Advances in semiconductor technology have allowed ICs to replace many mechanical relays, but relays still dominate in high-current circuits that must stand off high voltages of arbitrary polarity. Contact bounce in those relays, however, can prove troublesome to downstream circuitry. One approach to contact bounce combines a relay with a hot-swap controller. Such controllers are increasingly popular as the means for switching system components without shutting down the system power. In Figure 1, a relay contact replaces the pin of a mechanical connector. The drive circuit drives the relay closed, and that relay closure connects the input of the hot-swap circuitry to the power supply: 28V, in this case. The hot-swap controller, IC1, keeps the p-channel MOSFET, Q1, off for a minimum of 150 msec after the input supply reaches a valid level. That delay allows ample time for contact bounce in the relay to subside. After the 150-msec delay, IC1 drives the MOSFET gate such that the output voltage slews at 9V/msec. This controlled ramp rate minimizes the inrush current, thereby reducing stress on the power supply, the relay, and capacitors downstream from the hot-swap controller.

An example of relay contact bounce shows three bounces with an inrush-current peak of almost 30A (Figure 2). The top trace is output voltage at 10V/division, the lower trace is input current at 5A/division, and the output load is 54Ω in parallel with 100 µF. Use of the Figure 1 circuit under these conditions yields a better picture (Figure 3). The delayed rise in output voltage is clearly visible, with no hiccups arising from contact bounce. The input current shows much less variation, peaking under 1.5A before settling to a steady-state value of 500 mA.