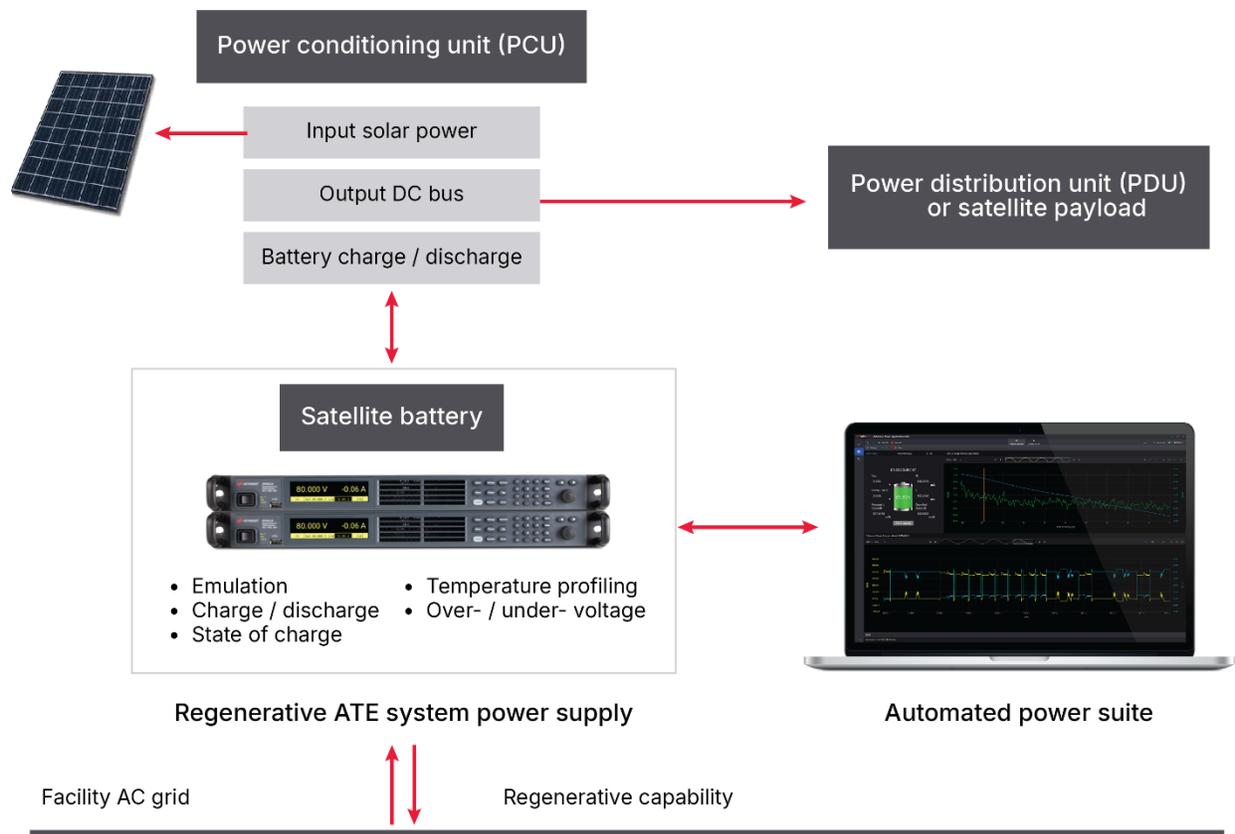


Figure 1. Typical configuration for a satellite battery test and validation system

Key Benefits for Satellite Battery Testing

- **Greater mission readiness assurance:** Validate battery and PCU behavior with sub-millisecond resolution with confidence.
- **Accelerated validation cycles:** Programmable profiles, seamless battery emulation, and automation reduce hardware swaps and shorten integration timelines.
- **Reduced test costs and energy footprint:** Regenerative operation returns discharge energy to the grid, cutting power waste and cooling demands in long-duration satellite tests.
- **Secure and compliant workflows:** Support for data isolation and KeysightCare services ensures compliance with classified aerospace programs.
- **Scalable for mission evolution:** High density, modular architecture scales from single-satellite subsystems to multi-kilowatt satellite constellations without redesigning the test infrastructure.

Why Choose a Keysight ATE System Power Supply

In aerospace and defense, satellite batteries are the lifeline of every mission — sustaining payloads, communications, and control systems through eclipses, surges, and deep-space conditions. Testing them demands uncompromising precision. Keysight high-power ATE system power supplies unify a regenerative two-quadrant source, advanced battery profiling and emulation, and automation-ready workflows to replicate mission timelines with fidelity. Engineers can emulate charge, discharge, and thermal profiles, stress-test hold-up margins, and validate protection logic under controlled, repeatable conditions — all while regenerating energy back to the grid to reduce facility strain. Designed to meet the rigorous standards of aerospace and defense programs, Keysight solutions scale from cell-level analysis to full-bus validation, giving teams the confidence to qualify satellite battery systems without compromise.

Learn More

- [How to Test Satellite Batteries](#)
- www.keysight.com/find/hdpower

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.



This information is subject to change without notice. © Keysight Technologies, 2025, Published in USA, November 4, 2025, 7125-1072.EN