APPLICATION NOTE

Accommodating Start-up Peak Power Demands

Power up your electromechanical or high capacitance devices optimally without interruption

KEYSIGHT

Peak Power Surge Demands

Electromechanical components such as motors, pumps, actuators, and fans are found in many of today's devices and equipment from various industries ranging from power tools, automotive, disk drives, HVAC, robotics to biomedical devices. Many test applications involving electromechanical components or devices containing large, discharged capacitors have peak power requirement that typically demand a quick high start-up current to boot. This start up current typically only lasts for a tiny fraction of time but may be two or three times higher than its usual steady operating current. Figure 1 below depicts an example of a typical peak power surge waveform.

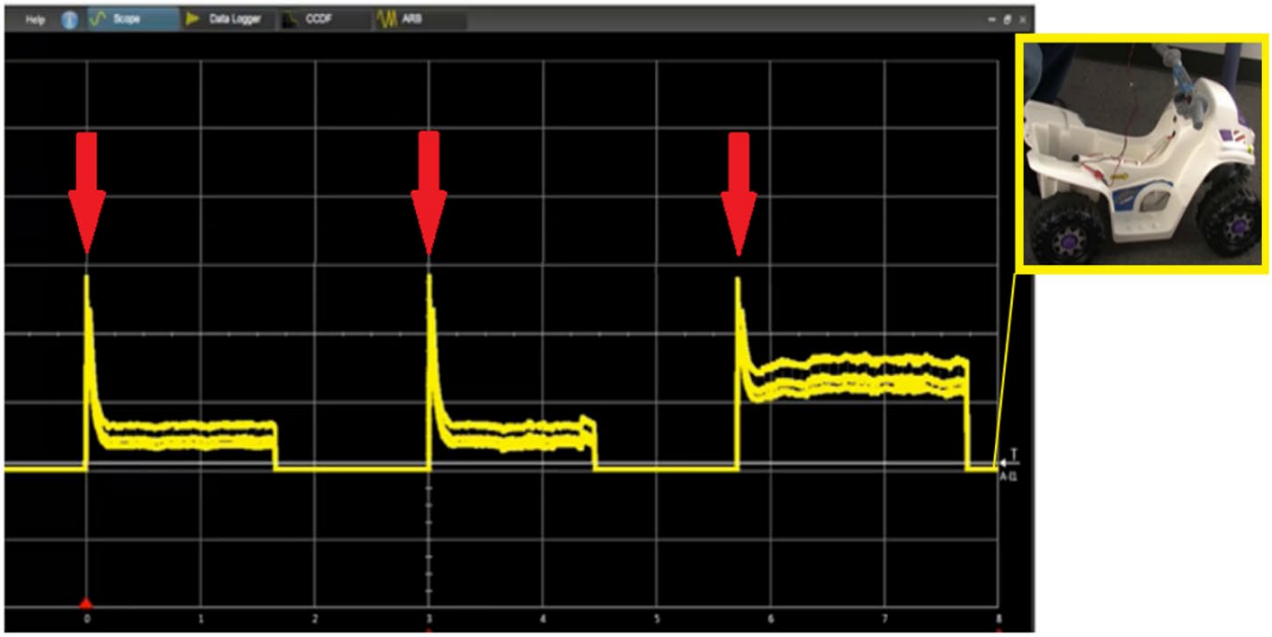

Figure 1. Example of a typical peak power surge waveform. The start-up current spikes as indicated by the red arrows each time the acceleration pedal on a toy electric vehicle (figure subset) is applied.

When selecting a suitable DC power supply, one of the most important specifications that you first need to consider is the power output rating that matches your requirements. Ignoring or failing to consider the start-up peak power requirement can have a negative impact on your power supply by heavily stressing the internal hardware when the load draws far more power than the power supply can accommodate on a regular basis. Your device under test (DUT) may also be damaged or may not operate optimally due to the under-power condition.

However, what if you do not need that highest power or peak power output for the majority time of your tests but only for a very short period of time as outlined in the applications above. Investing in a more expensive, higher power-rated supply for just that tiny fraction of time is probably not ideal as well.

Keysight E36150 Series Provides Peak Power Handling Solution

The E36150A series DC power supply with peak power handling feature is precisely the solution for such applications. The peak power handling feature is suited for accommodating peak power surges of up to three times of its 800W rated output, delivering a total of 2400W for at least seven milliseconds when powering electromechanical devices during testing, whether for R&D, design verification, or manufacturing.

This application note demonstrates the peak power handling feature of this product series and some of the testing requirements or challenges to power up your electromechanical or high capacitance DUTs optimally without interruption, including:

- Sufficient peak power with sharp rise speed
- Peak power duration, interval, and stability
- Scope view for quick time-domain analysis and visualization of the peak power waveform without the need for an external probe and oscilloscope
- Peak power clamping mechanism to protect your power supply and DUTs

Figure 2. Keysight E36150 Series Autoranging DC Power Supply comes with Peak Power Handling and Scope View advance features.

Dynamics of peak power surge demands from electromechanical and high capacitance devices

Whenever electromechanical loads are powered, it draws a huge spike of external current to overcome the threshold forces of inertia from the mechanical loads. Once it generates enough momentum, the current requirement will diminish sharply and then drop to its operational level. As for powering discharged, high capacitance devices, similar huge start-up current is drawn to charge up the large capacitors within. In such scenarios, a power supply will typically switch into a constant current mode to exhaust its maximum current output rating, with undesirable significant drop of voltage output until the capacitance is filled.

The dynamics of the current spike rise- and fall-time can be very rapid. Therefore, the power supply must not only provide sufficient power and duration but also operate at the required speed. In some testing applications, the peak power requirement may be recurring, for example, when the electromechanical in the DUT are powered on and off intermittently. In such a scenario, the power supply would need to provide the peak power source repeatedly, and the interval duration of when the power supply can deliver the next peak power becomes important.

Advantages of powering your devices with E36150 peak power handling feature

The E36150 series power supplies were designed and fine-tuned to deliver stable peak power. The maximum peak power output duration can typically last for at least 7 milliseconds. It can be prolonged and scaled depending on the total power drawn from the connected load. Figure 3 shows examples of typical peak power durations from the E36154A model at two data points of 7ms for 2400W and 21ms for 1600W, respectively. At the end of the peak power duration when all of the peak power storage banks have been exhausted, the constant power loop will kick in to transition the voltage output downward to clamp the total power back to 800W with the current output remaining at 80A. This is the peak power auto-clamping mechanism implementation, which is critical to preventing extended stress to the power supply's internal hardware and ensuring that no forced shutdown occurs during your test setup. In terms of speed, the typical rise time is less than 0.15ms for the peak current to reach the peak at 80A.

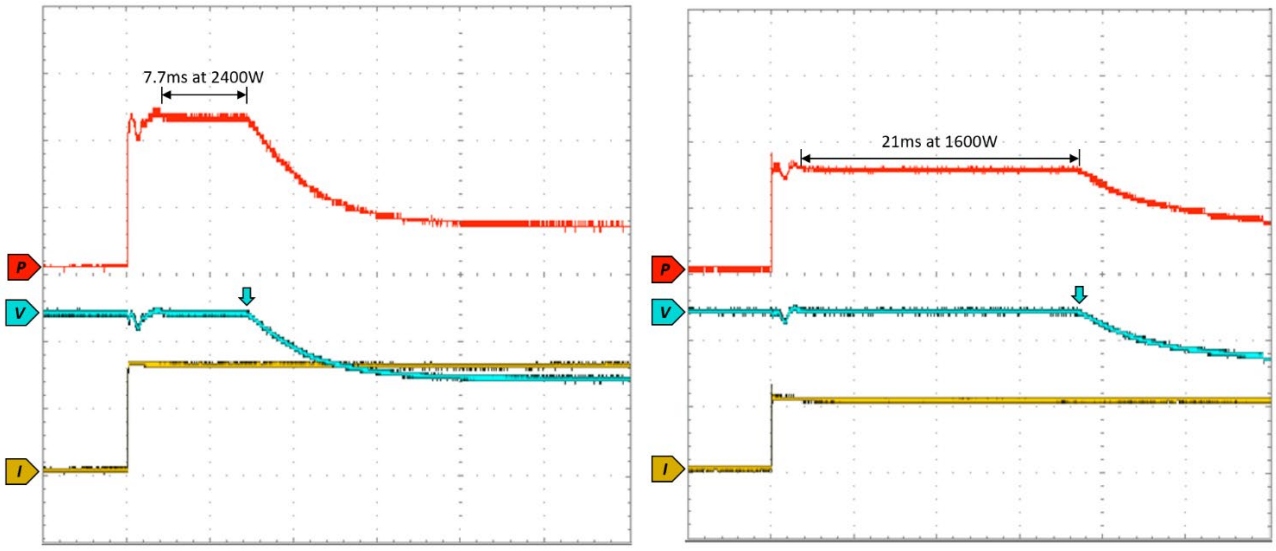

Figure 3. Examples of peak power outputs of 2400W (left) and 1600W (right). The Blue arrow indicates the point of constant power loop activation in the auto clamping mechanism to transition the total power output back to 800W when all of the peak power storage banks have been exhausted.

Figure 4 shows an example of the typical interval durations between peak power outputs from the E36154A model. The typical interval duration is measured at around 250ms for the peak power storage banks to recharge, and the system would be ready for the next peak power discharge with great stability and reliability. The innovative design and extensive fine-tuning have equipped the power supply with this peak power breakthrough capability.

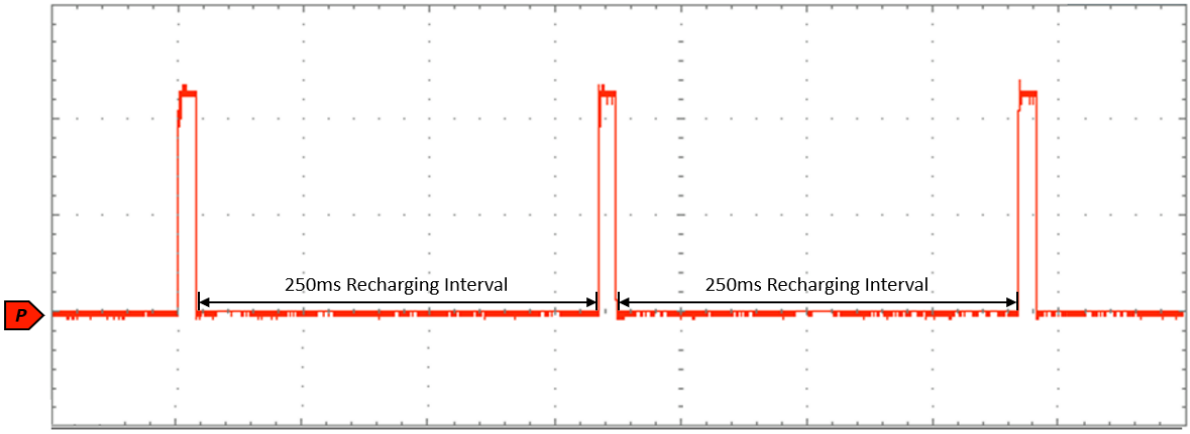

Figure 4. Typical interval durations in between peak power outputs for repeating peak power outputs.

Another useful feature of the E36150 series is the Scope View option, which functions as a built-in oscilloscope, allowing you to quickly visualize and analyze peak power waveforms in the time domain without needing an external probe or oscilloscope. The Scope View utilizes a high-speed digitizer that supports up to 10 us / 100 kHz sampling rate and 256K samples. It allows you to set automatic triggers on when meeting either the current or voltage user-set threshold configuration or programmed into your specific output sequence. Figure 5 shows an example of the voltage and current traces captured during peak power output from the Scope View of the E36154A model.

Figure 5. Current and voltage traces in the time domain captured from the Scope View of E36154A during peak power output.

Conclusion

Using a power supply with peak power handling features is the perfect solution when testing and powering up your electromechanical or high capacitance devices that require a quick surge of peak power source for only a tiny fraction of time rather than investing in a more expensive higher power rating supply that you do not necessarily need. Together with the Scope View feature, it will also allow you to visualize the voltage and current traces in the time domain during peak power output, therefore, eliminating the need for additional external oscilloscope and probe that save you setup time and cost.

Learn more about Keysight's E36150 Series bench power supplies:
www.keysight.com/find/E36150

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