Double-Pulse Test for SiC & GaN

Characterize switching loss, turn-on and turn-off behavior, and reverse recovery in wide-bandgap power devices with a clean, stable bus rail behind every pulse.

APPLICATION BRIEF · HVX-SERIES HIGH VOLTAGE POWER SUPPLIES · dc-62022201

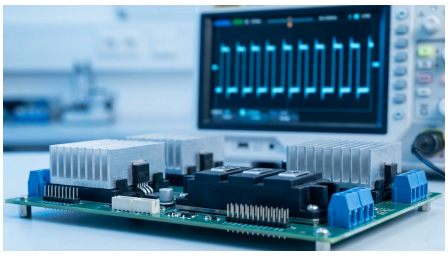


Illustration: a power-module evaluation board with heat sinks and screw terminals in front of an oscilloscope. The hero image was kept by decision in fix batch 1.

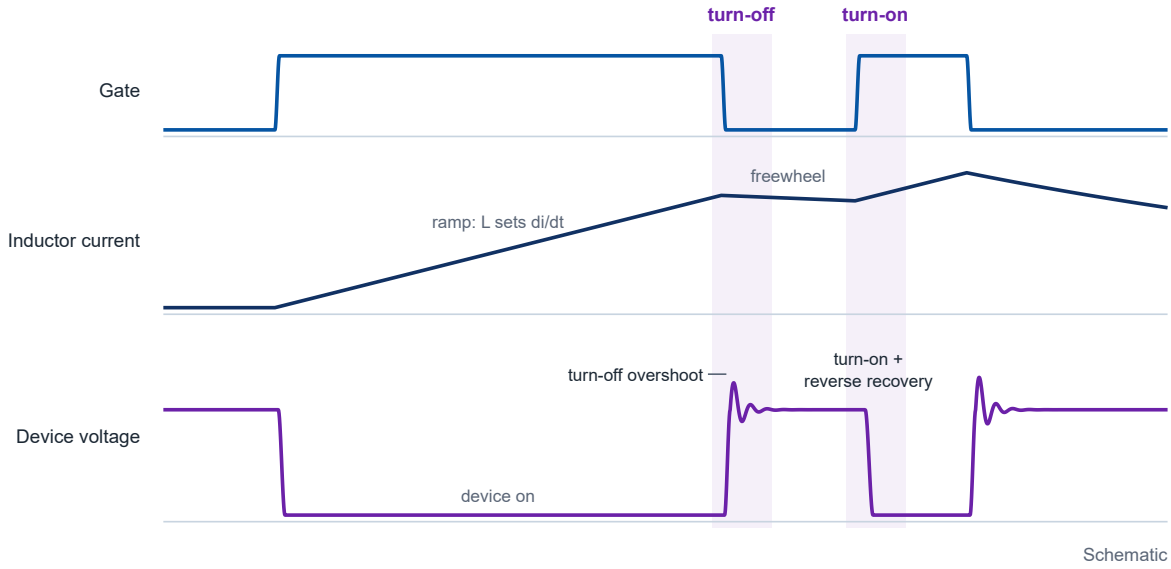
Double-Pulse Test for SiC & GaN

The double-pulse test is the standard way to characterize a power switch. Two gate pulses drive the device under test while an inductive load sets the current, and the oscilloscope captures the device through turn-on, turn-off, and the reverse recovery of the freewheeling diode. From those waveforms come the numbers that define the part: switching energy, voltage and current overshoot, di/dt and dv/dt, and the safe operating boundaries. It is the test that tells a power-electronics designer whether a device will survive in a real converter.



Silicon carbide and gallium nitride make this test harder than it used to be. Wide-bandgap devices switch fast, with edges of a few nanoseconds to a few tens of nanoseconds and slew rates that silicon did not reach. That speed is the whole point, but it puts strict demands on the bench. The DC bus that holds the test voltage has to be steady and quiet, because any ripple or droop on the rail shows up directly in the measured loss numbers and corrupts the comparison between devices. The pulse current itself comes from the bus capacitor, not from the supply: a pulse of a few microseconds is far shorter than any regulator's response, so the capacitor supplies the charge and the supply's job is to recharge it to the same voltage before the next pulse pair.

Then the bench has to reset and run again. Characterization sweeps the same device across many bus voltages and load currents, and a production or qualification flow repeats that across many parts. The supply needs to step to a new bus voltage quickly, settle, and report that it is ready, so the next pulse fires against a known condition.



SCHEMATIC **Figure 1.** The double-pulse test. The inductor sets di/dt during the first pulse, the off time freewheels the current, and the two switching transitions, turn-off overshoot and turn-on with reverse recovery, are where the loss numbers come from. The bus rail behind all of it has to stay put.

How the BNC HVX-Series line solves it

The BNC HVX-Series gives a double-pulse bench the clean, stable rail it needs. The supply is fully digitally regulated with a microcontroller and FPGA, so the bus voltage is held tightly: ripple is specified at 0.01 percent of nominal plus 100 mV peak to peak, which is 0.25 V on a 1.5 kV unit, line regulation is tighter than plus or minus 0.01 percent of nominal across a 10 percent mains swing, and stability holds within 0.01 percent of nominal over an eight-hour session. A quiet rail means the switching-loss numbers reflect the device, not the supply.

Recharge between pulses is the other half. After a load change the HVX-Series recovers to within 0.1 percent of nominal in **under 1 millisecond**, so the bus capacitor is back at its set voltage well before the next pulse pair, and the 16-bit setting resolution, about 23 mV on a 1.5 kV unit, makes fine bus-voltage sweeps practical and repeatable. The supply charges the bus capacitor, holds it between pulses, and reports its state over the on-board interface.

Control is automation-ready. Ethernet and RS232 with a standard SCPI command set let the supply take bus-voltage commands from the same script that drives the pulse generator and the scope, and the time-tagged event log records the run. Rack the 2U enclosure into the double-pulse bench beside the rest of the instrumentation.

Which HVX-Series models and options fit

Double-pulse bus voltages follow the device rating: 650 V and 1200 V parts are tested at bus voltages of about 400 V to 800 V, 1700 V parts up to about 1200 V, and 3.3 kV modules up to about 2.2 kV, so the 1.5 kV class covers most device work and the 5 kV class covers high-voltage modules.

Table 1.

Need	Recommended HVX-Series model	Rating
650 V to 1700 V SiC and GaN, bus to 1.5 kV	HVX-1500-2000	1.5 kV, 2000 mA, reversible
3.3 kV modules, bus above 1.5 kV	HVX-5000-400	5 kV, 400 mA, reversible

Need	Recommended HVX-Series model	Rating
6.5 kV and 10 kV modules and stacks	HVX-10000-200	10 kV, 200 mA, reversible

For a double-pulse bench the option that matters most is **Arc Detection**. Wide-bandgap devices that fail during a switching test fail fast, and a supply that detects the flashover and shuts the output off protects the fixture, the scope front end, and the surrounding instrumentation, while capturing the exact point of failure. **Ramp Control** is useful for bringing the bus capacitor up at a defined gradient rather than an inrush step, which is gentler on the bus film capacitors and gives a controlled, repeatable charge. Choose the reversible variant where the characterization plan exercises both polarities of the device.

Recommended configuration

For a double-pulse bench covering 650 V to 1700 V SiC and GaN parts, a **HVX-1500-2000** is the center. Its 1.5 kV range covers the bus voltages those devices are tested at, its 0.25 V ripple floor and 23 mV setting step are less than half the 5 kV unit's 0.6 V and 76 mV, and 2 A of charging current recharges the bus capacitor quickly between pulse pairs. Reversible polarity is rarely needed for a double-pulse bus; order it where the plan also exercises the device in reverse. Add **Arc Detection** with output shut-off as the primary protection and **Ramp Control** for a controlled bus charge.

Benches testing 3.3 kV modules at bus voltages above 1.5 kV step up to the **HVX-5000-400**, and 6.5 kV and 10 kV modules use the **HVX-10000-200**. In every case, drive the supply over Ethernet with SCPI from the same sequencer that controls the gate driver and the oscilloscope, and rack the 2U unit into the bench.

Talk to an application engineer

Berkeley Nucleonics can help you match a HVX-Series model and option set to your double-pulse bench. Call **800-234-7858** or email info@berkeleynucleonics.com.

For a quick question, chat with an engineer at berkeleynucleonics.com.

Ask now → Chat with our assistant and get an answer in seconds.