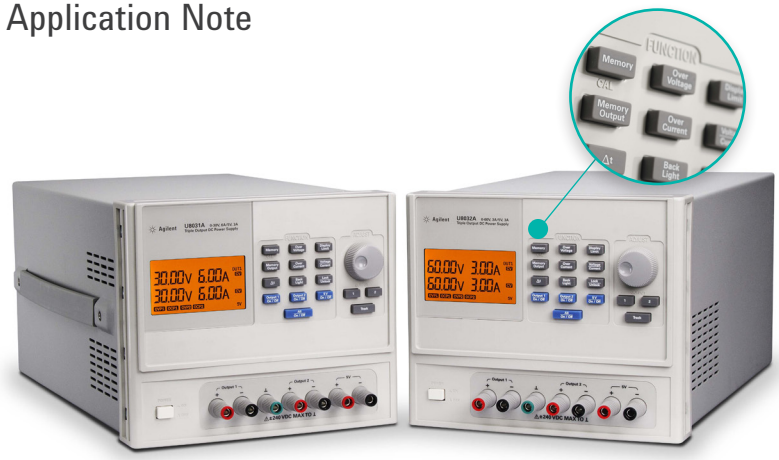
Using the U8030 Series Power Supply **Output Sequencing** Feature

Application Note



The Agilent U8030 Series Triple-Output DC Power Supply is the first triple-output DC power supply in its class to offer an output sequencing feature. With the easy-to-use knob and intuitive keypad, you can store three settings and recall these settings in sequence either as single or loop operation. The stored settings remember the voltage and current limit value settings; overvoltage protection (OVP) and overcurrent protection (OCP) on or off states; and OVP and OCP trip levels.

The U8030 Series power supply offers two models, the U8031A and U8032A, each with different voltage and current ratings to cater to your needs. Both models are compact bench instrument that provide excellent load regulation and clean output noise for continued stability, and offer a total output of 375 W. The U8030 Series power supply has three outputs—one fixed output and two variable outputs—that can be controlled individually or simultaneously and a tracking feature that duplicates output setting from output channel 1 to output channel 2 and vice versa. With these features and performance, the U8030 Series power supply is an ideal power source alternative for electronics manufacturing, research and development, and the education sector.
This application note presents three test applications that demonstrate the capabilities of the U8030 Series power supply.

- Testing PC fan speed control
- Testing the power-up reliability of an embedded system
- Testing line regulation for DC-to-DC converters

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Testing PC Fan Speed Control

A conventional approach to testing PC fan speed control involves connecting a power supply to a linear voltage control type of fan and turning the knob on the power supply to vary the voltage. You then observe how the PC fan speed and supply current increase as you increase the output voltage of the power supply. In the application of testing samples in a production line, however, the task of switching between different power settings would be tedious. Another method is to automate the test by using a PC to control a programmable power supply to set different levels of voltages; however, this method requires programming skills.

Reasons for Testing

- Validate the actual operation against specifications
- Evaluate the power consumption of the device to compare against expected values and help in optimizing the performance of the device

These items require the U8030 Series power supply to step the voltage to test the PC fan speed and validate that the DC motor performs according to the expected values. This is useful for QA testing in a production line for PC fan manufacturing. Also, this test lets you evaluate the efficiency of the fan motor to help you optimize the performance of the PC fan, especially with the increased awareness for energy conservation and noise pollution from electrical devices.

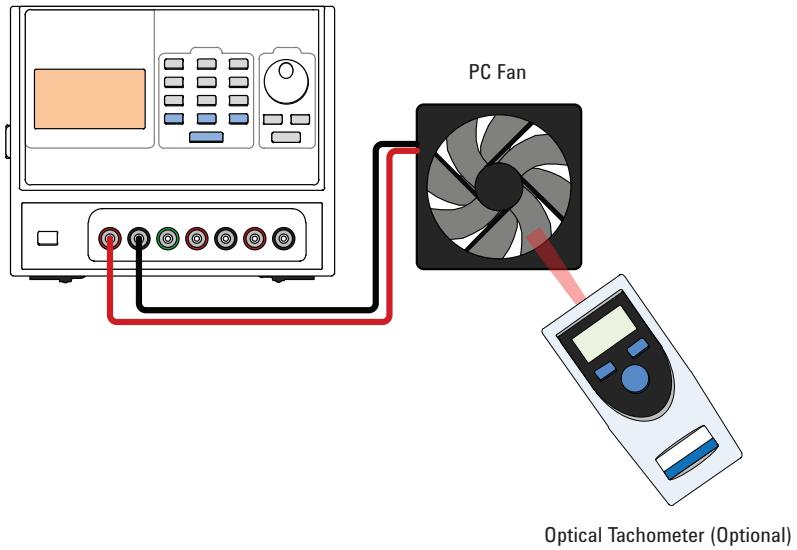

Figure 1: Setup to test PC fan speed control with an optional optical tachometer

Recommended Setup

The U8030 Series power supply has features that address the challenges of conventional approaches. By storing three different settings into the U8030 Series power supply, you can accurately set the voltage yourself and observe the PC fan operation at different voltage settings. In a more elaborate setup, you can use an optical tachometer to measure the revolutions per minute (RPM) of the PC fan when operating on different supply voltages. Also, by making full use of the two variable outputs on the U8030 Series power supply, you can test two PC fans simultaneously.

Prepare the U8030 Series power supply by storing three different voltage levels and setting the time intervals for each stored voltage level. For this test setup, the memory output single operation is used; this memory output feature always recalls the three stored settings in sequence and then turns off the power supply output.

To perform this test, connect a PC fan to the variable output terminals of the power supply (see Figure 1), and then enable the memory output single operation. Store the following voltage levels and time intervals (see Table 1) into the U8030 Series power supply.

Table 1: Settings to step the voltage to test the PC fan

Memory Location	Voltage (V)	Time Interval (s)
M1	5	Δt1 = 5
M2	7	Δt2 = 5
M3	12	Δt3 = 2 (default)

Should any tested PC fan fail to rotate or observed to draw excessive current, which you can view using the dual display front panel on the U8030 Series power supply, at any one of the set voltage levels, you can perform your troubleshooting procedure and return to the test to determine if you've resolved the issue.

Testing the Power-Up Reliability of an Embedded System

Embedded systems often include hardware (processor, flash memory, DSP) and software (for extensibility and programmability). They are designed to perform one or a few specific functions, often with real-time computing constraints. Examples include MP3 players, routers, GPS receivers, and safety features in vehicles such as anti-lock braking system (ABS), electronic stability control (ESC), and traction control (TCS).

One conventional approach in testing the power-up reliability of an embedded system is to have someone manually and repetitively cycle the power, that is toggle the power switch on and off, and then record the number of power cycles and the number of times the embedded system properly powers up. This is tedious work. A more efficient approach is to automate the power cycling, and add test code into your firmware to log the number of times the system properly powers on.

Reasons for Testing

- Determine the reliability of an embedded system that includes software and hardware
- Analyze particular failures by simulating power cycle situations

These items require precise power settings that can be logged and reproduced in order to create a complete analysis of the reliability of the embedded system. By subjecting the embedded system to continuous power cycles over a predetermined period, you can determine if its hardware and software function as expected.

Recommended Setup

The U8030 Series power supply has an output sequencing feature that addresses the challenges of conventional approaches. By storing three different settings into the U8030 Series power supply, you can configure the power supply to continuously cycle the power of the embedded system. Furthermore, with the three output channels on the U8030 Series power supply, you can test three embedded systems simultaneously.

Prepare the U8030 Series power supply by storing three different voltage levels and setting the time intervals for each stored voltage levels. For this test setup, the memory output loop operation is used; this memory output feature always recalls the three stored settings in sequence indefinitely until cancelled. Based on the time intervals set, you can determine the number of times the power supply will turn on the embedded system. On the embedded system, you can add a test code into your firmware that logs the number of times the system properly turns on.

Connect the U8030 Series power supply output to the power terminals of the embedded system, and then enable the memory output loop operation. The embedded system will cycle the power at a rate programmed into the U8030 Series power supply.

Store the following voltage levels and time intervals into the U8030 Series power supply.

Table 2: Settings for one power cycle every minute

Memory Location	Voltage (V)	Time Interval (s)
M1	0	Δt1=15
M2	5	Δt2=30
M3	0	Δt3=15

The values in Table 2 program the U8030 Series power supply to have one power cycle (turn on and turn off) within the period of one minute (see Figure 2). For this test, our test period will be 24 hours; therefore, you can calculate that the power supply will produce 1,440 power cycles.

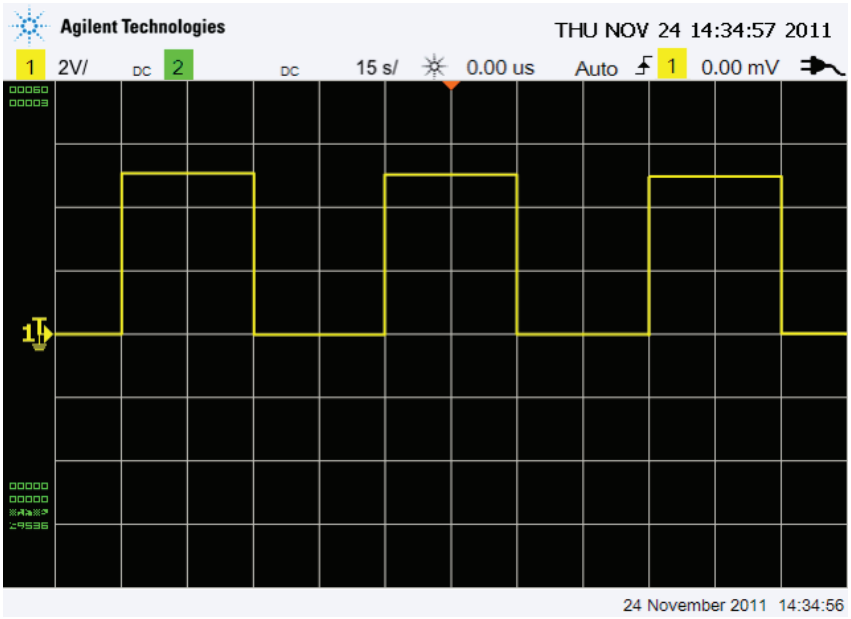

Figure 2: Display shows a power cycle every 60 seconds

At the end of the test period, compare the logged data from the test code in the embedded system with the number of power cycles generated by the power supply. Any mismatch indicates an issue with either the hardware or software on the embedded system.

Testing Line Regulation for DC-to-DC Converters

The DC-to-DC converter is a key component between the power source and the complex electronic components in a wide range of devices from mobile phones and notebook computers to hybrid vehicles and solar panel arrays. The robustness of an electrical device depends on the efficiency and reliability of the DC-to-DC converter.

The line regulation of a DC-to-DC converter refers to its ability to maintain a constant output voltage over a wide range of input voltages. As an example, the line regulation test for a 24 V DC-to-DC converter may vary its input voltage from 18 V to 36 V, while verifying that its output voltage remains constant.

The bench setup for a line regulation test consists of a bench power supply to provide the input voltage to the DC-to-DC converter, a load to sink its output current, and a digital multimeter (DMM) to measure its output voltage. This test is time consuming with a typical bench power supply because you have to manually adjust the power supply to vary the input voltage to the DC-to-DC converter.

Reasons for Testing

- Determine if a DC-to-DC converter is able to maintain a constant output voltage over its specified operating input voltage range

Recommended Setup

The U8030 Series power supply has features that address the challenges of the conventional approach. Offering up to 375 W at three outputs and excellent load regulation for stable output, the U8030 Series power supply lets you accurately test DC-to-DC converters. Also, the U8030 Series power supply is integrated with safety features such as overvoltage (OVP) and overcurrent (OCP) protection, so you can minimize the risk of damaging your unit-under-test (UUT). The U8032A is the recommended model because its output voltage can be set to a maximum of 60 V.

Prepare the U8030 Series power supply by storing three different voltage levels and setting the time intervals for each stored voltage level. For this test setup, the memory output loop operation is used; this memory output feature always recalls the three stored settings in sequence indefinitely until cancelled.

As an example for a 24 V DC-to-DC converter, you may store the following voltage levels and time intervals into the U8030 Series power supply (see Table 3).

Table 3: Settings to test line regulation for a 24 V DC-to-DC converter

Memory Location	Voltage (V)	Time Interval (s)
M1	18	Δt1=1
M2	36	Δt2=2
M3	18	Δt3=1

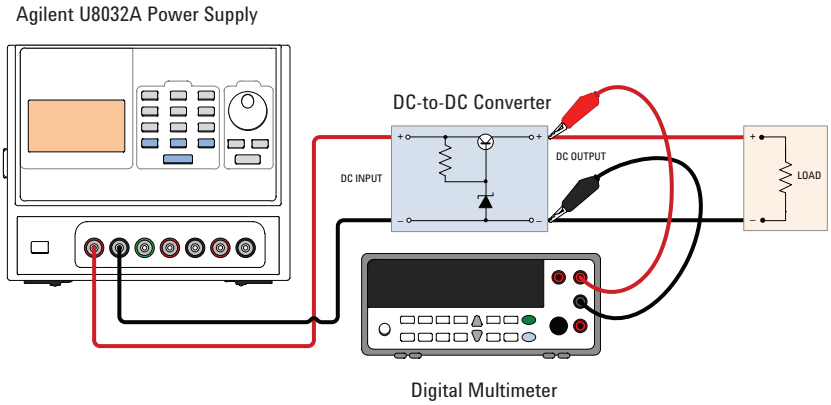

Figure 3: Setup to test line regulation for a 24 V DC-to-DC converter

The setup is shown in Figure 3. Connect the U8030 Series power supply variable output terminals to the input terminals of the DC-to-DC converter with leads that are as short as possible to minimize voltage drop. For safety, the output of the U8030 Series power supply should be turned off while making this connection. The output of the DC-to-DC converter is then connected to a load configured to draw the rated output current. A digital multimeter (DMM) is used to measure the output voltage of the DC-to-DC converter at its terminals. Turn on the U8030 Series power supply output, and enable the memory output loop operation of the U8030 Series power supply, which automatically varies the input voltage to the DC-to-DC converter. The DMM captures the minimum and maximum values of the output voltage of the DC-to-DC converter, which can be compared against its specifications. If the DMM has a limit function, you can set lower and upper limits on the DMM. This notifies the operator if the output voltage falls outside its specifications, creating a simple yet effective automated line regulation bench test without the need for a PC or software. Turn off the U8030 Series power supply output before connecting the next device.

Summary

The U8030 Series power supply is a triple-output DC power supply with an output sequencing capability. In addition to providing excellent load regulation and clean output noise, the U8030 Series power supply has multiple channels so you can perform multiple tests concurrently, thereby increasing your efficiency at performing tests. With the easy-to-use output sequencing feature, you can easily store and recall three settings in sequence either as single or loop operation. By enabling the U8030 Series power supply to automatically sequence through a series of preset voltage steps, you are able to complete your bench tests faster and with fewer errors.

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Revised: January 6, 2012

Product specifications and descriptions in this document subject to change without notice.

Published in USA, January 6, 2012
5990-9662EN

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