1-GHz Optically Isolated Measurement System Offers 120 dB CMRR Up to 100 MHz

At the recent APEC conference in Long Beach, Tektronix previewed IsoVu, a new measurement system platform that offers complete galvanic isolation between a device under test (DUT) and an oscilloscope through the use of electro-optical sensors. According to the company, IsoVu is the industry's first measurement solution capable of accurately resolving high-bandwidth differential signals in the presence of large common-mode voltages. The technology will also offer immunity to external interference and radiated emissions, minimizing the impact of EMI on measurements.

To date, design engineers working on power device designs involving GaN and SiC power devices and other high-speed applications have had no way to accurately visualize differential signals when common-mode interference is present. As a result, these signals are essentially hidden, making it difficult for engineers to see what is actually occurring inside circuits, slowing debug and characterization efforts. Engineers also face challenges making measurements in noisy environments or those that have high EMI.

The IsoVu technology has the potential to resolve these challenges. It uses an electro-optic sensor to convert the input signal to optical modulation, which electrically isolates the device-under-test from the oscilloscope. IsoVu incorporates four separate lasers, an optical sensor, five optical fibers, and sophisticated feedback and control techniques. The sensor head, which connects to the test point, has complete electrical isolation and is powered over one of the optical fibers (see Fig. 1.) Ten patent disclosures have been filed for this technology. This system is only compatible with Tek scopes having the VPI interface, which represents many of the instruments Tektronix has produced over the past ten years.

"This is an outstanding example of the type of innovative thinking that drives us at Tektronix to tackle difficult problems that have never been resolved in the past," said Earl Thompson, senior vice president, Time Domain Business Unit, Tektronix. "There's no getting around the fact that an electrical connection between the oscilloscope and the device under test impacts measurement results. By moving to an optical connection, this technology has the potential to eliminate that as a problem and as a result could significantly advance the state-of-the-art in power measurement and EMI test systems."

According to Tom Neville, product marketing manager at Tektronix, the design of IsoVu started with input from customers who expressed a need for isolation, wide bandwidth, and common-mode rejection. "In particular, we talked to the GaN vendors because they have the most stringent requirements," said Neville.

After looking at 15 different architectures, Tek found the way to meet the requirements was to use optical isolation with power over fiber, which eliminates the need for batteries or wall warts to power the sensor electronics. In addition, the sensor head is mounted on a standard camera tripod, which places it about 6 inches above the board being probed, minimizing capacitive coupling to ground (typically about 2 pF). Since the sensor head is optically isolated this small parasitic capacitance is the only common-mode loading on the measurement.

IsoVu technology offers greater than 120-dB common-mode rejection (CMR) from dc to 100 MHz. According to the company, this is 100 dB better than previously available measurement systems (Fig. 2.) At 1 GHz, it will provide 80 dB (10,000:1) CMRR, which is more than a thousand times better than previously available measurement systems. As a result, users will be able to measure anywhere in their circuit without common-mode interference.

Using this technology, engineers will be able to accurately measure small differential signals (5 mV to 100 Vpp) in the presence of large common-mode voltages less than 2 kV from dc to 1 GHz. This will be the first signal acquisition product where the common-mode voltage capability does not de-rate over bandwidth (Fig. 3.)

According to Neville, IsoVu enables engineers to view signals that were previously unviewable due to loading of the measurement. As an example he cites ripple on the high-side gate in a GaN-based power converter. "Now customers can see the true $V_{GS}$."

Adding to its versatility, Tektronix plans to offer a 10-meter fiber optic cable option with the same performance specifications as the 3-meter option to allow users to move their test system away from the interference and radiated emissions of the device under test. As such, it will be well-suited for such applications as remote testing and EMI validation. A variety of plug-in tip options will be offered. IsoVu will begin shipping in the third quarter.
For more information, see the Tektronix white paper, “IsoVu Optically Isolated DC - 1 GHz Measurement System Offers >120 dB CMRR with 2kV Common Mode Range,” published 3/16 and available online.

**Fig. 1.** A new measurement system that addresses the needs of GaN and SiC devices, IsoVu uses an electro-optic sensor to convert the input signal to optical modulation, which galvanically isolates the device under test from a Tektronix oscilloscope. IsoVu is touted as the only measurement system with the combination of wide bandwidth (1 GHz), wide dynamic range (up to 50 V differential), high common-mode range (up to 2 kV) and high common-mode rejection (120 dB up to 100 MHz).

**Fig. 2.** The CMRR of Tektronix’s IsoVu measurement system offers 120 dB of CMRR at 100 MHz. In contrast, Teledyne LeCroy’s DA1855A differential amplifier, which according to Tek had been the gold standard for CMRR with 120-dB CMRR at dc, derates to just 20 dB at 100 MHz. And that is just the diff amp and doesn’t include the effects of the probe.
Fig. 3. Unlike previous measurement systems, IsoVu does not derate dynamic range over frequency.