4 MORE WAYS TO BUILD YOUR

Power Supply Skill Set: Part 2

KEYSIGHT TECHNOLOGIES

Introduction

Today's designs place higher demands on the systems that power them, and you may find that more of your design problems are being caused by these power systems. This eBook supplements our first set of power skills and provides four additional tips to build your power supply skill set.

Check out the first *4 ways to Build Your Power Supply Skill Set* eBook

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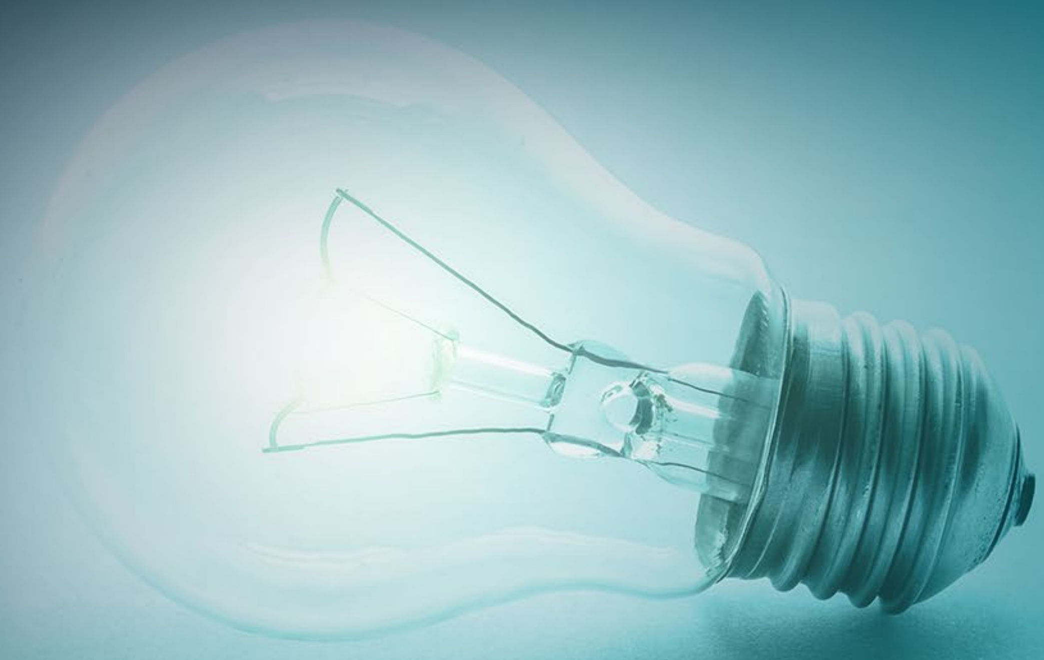
4 More Ways to Build Your Power Supply Skill Set

TIP 1

Powering Low-Power Devices



TIP 1
Powering Low-Power Devices

Many devices are designed to run on lower voltages; and lower current. These low-power devices can easily be destroyed by applying too much power. The best way to avoid power damage is to use a power supply intended for low power applications.

The minimum value for overcurrent protection (OCP) may not be low enough on a higher wattage power supply. A favorite 120 W bench supply limits the OCP to be 100 mA or higher. A lower wattage supply is better suited to power a low-power device. For example, current above 20 mA can damage a sample LED array. It makes sense to use a power supply that can protect a device by limiting current using CV/CC transition or OCP.

CV/CC transition prevents an overcurrent situation by holding the current at the limit. By removing the overcurrent condition, the power supply returns to normal operation. Figure 1 shows a graph demonstrating the current limited to less than 20 mA.

OCP is a latching function. Once the current exceeds 20 mA, the output is set to 0 volts and remains at zero. Clearing the OCP re-enables the output.

A power supply with lower output power typically has less noise than a higher output power supply. The power supply used to test the LED array has less than 350 uVrms output noise.

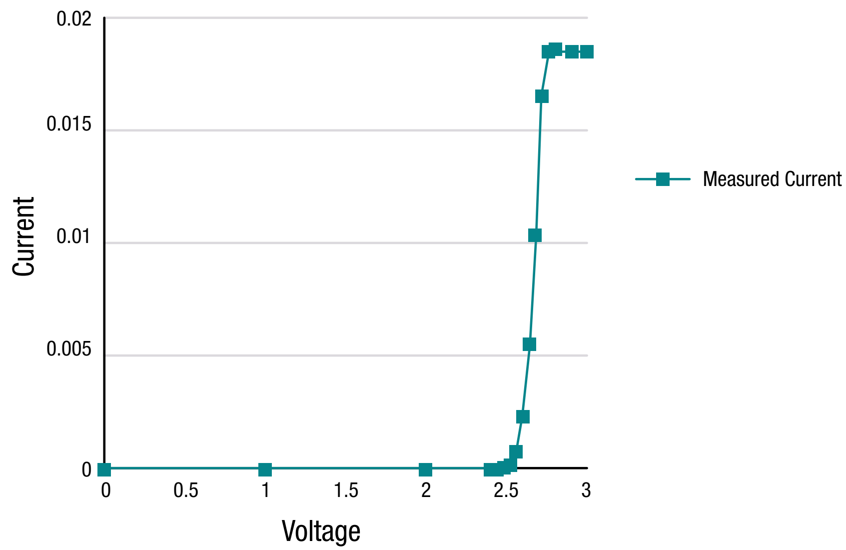


Figure 1: Characterizing the voltage and current for a small LED array with a CC limit of less than 20 mA

The E36312A triple output power supply has a 20 mA range on all three outputs for measuring low currents. **Measurements less than 20 mA are made using its low range** adding additional resolution and accuracy.

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Blog: *The difference between constant current and current limit in DC power supplies*

TIP 2

Characterizing Power Usage Over Time

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Characterizing Power Usage Over Time

Many devices are designed to use varying amounts of power over time. Some devices prolong battery life by switching between an active and sleep state. Batteries and capacitors charge over time. In the past, external analyzers were needed to record the voltage and current over time.

Charging a Supercapacitor

A bench power supply can be used to determine the charge rate of a supercapacitor. Supercapacitors can hold a significant amount of energy and care should be taken to avoid damaging them. The three primary concerns are:

1. Voltage polarity
2. Limiting the charge rate
3. Preventing overvoltage

Supercapacitors are typically designed to operate at 2.7 V or less. Higher voltage charges are possible by using a series of supercapacitors. The charge current needs restriction as supercapacitors will not limit the charge current as they have low series resistance.

A bench power supply can be configured with a maximum voltage and constant current limit. The supply will monitor the voltage and current. These measurements are gathered manually over time, or by a computer.

A simple program or an application, like BenchVue, can query the power supply to collect and plot the data. A few new bench power supplies include a graphical interface and direct to USB memory recording. The example in Figure 2 shows a super capacitor charging at its maximum charge rate of 5 A until it reaches its voltage limit of 2.7 V.

Once the capacitor is at 2.7 V, the capacitor will draw less current over time. The charged capacitor is removed from the power supply to avoid discharging into the power supply. The USB data is later imported into Excel for further analysis.

Figure 2: The E36312A capturing the charging of a 100 F supercapacitor

READ MORE

Tip: *Understanding constant voltage and constant current modes.*

TIP 3

Understanding Transient Response

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Transient Response

Have you ever noticed the lights in your house dim when the air conditioning starts? Air conditioners draw a significant amount of current which cause a drop in voltage which dims the lights. A little while later, the voltage will recover. Changing a load on a DC power supply creates a similar voltage transient. The power's output voltage drops when the demand for current suddenly increases. Likewise, a decrease in current causes the power supply's voltage to rise momentarily. Transient response is the speed at which a power supply recovers to a significant change in the load. For example, the transient response time for E36312A is 50 us to recover within 15 mV when the current changes from 50 percent to 100 percent. The maximum current for channel one is 5 A, and 50 percent is 2.5 A.

WATCH NOW

Video: DC Power Supply Transient response what is it how is it measured and why is it important

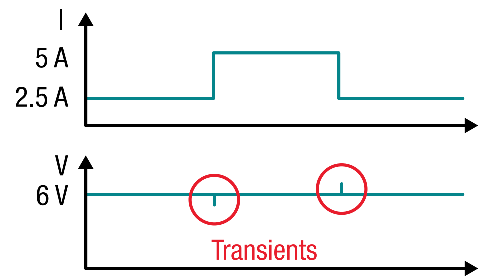


Figure 3: The top chart shows the current profile increasing from 50 percent to 100 percent, and then returning to 50 percent. The corresponding voltage is shown in the lower chart, including small transients.

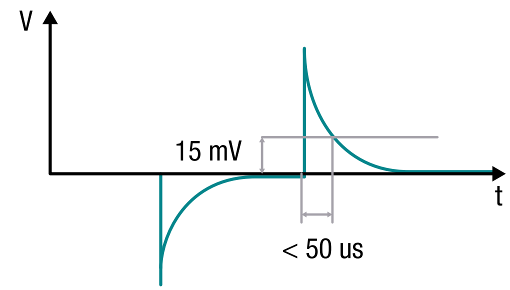


Figure 4: The output voltage in the graph shows the small voltage transients.

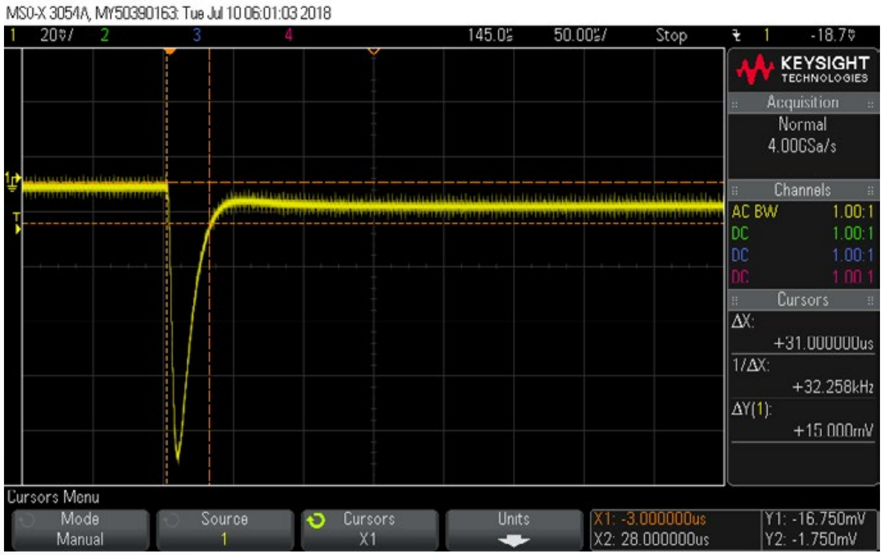


Figure 5a: Transient measurements made on an E36312A channel 1. The voltage recovers to within 15 mV in just over 30 us following a change in current from full load to half, and vice versa.

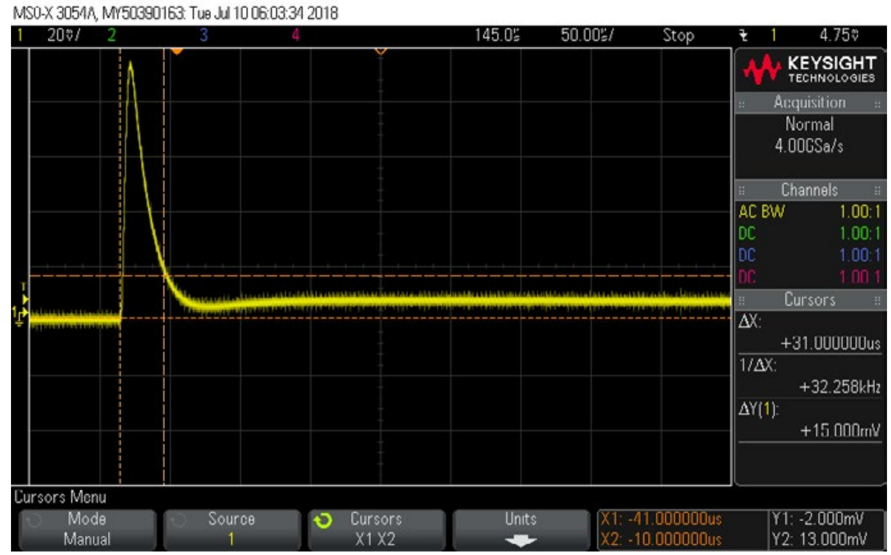
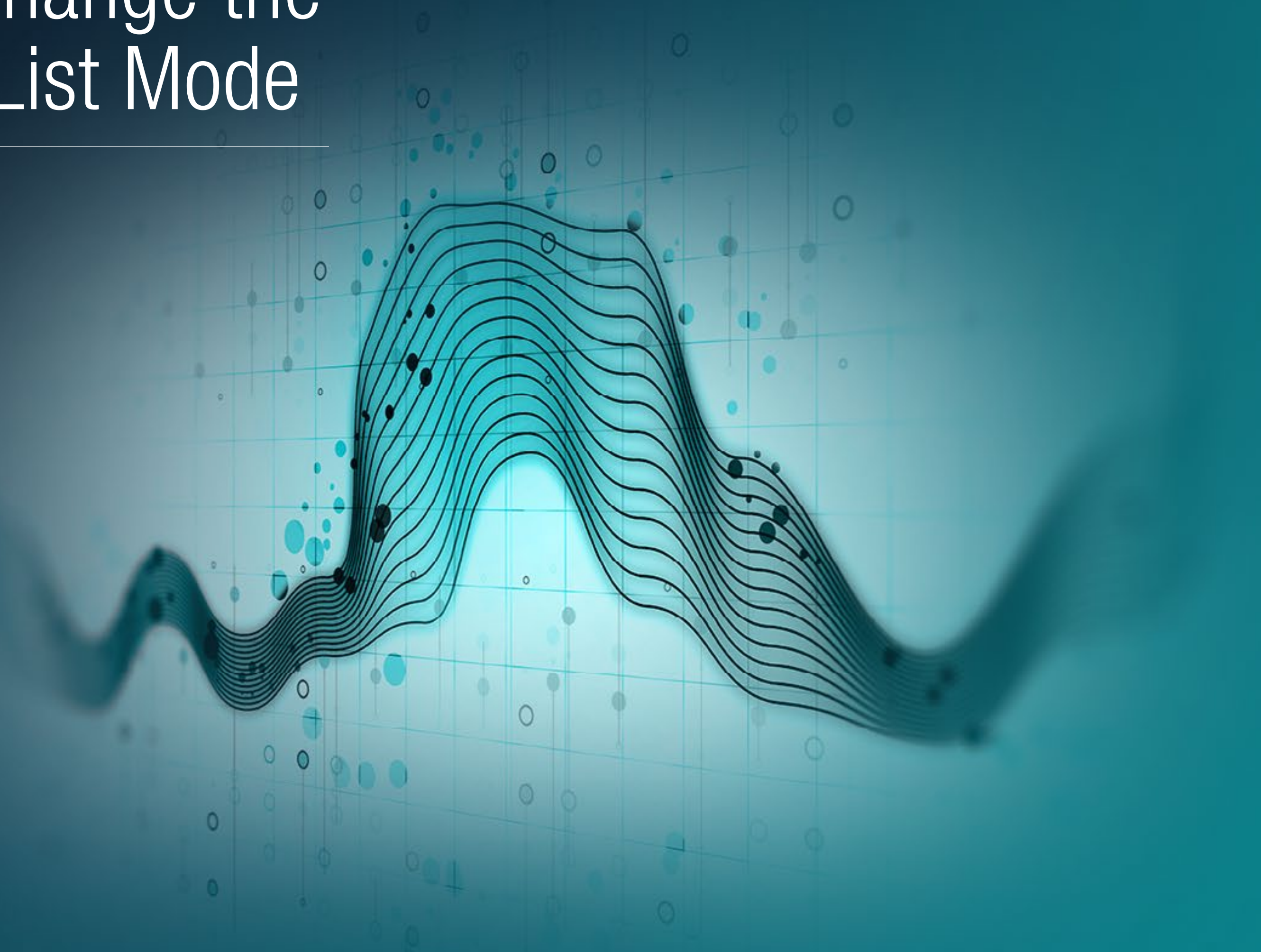


Figure 5b: The peak voltage deviation is not specified as it is dependent on the load. Always, keep the connecting wires short and twisted to help achieve a faster transient response.

TIP 4

Dynamically Change the Output Using List Mode



TIP 4

Dynamically Change the Output Using List Mode

List mode allows a power supply to act like a digital to analog converter, DAC, or low-frequency function generator. Typical applications include generating pulse trains, ramps, and staircase waveforms. Power supplies that offer list mode vary in the maximum number of steps; 100 to 512. Keysight power supplies have several triggering options to allow multiple channel power supplies or external instruments to synchronize with the list. Each step in a list typically includes a voltage level, current limit, and output triggers. Listed below are additional options:

- Use an external trigger or button press to initiate the list
- Advance each point based on time or trigger
- Output the list once or repeat it
- Use a unique list for each output of a multiple output supply
- Ability to hold the output at the last voltage or return to the initial voltage at the end of the list

For example, the list mode can be used to dim a light in a non-linear pattern as our eyes sense the change in light non-linearly. The light appears to dim more uniformly by changing the lamp voltage along a curve as shown in Figure 6. Points along the curve are used to form a list of output voltages. A list can be entered from the front panel of the Keysight E36312A bench power supply, as shown in Figure 7. For this example, you want the power supply to operate as a voltage source and select current values larger than the light requires. The beginning-of-step trigger (BOST) and end-of-step trigger (EOST) are used to generate an external trigger at the beginning and the end of a step.

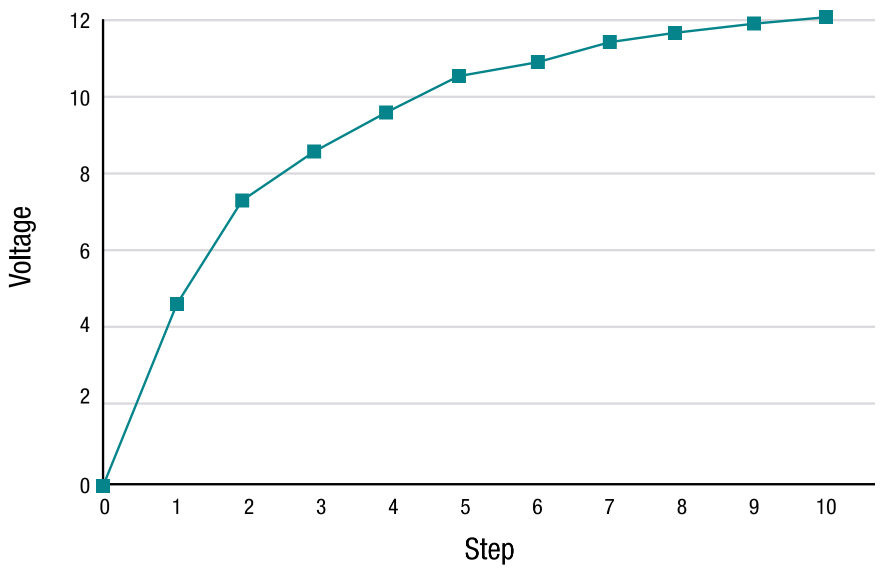


Figure 6: Changing the lamp voltage along a curve provides the appearance of uniform illumination

Output 2 – Output LIST

Step	Voltage	Current	Time	BOST	EOST
0	0.000	1.000	3.000	☑	☐
1	4.600	1.000	3.000	☐	☐
2	7.200	1.000	3.000	☐	☐
3	8.600	1.000	3.000	☐	☐
4	9.700	1.000	3.000	☐	☐
5	10.400	1.000	3.000	☐	☐
6	10.900	1.000	3.000	☐	☐
7	11.400	1.000	3.000	☐	☐

Figure 7: List of steps entered E36312A

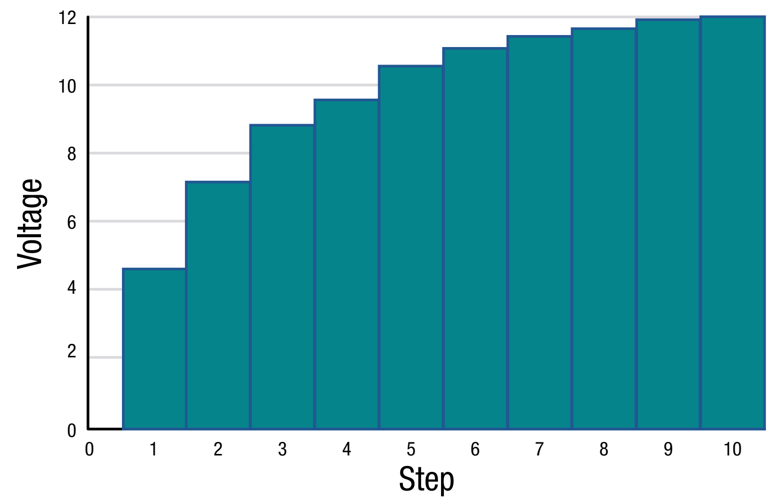


Figure 8: Power supply output based on list

WANT TO LEARN MORE?

Get Our Guide on Selecting Power Supplies

Whether you need a basic power supply or more sophisticated features for specific applications, this guide helps you select the power supply for your needs. Selecting a power supply with too much power can cause lots of headaches. The most common problems are increased output noise, an inability to set current limits, and less meter accuracy.

How Much Power?

Evaluate the voltage, current and power for your device upfront and select a power supply that slightly exceeds the device's limits so that you have enough power to handle transient or surge currents which are common when powering up a device. If you are designing a low power device, use a power supply with a low range that can accurately measure current being drawn.

Built-in Features?

Newer high performance power supplies provide convenient, built-in features to eliminate the need for additional equipment, such as a scope, multimeter or a second power supply. For example, some power supplies come with built-in multimeter level accuracy, or dataloggers that can capture power transients, or even auto-series to cover voltage current combinations that previously required multiple power supplies. Specialized power supplies may include sophisticated features such as dynamic current characterization or the ability to source and synchronize current.

Form Factor?

Bench power supplies should be small, but have large bright displays and front panel connectors. System power supplies are designed to minimize rack space but their longer depth and loud fans do not belong on a bench!

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Selection Guide: *Power Product Solutions*

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