Simple, Fast Pulse Source Outpaces Expensive Lab Equipment

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A source of fast pulse edges, simulating a step function, is often useful in making lab measurements of one kind or another. For example, it is possible to evaluate the rise time of RG-58/U or other coaxial cables using lengths of only 10 to 20 feet if an edge rate on the order of 1ns–2ns is available. The ubiquitous HP8012B pulse generator, a workhorse in many labs, falls short at 5ns, and is not quite fast enough for the task at hand. The gate drive output rise and fall times of certain switching regulator controllers are faster than 2ns, making such devices potentially ideal pulse sources.

Figure 1 shows a simple implementation using an LTC3803 constant frequency flyback controller. The controller self-clocks at 200kHz; applying a sample of the output to the SENSE pin causes the device to operate at its minimum duty cycle, producing a 300ns output pulse width. Supply bypassing is important, as the output delivers upwards of 180mA into a 50Ω load. The 10µF bypass and 200Ω decoupling components minimize pulse top aberration without compromising droop.

The output directly drives a 50Ω termination to nearly 9V. If pulse fidelity is of prime importance, back termination (as shown) is recommended to suppress triple transit echos by absorbing reflections from cabling and the far-end termination. Back termination is also useful when driving passive filters and other attenuators, which expect to see a specific generator impedance. The LTC3803 output impedance is about 1.5Ω, which should be borne in mind when choosing a back termination resistor. Back termination works well up to impedances of at least 2k, beyond which it is difficult to support the necessary bandwidth in the resistor and circuit connections, degrading pulse fidelity.

In a back-terminated 50Ω system the output characteristics are as follows: pulse amplitude 4.5V, symmetric rise and fall times of 1.5ns, pulse top aberration less than 10% and droop well under 5%. The rise and fall times are not degraded when directly driving 50Ω. For best pulse fidelity, connect the 10µF supply bypass capacitor as close as possible to the V_{CC} and GND pins of the LTC3803, and route the output directly to the back termination resistor and/or connector using stripline techniques. A 100-mil trace width on 1/16-inch, double-sided board approximates a 50Ω surge impedance. ■

Figure 1. Switching regulator controller produces 1.5ns edges into 50Ω