Powering DC-to-DC Converters Using the Agilent N6705A DC Power Analyzer

Application Note

Introduction

This application brief describes an example of how an R&D engineer can test DC-to-DC converters using the capabilities of the Agilent N6705A DC Power Analyzer.

Description

Applications where a single unregulated power source needs to be transformed to a particular regulated voltage commonly use DC-to-DC converters. For example, a mobile handset has a central battery that powers various sub-circuits in the handset. Each sub-circuit has different power requirements.

The DC-to-DC converters inside the handset transform the battery voltage into a controlled voltage. In some cases, sub-circuits drawing varying or pulsating current from the handset battery cause a ripple on the battery voltage. DC-to-DC converters regulate the ripple before the voltage reaches the handset components.

An example power test of a DC-to-DC converter is powering the converter with a DC voltage containing a small ripple and measuring the ripple rejection on the output of the converter with a measurement instrument. As shown in Figure 1, the DC-to-DC converter requires a small AC voltage riding on the DC voltage to conduct this test.

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Problem

In this example, an R&D engineer would create a sinewave using a function generator and mix the signal with a DC signal from a power supply to power the DC-to-DC converter. Some power supplies have analog inputs that add external signals such as the signals from function generators to the DC output. However, this method requires additional cabling, time and effort to configure. One could also create custom mixer boards that accept inputs from the function generator and a power supply. This method also requires additional time and effort to create an additional piece of equipment. Both of these methods complicate creation of the signal by introducing additional pieces of equipment.

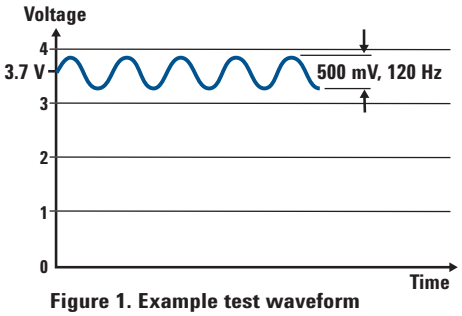

Figure 1. Example test waveform powering DC-to-DC converters

Solution: The Agilent N6705A DC Power Analyzer

The N6705A DC Power Analyzer can create the arbitrary waveforms required in this type of application. Designed as a general purpose bench instrument, the DC Power Analyzer has the power of up to four power supplies, a function generator, an oscilloscope, a voltmeter, an ammeter and a datalogger in 4 U of rack space. All capabilities of the instrument can be accessed from the front panel. R&D engineers can program the instrument without having to write a single line of code! While the design has been optimized for use on the bench, the N6705A DC Power Analyzer is also an LXI Class C instrument with LAN, GPIB and USB interfaces.

This modular instrument accepts up to four of the more than twenty power modules originally created for the Agilent N6700 Modular Power System designed for use in automatic test equipment. These power modules have three performance tiers: basic, high-performance and precision. While all modules are capable of creating arbitrary waveforms from the front panel of the N6705A, the N675x High-Performance and the N676x Precision 50 V and 60 V DC power modules have the speed and accuracy necessary for this application.

Simulating power waveforms

The N6705A DC Power Analyzer has built-in arbitrary waveform controls that allow bench users to easily setup a voltage waveform. Figures 2a and 2b show the arbitrary waveform setup screen and the actual waveform output voltage using scope mode on the N6705A of the waveform described in Figure 1. The voltage peak for the sinewave is 250 mV (v0), the DC voltage is 3.7 V (v1) and the frequency is 120 Hz (f).

In addition to this specific waveform, the N6705A can also generate several other built-in waveforms such as pulses, ramps and trapezoidal waveforms and can even produce user-defined voltage and current waveforms. These waveforms are useful in other DC-to-DC converter power applications such as simulating voltage dropouts, battery decay or other user specific conditions.

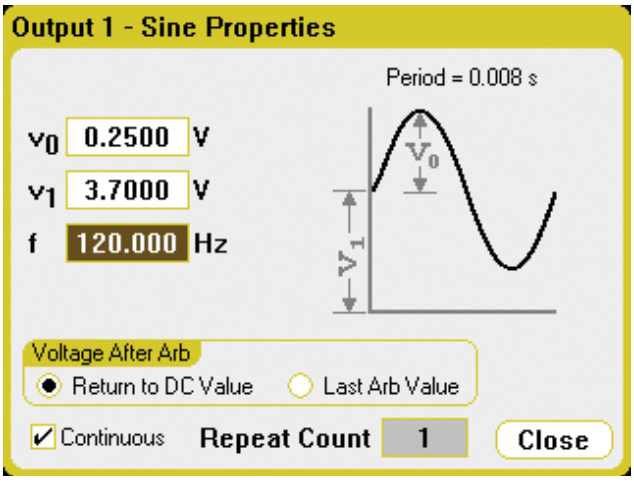

Figure 2a. N6705A screenshot of the arbitrary waveform setup screen.

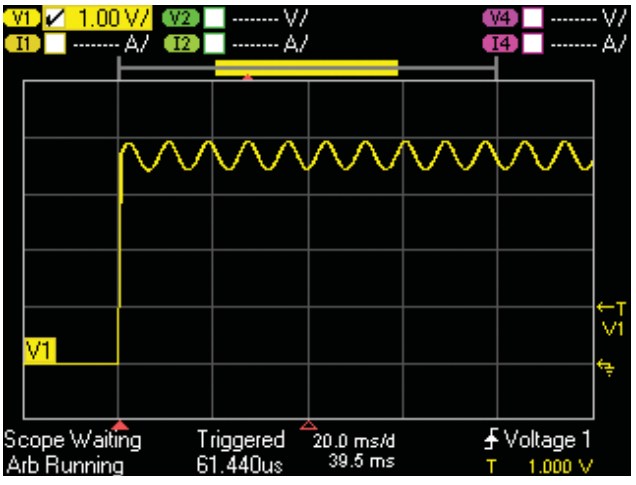

Figure 2b. N6705A screenshot of the scope view displaying a 120 Hz signal.

Speed and accuracy

While most power supplies lack the ability to produce low-frequency waveforms, the N675x and N676x 50 V and 60 V DC power modules have fast programmable outputs capable of producing low-frequency waveforms. The up-programming and down-programming times fall below 1 ms for voltages under 10 V. Depending on the voltage setting and module number, the power modules are capable of producing up to 3600 Hz waveforms at 600 mV pk-to-pk or less.

Added capability

Often, R&D engineers are doing multiple tasks at once and need a flexible instrument to adapt to their changing needs. The N6705A has added capability with its multi-functionality. It can characterize the current going into the device under test (DUT) and log voltage and current data over a period of time. Additionally, the N675x and N676x modules have autoranging outputs that expand the power curve giving the user more voltage and current combinations in one power supply. This autoranging capability is especially useful for testing DC-to-DC converters that have a wide range of input voltages and nearly constant power consumption.

Summary

Agilent Technologies' N6705A DC Power Analyzer is a flexible solution with the built-in capability to produce low-frequency arbitrary waveforms to power DC-to-DC converters in a wide variety of test conditions. Since DC-to-DC converters are prevalent in various power applications, it is important to have an easy-to-use, flexible solution. The DC Power Analyzer provides this in an intuitive, all-in-one instrument.

Related applications

- IC regulator testing
- Power supply testing
- Vehicle charging system simulation

Related products

- N6700 Low-Profile Modular Power System

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