APPLICATION NOTE

Regenerative Power Solution for Automotive Start-Stop Testing

Introduction

Urban driving situations often require a great deal of stop-and-go traffic. Meanwhile, the engine is still running using fuel and producing carbon emissions. A start-stop system's design increases fuel efficiency; it turns off the engine when not in use. For example, if the driver has stopped at a traffic light, the start-stop system stops the engine. As soon as the light turns green and the driver releases the brake pedal, the start-stop starter motor gets the signal to restart the engine. When the driver presses the gas pedal, the car moves away quickly and reliably.

Automatic Start-Stop Testing Process

Testing the start-stop system requires test solutions of the highest caliber of speed, performance, and accuracy to recreate the power signal produced in a car during regular operation. Rigorous test requirements are required to ensure the proper functioning of the vehicle. Every single test must perform to the highest of set standards to ensure the safety of its passengers.

When a vehicle has reached a stopping point at which its engine shuts off, the battery needs to deliver the power necessary to restart the engine again when the car needs to begin moving. It is critical to choose a solution that can accurately emulate the vehicle's many signals during normal operation. Programmable power solutions typically replace power sources such as batteries during testing.

This process enables you to perform the test quickly and accurately. The power solution must have the performance and speed necessary to recreate the power signals produced in a car during operation.

KEYSIGHT TECHNOLOGIES

Test criteria

Output speed: When it comes to output speed, not all power solutions are equal. A power solution's ability to generate a fast ramp change in current / change in time or change in voltage / change in time is key to properly powering on the different systems inside a vehicle — such as the start-stop system. A battery can supply a large current pulse in a short amount of time. A power solution used for this testing should be able to do the same. The ability to generate a high-power signal with fast up and down ramps is a distinguishing factor between power solutions.

Output stability: Ripple and noise are important elements along with the output settling time. When a power signal transitions from high to low or low to high, it requires a period to settle once it has reached its desired level. During this time, a few things can happen. The output could oscillate, causing the voltage to undershoot or overshoot. These occurrences depend on the design of the power solution and how well the circuitry regulates the output.

Figure 1 displays the output behavior of a basic performance power supply as it tries to create a current ramp. There is an overshoot at the peak of the current transition. This resulting waveform is not desirable. In comparison, Figure 2 shows the output behavior of a high-performance power supply under similar test conditions. Because the ramp is stable and does not produce an overshoot, this is the preferred result.

While these types of differences in power supply performance might not seem significant, its impact on automotive testing is mission critical. A test engineer depends on power supplies to provide the required output characteristics. If a power supply fails to perform, it jeopardizes the passenger's safety — every detail counts when it comes to passenger safety.

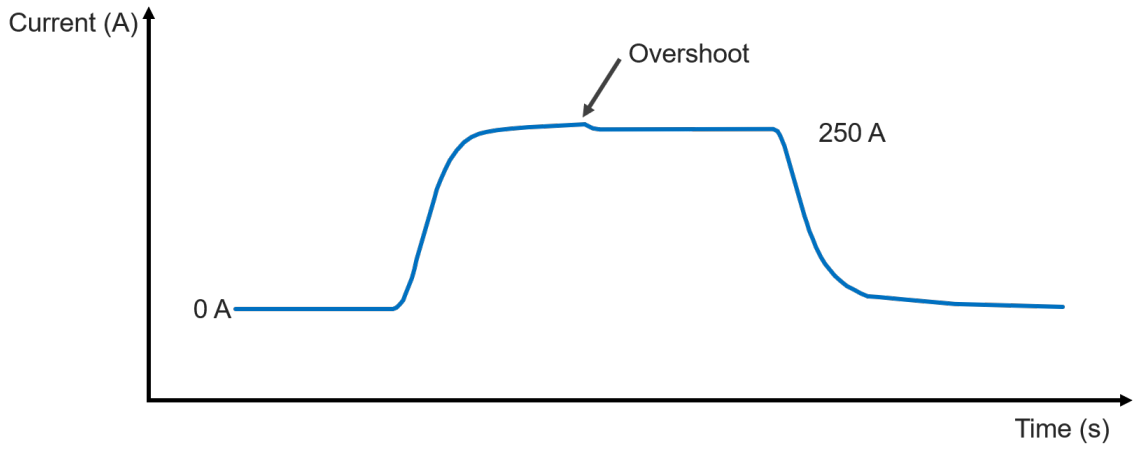

Figure 1. This line drawing shows a current transition from 0 A to 250 A using a basic performance power supply resulting in an overshoot at the peak of the waveform

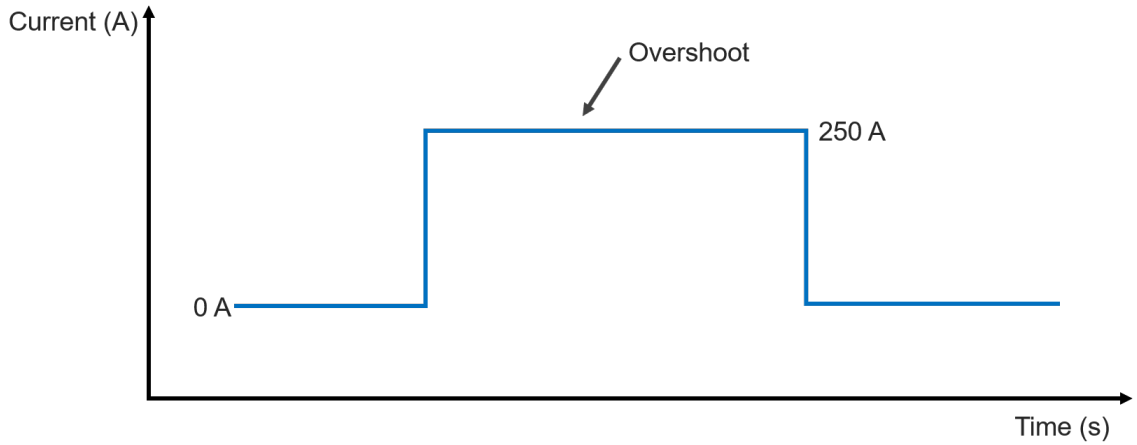

Figure 2. The example shows a current transition from 0 A to 250 A using a high-performance power supply resulting in no visible overshoots

Figure 3 shows the unfavorable settling conditions as the output tries to reach a point of stability. This deviation will invalidate an entire test if the engineer is not aware of the power supply behavior. Figure 4 displays the output behavior of a high-performance power supply under similar test conditions. You will see the deviation disappears, and the result is a current waveform with a clean transition.

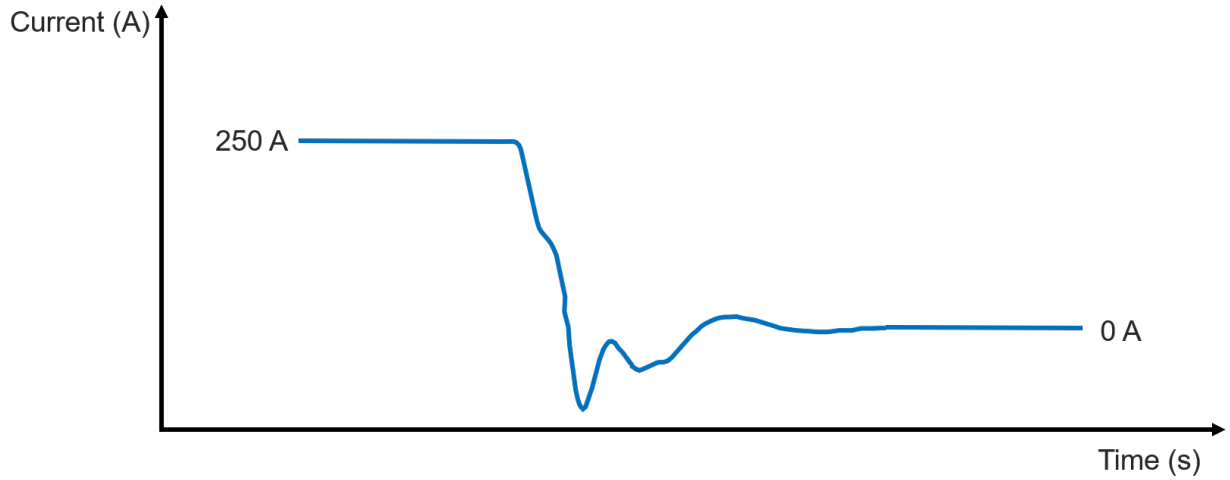

Figure 3. This example shows a current step from 0 A to 250 A using a basic performance power supply resulting in an undesirable waveform

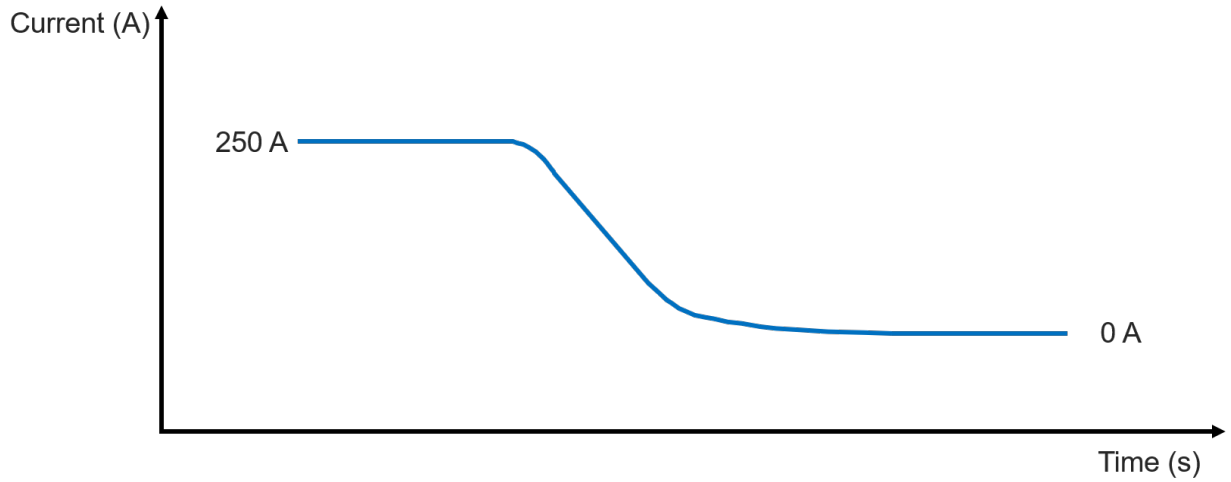

Figure 4. Example of a current step from 0 A to 250 A using a high-performance power supply resulting in a smooth transition

The examples in this application note illustrate testing solutions that vary in their reliability and performance. The goal is to focus on the test and not on the equipment. Choosing high-performance test solutions that deliver high-quality results can lead to a positive return on your investment.

For your automotive test applications such as start-stop systems, the Keysight RP7900 Series regenerative power supply provides both sourcing and electrical loading up to 30 kW. It offers fast output speed and sub-millisecond command process time.

Key Test Applications

The RP7900 Series regenerative power supply offers three different functionalities for simulating either voltage or current transient to emulate real-world automotive testing conditions.

Step: A one-time event that steps the output voltage or current up or down in response to a triggered event.

Constant dwell arbitrary waveforms: An arbitrary waveform generator (ARB) enables you to generate multiple user-defined voltages or current waveforms of up to 65,535 data points. One dwell setting is applicable for the entire ARB — from 10.24 µs to 0.30 seconds.

List: A list can consist of up to 512 steps. Each step has an associated dwell time that specifies the time in seconds the list will remain at that step before advancing to the next step.

Summary

In addition to output transients, the RP7900 Series regenerative power supply is a bidirectional power supply offering a continuous and seamless transition between sourcing and sinking. It can sink 100% of its rated output current for an indefinite amount of time. A bidirectional supply is ideal for testing energy storage and converters.

Most electronic loads convert energy to heat, causing a temperature rise in a rack leading to measurement errors. A regenerative power supply safely returns the energy to the grid eliminating additional expense to remove the excess heat. The RP7900 Series regenerative power supply returns 90% of power to the grid, reducing cooling costs.

When it comes to vehicle testing, every detail matters — the RP7900 Series regenerative power supply will meet your automotive test requirements to ensure passenger safety.

Web Resources

To learn more, please visit RP7900 Series regenerative power supplies.

Watch the RP7900 Series regenerative power system overview.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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