

# Keysight Technologies

## Increase DC-input Battery Adapter Test Throughput By Several-fold

### Application Note

#### Description

DC-input battery adapters for mobile phones, laptops and other portable devices need to correctly power their host device and charge the internal battery pack. Not only can errant battery adapters damage the host device or battery pack, they can also pose a safety hazard. Complete functional testing is needed to mitigate such risks.

## Problem

Battery adapters are extremely cost-sensitive. Even fractions of a second of test time are critical, therefore functional test must be thorough while test time must be minimized. Most efforts to reduce test time usually return only modest improvements. A more effective approach to reduce test time is necessary.

## Solution

Parallel device testing dramatically increases test system throughput. Unlike a lot of other, more conventional equipment, Keysight Technologies, Inc. provides advanced capabilities that support high throughput parallel battery adapter testing, including:

- The N6700 Modular Power System features Channel List commands for simultaneous operation of its multiple power supply modules.
- The N6700A-B provides four 100 W outputs in a 1-U package for high density.
- The N6752A 50 V, 10 A, 100 W autoranging power supply module has flexibility for powering 12 V or 24 V DC input battery adapters at full power.
- The N6752A 50 V, 10 A, 100 W autoranging power supply module has precision and dynamic measurement capabilities for testing standby and inrush currents.
- The N6743B 20 V, 5 A, 100 W power supply module is an economical alternative when the primary focus is powering the battery adapters.
- The N3300A Electronic Load System features multiple Save and Recall states for setting the conditions of its multiple electronic load modules simultaneously.
- The N3300A holds up to six load modules in a 3-U package for high density.
- The N3302A 60 V, 30 A, 150 W load module features multiple voltage and current ranges for accurate battery adapter testing at both high and low levels.

## Battery Adapter Description

A battery adapter is a DC/DC converter that takes an unregulated +9 to +16 volts DC in from the vehicle electrical system and furnishes regulated DC power out to the mobile phone, laptop or other portable device, as shown in Figure 1. Depending on the device, battery adapters output from 3 to 20 volts and up to 50 watts, to power the device for active operation and to recharge its battery in a few hours or less. It is important to test the battery adapter's ability to regulate its output voltage and current so that it will properly power the device and recharge its battery.

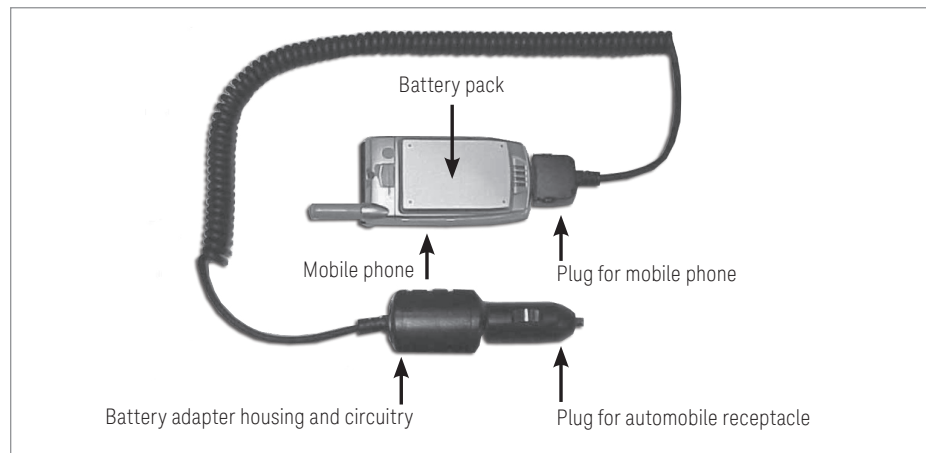


Figure 1. Example Battery Adapter and Host Device

## Common Battery Adapter Tests

The majority of functional tests for a battery adapter relate to either its output or input, as listed in Table 1. For additional details on many of these tests, refer to Keysight Technologies application note AN 372-1 Power Supply Testing, part number 5952-4190.

Table 1: Common Battery Adapter Functional Tests

Output Related Tests	Input Related Tests	Other Tests
Output accuracy, CV & CC	Input current, NL & FL	Start up time
Load regulation, CV	Inrush current	Line regulation, CV
Transient response, CV		
Ripple voltage V p-p		
Short circuit current		
Reverse leakage current		
Battery charge terminate		

CV = Constant Voltage, CC = Constant Current, NL = No Load, FL = Full Load

## Conventional Test System Configuration

Based on the required set of tests, an appropriate set of test equipment can be identified and configured to address these test needs. A conventional system configuration is illustrated in Figure 2. This configuration tests battery adapters sequentially one at a time.

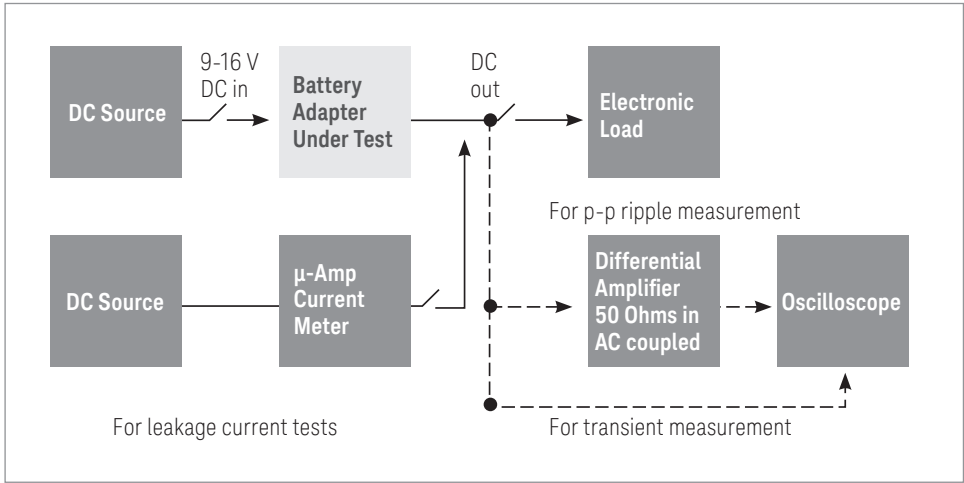


Figure 2 Conventional Test System Configuration

## Parallel Device Test Solution Example Using Keysight Equipment

A large portion of test execution activity involves the DC source for input power and electronic load to set conditions and make measurements. These are opportune areas for throughput improvement. Configuring the test system so that it can simultaneously execute most of the tests on multiple devices by using multiple DC sources and loads is a cost effective way to achieve a large improvement in test throughput. Figure 3 depicts an example test configuration to test four devices in parallel. The N6700 Modular Power System and N3300A Electronic Load System are excellent choices for this configuration having multiple channels and advanced programming capabilities.

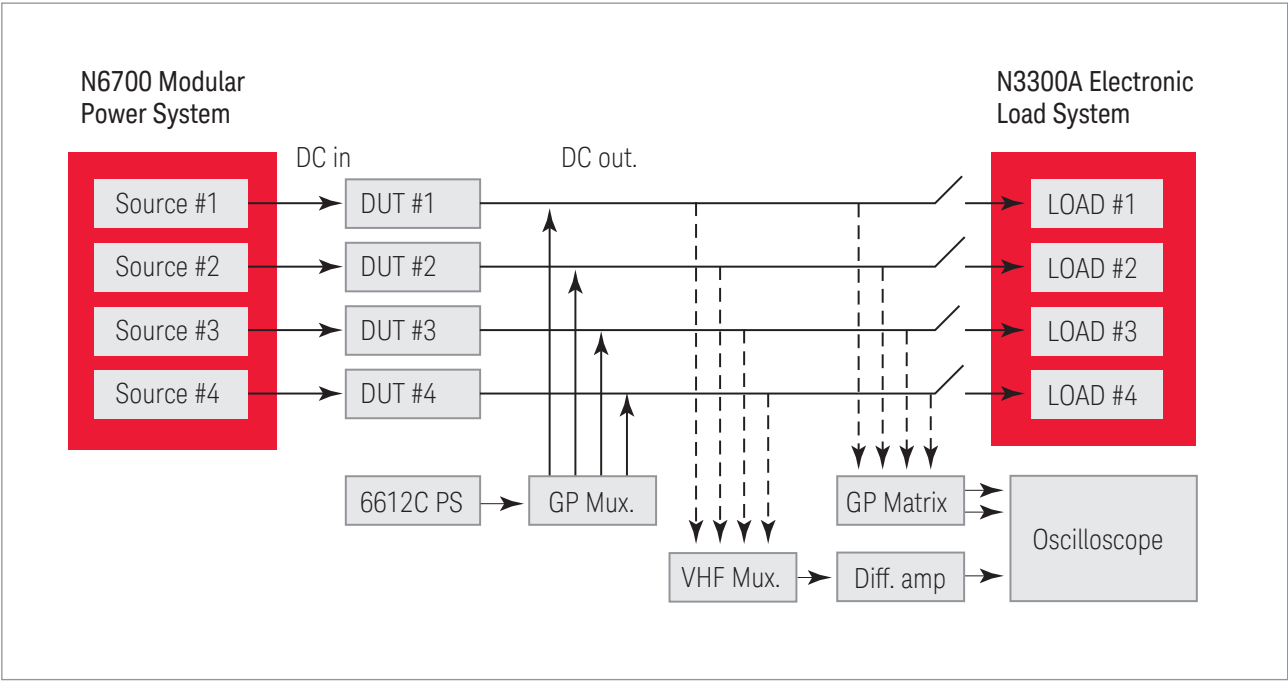


Figure 3. Parallel Device Test System Configuration

## Sequential versus Parallel Test Execution

Sequential execution for an Input Current test for the conventional system is illustrated on the left side of Figure 4. Test execution has to loop through the sequence four times, once for each of the four DUTs. In comparison, test execution for the parallel device test system is illustrated on the right side of Figure 4. Test execution requires only one pass through the sequence for all four DUTs. Using Save and Recall states and Channel List programming features allow all four Loads and DC Sources to be changed and read back simultaneously.

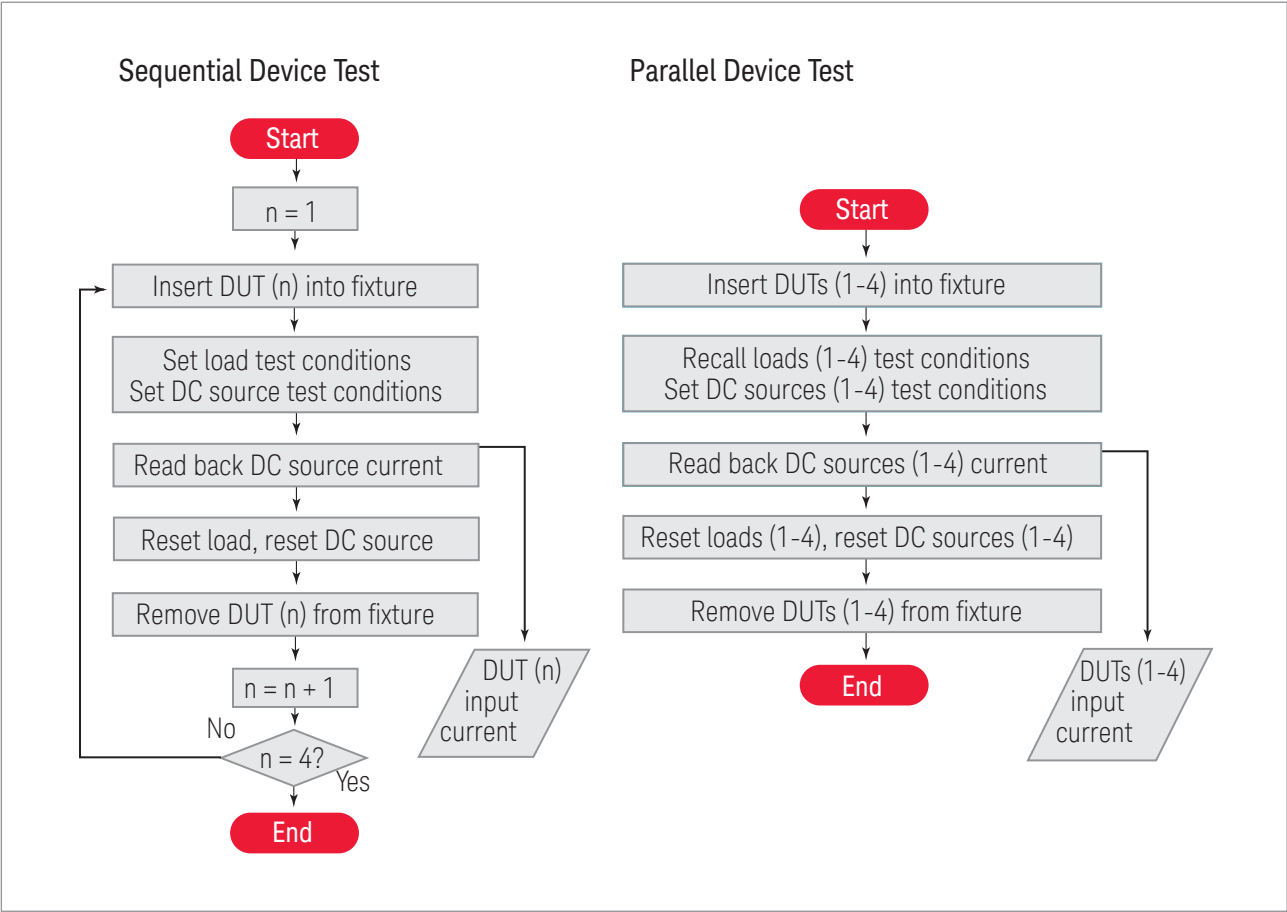


Figure 4. Sequential versus Parallel Execution for Input Current Test

## Optimum Parallel Device Test System Configuration

A parallel device system is likely to strike a balance between different tests executed in parallel and in serial, dictating where multiple system components are needed. Using multiple power supplies and loads for parallel DC adapter testing is a given for several reasons:

- One of each is needed to power up and load each DUT.
- Perform the majority of test measurements taken.
- Establish operating conditions for all the tests.
- Support parallel program execution, when designed for such.
- Are relatively low cost.

In comparison, the other equipment does not have this overall breadth of impact. The more effective solution is usually to use a single, higher performance instrument and multiplex its input to each DUT.

## How Many Devices to Test in Parallel?

As more devices are tested in parallel, the throughput is reduced in proportion, to a certain point. Sequential test operations and measurements become an increasingly dominant factor in the overall test time. The time to load and unload devices from their test fixture is also a limiting factor. A pair of test fixtures and switch bank is often employed. One is unloaded and reloaded while the other is engaged for testing. Time studies for handling and test execution are needed to optimize overall throughput at the test system.

## Improvement in Throughput Using Parallel Testing

For individual tests that make use of the DC Source and Load, such as Input Current, the improvement in throughput is comparable to the number of devices being tested in parallel. In this case a four-fold throughput improvement is realized. Overall throughput improvement depends on many factors, but given that the majority of test conditions and measurements make use of the DC Sources and Loads, a three-fold overall throughput improvement is typical when testing four devices in parallel. This of course requires that the DC Sources and Loads will support multiple channel simultaneous operations. Multiple channel simultaneous operations can be done using the Channel List feature with the N6700 Modular Power System, and Save and Recall states feature with the N3300A Electronic Load System.

Such dramatic improvements in throughput more than offset the expense of the additional DC Sources and Loads, making it a very cost effective solution. The limiting factor ultimately becomes how fast the devices can be loaded and unloaded from the test fixture. Therefore test equipment is no longer a limitation, when taking advantage of advanced capabilities provided by Keysight Technologies products.

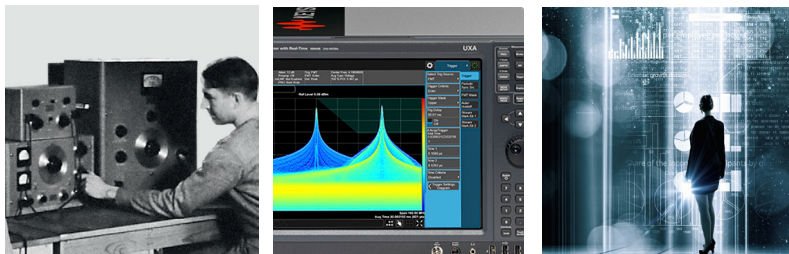
## Related Applications

- DC/DC converter test
- Voltage Regulator Module (VRM) test
- Point Of Load (POL) Regulator test

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This document was formerly known as application note number 1506

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