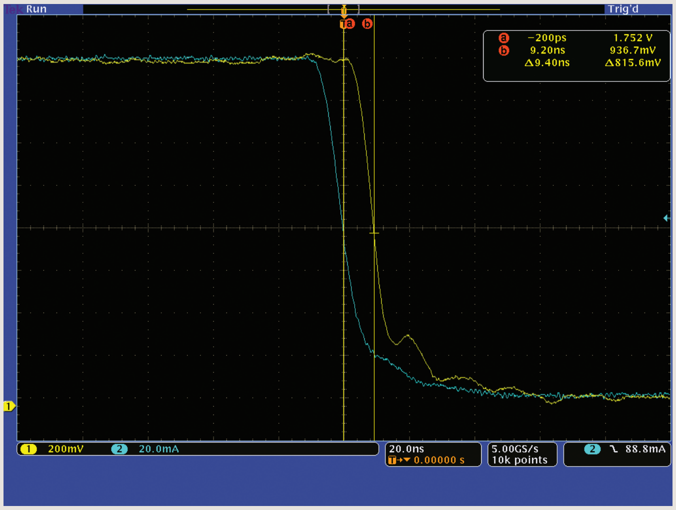

Figure 3. 9.4 ns skew between voltage and current signals.

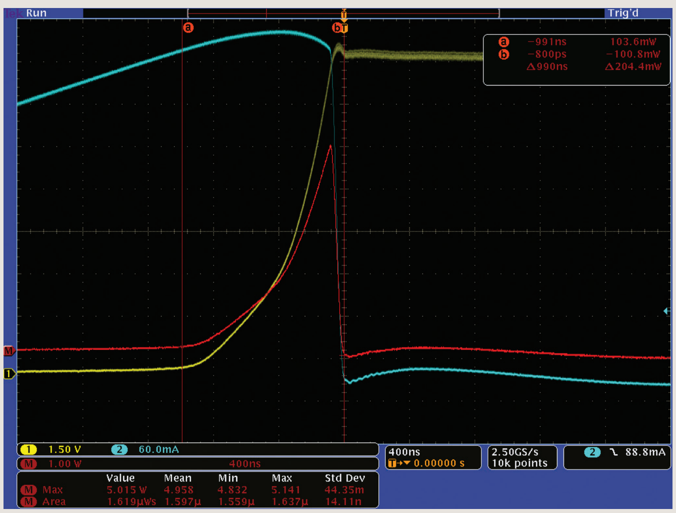

Figure 4. With skew, the peak amplitude of the power waveform is 5.141 W.

Making Accurate Power Measurements: Probing Considerations

Eliminating Skew between Voltage and Current Probes

To make power measurements with a digital oscilloscope, it is necessary to measure voltage across and current through the drain-to-source of the MOSFET switching device or the collector-to-emitter of an IGBT. This task requires two separate probes: a high-voltage differential probe and a current probe. Each of these probes has its own characteristic propagation delay. The difference in these two delays, known as skew, causes inaccurate power measurements and distorted timing measurements.

It is important to understand the impact of the probes' propagation delays on maximum peak power and area measurements. After all, power is the product of voltage and current. If the two multiplied variables are not perfectly time aligned, then the result will be incorrect. The accuracy of measurements such as switching loss suffers when the probes are not properly de-skewed.

Figures 3 through 6 are actual oscilloscope screen views that demonstrate the effects of skew in probes. Figure 3 reveals the skew between the voltage and current probes, while Figure 4 displays the results (5.141 W) of a measurement taken without first de-skewing the two probes.

Figure 5 shows the effect of de-skewing the probes. The two reference traces are overlapping, indicating that the delays have been equalized. The measurement results in Figure 6 illustrate the importance of proper de-skewing. As the example proves, skew introduced a measurement error of 5.3%. Accurate de-skew reduces error in peak-to-peak power loss measurements.

Some power measurement software will automatically de-skew the chosen probe combination. The software adjusts the delay between the voltage and current channels using live signals to remove the difference in propagation delay between the probes.

Also available is a static de-skew function that relies on the fact that certain voltage and current probes have constant and repeatable propagation delays. The static de-skew function automatically adjusts the delay between selected voltage and current channels based on an embedded table of propagation times for selected probes. This technique offers a quick and easy method to minimize skew.

Eliminating Probe Offset

Differential and current probes may have slight amplitude offset. This offset should be removed before taking measurements because it can affect accuracy. Some probes have a built-in, automated method for removing the offset.

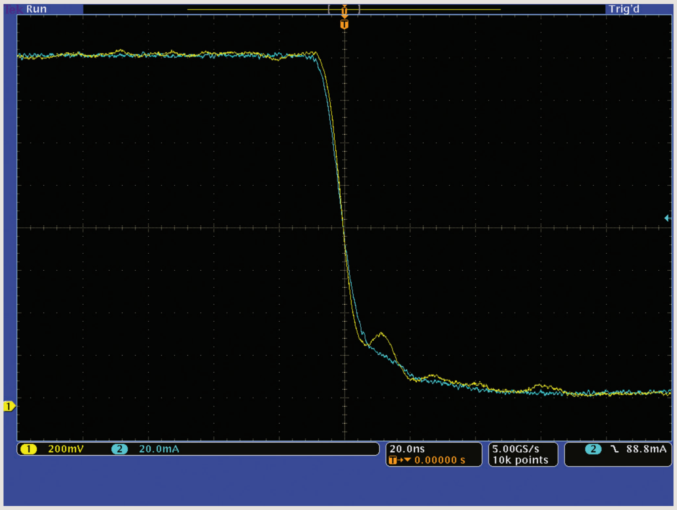

Figure 5. Voltage and current signals aligned after de-skew process.

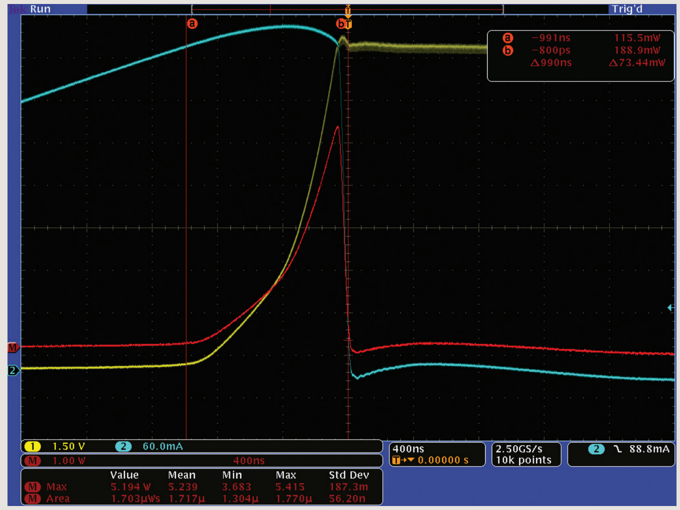

Figure 6. Peak amplitude has risen to 5.415 W (5.3% higher) after de-skew.

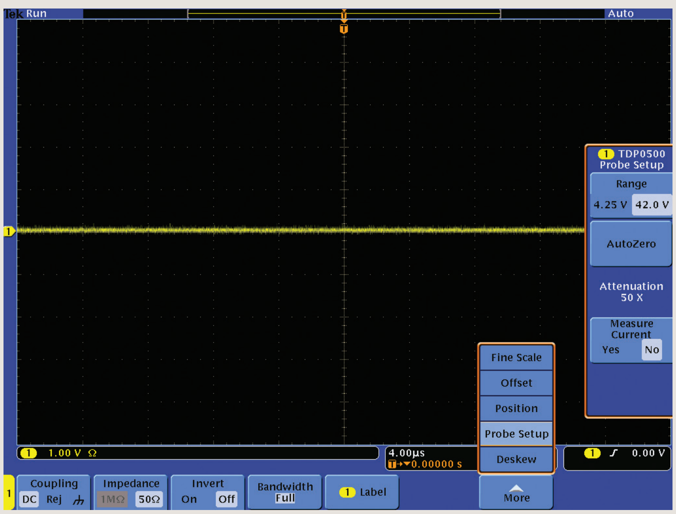

Figure 7. TekVPI probe menu displaying the AutoZero feature.

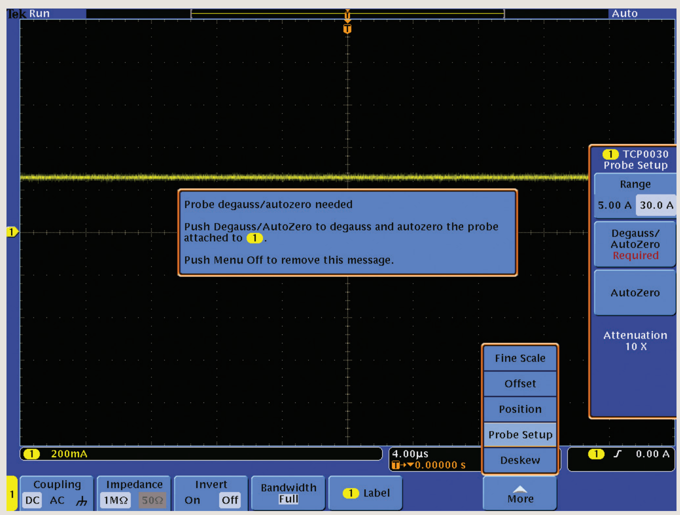

Figure 8. Degauss warning indicator alert from a TekVPI current probe.

A probe that is equipped with the Tektronix TekVPI™ Probe Interface works in conjunction with the oscilloscope to remove any DC offset errors in the signal path. Pushing the Menu button on a TekVPI probe brings up a Probe Controls box on the oscilloscope that displays the AutoZero feature, as shown in Figure 7. Selecting the AutoZero option will automatically null out any DC offset error present in the measurement system.

A TekVPI current probe also has a Degauss/AutoZero button on the probe body. Depressing the AutoZero button will remove any DC offset error present in the measurement system. Degauss removes any residual DC flux in the core of the probe's transformer, which may be caused by a large amount of input current. Tektronix TekVPI current probes offer a Degauss warning indicator, as shown in Figure 8, which alerts the user to perform a degauss operation, preventing the probe from significantly drifting over time and impacting measurement accuracy.