

The Power to Measure Power: Tektronix Oscilloscopes Supporting Advanced Research at U.C. Irvine



Solution Summary

Challenge	Research and advance high frequency switched circuit power processing technology
Solution	Tektronix TDS3000B Series digital phosphor oscilloscopes
Benefits	Excellent bandwidth, high sample rate, FFT math functionality, and easy storage and documentation

Every electronic device – from cell phones to computers to satellites – requires power to operate properly. However, traditional power processing circuits are low in efficiency and bulky in size. In recent years, high frequency switching circuit technology has developed into the trend of the future, facilitating power with great efficiency, small size, and low weight.

The research and advancement of switched circuit power processing is the goal of the Power Electronics Laboratory at the University of California, Irvine. With a worldwide reputation for innovative research, unique industrial applications, and high-quality graduate students, the laboratory has set a precedent for excellence. Its research goal is to find simple, elegant, and effective solutions to fundamental and persistent

engineering problems, generalize its theoretical findings, and provide modern design guidelines to the engineering community.

Equipped with state-of-the-art instrumentation for design, simulation, layout, and prototyping of switching/analog circuits, the Power Electronics Laboratory requires equally proficient test and measurement tools. Without them, faculty and students at U.C. Irvine would not be able to conduct research on topics such as switching flow-graph nonlinear modeling, one-cycle control of Class-D amplifiers, power factor correction methods, active power filters, and active and passive soft switching methods.

In designing and creating innovative circuits that store, convert, and supply power, members of the Power Electronics Laboratory are dependent upon numerous Tektronix TDS3032B and TDS3054B oscilloscopes.

“We’ve used a variety of test tools, but we prefer Tektronix instruments because of their straightforward operation, high performance and accuracy, and advanced functionality,” indicated Dr. Guozhu Chen, Professor of Power Electronics, U.C. Irvine.

A digital phosphor oscilloscope (DPO), TDS3000B models deliver superior insight into complex signals with the ability to display, store, and analyze three dimensions of signal information in real-time: amplitude, time, and distribution of amplitude over time. Fast waveform capture rates make it easier to acquire and display infrequent waveforms or waveform variations, while the intensity-graded display helps U.C. Irvine faculty and students locate and characterize waveform anomalies that can be elusive on traditional digital storage oscilloscopes.

TDS3000B Series oscilloscopes are ideal for power supply design and troubleshooting, providing the ability to measure voltage, current, power, and harmonics.

Faculty and students in the Power Electronics Laboratory are using the instruments to acquire and analyze both static state and dynamic state measurements of their circuits. The former requires considerable oscilloscope bandwidth to ensure that high-frequency signals are remaining constant. The latter requires high oscilloscope sample rate to capture sudden changes in both voltage and current.

“Test and measurement tools from other companies provide sufficient bandwidth, but not high enough sample rate or waveform capture rate,” said Dr. Chen. “We not only need high bandwidth to measure the static state waveforms, but also single-shot acquisition to capture the fast shifts in dynamic state signals. The combination of bandwidth, sample rate and waveform capture rate provided by Tektronix is rare, and absolutely necessary for measuring power electronics.”

TDS3000B models range in bandwidth from 100 MHz to 600 MHz, sufficient for most power supply switching

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frequencies. The instruments provide sample rates up to 5 GS/s and up to 3,600 wfms/s waveform capture rate, capturing and displaying fast current and voltage fluctuations.

In addition to acquiring static state and dynamic state signals, the faculty and students of the laboratory are also calculating the harmonic spectrum of their power circuits. These measurements require sophisticated math capabilities provided by the TDS3000B Series’ Fast Fourier Transform (FFT) feature. FFT offers advanced analysis functionality that converts a time domain acquisition into a true harmonic display, revealing the relative magnitude of the harmonics to the fundamental frequency.

“In the past, we had to transfer waveform data onto a PC, use software to convert the time domain into frequency measurements, and then compute the voltage, peak value, and frequency of our circuits,” mentioned Dr. Chen. “It was a slow, inaccurate process. The FFT functionality of the TDS3000B Series oscilloscopes allows us to determine the purity and harmonics of our waveforms with the touch of a button.”

Dr. Chen also indicated the instruments’ 9-bit vertical resolution is critical for acquiring, viewing, and storing long waveforms.

TDS3000B Series Oscilloscopes Offer Easy Operation and Documentation

Members of the U.C. Irvine Power Electronics Laboratory use the TDS3000B Series oscilloscopes for more than power measurements and math computation. The instruments’ ease-of-use and integration with PCs greatly enhance their ability to capture, transfer, document, and analyze measurement results.

“The oscilloscopes’ analog-style display, floppy disk drive, and OpenChoice™ software make it easy to store and document our power measurements,” indicated Dr. Chen. “The Tektronix interface is very convenient and straightforward.”

Tektronix’ OpenChoice™ documentation and analysis software simplifies the capture of waveforms, measurement data, and oscilloscope settings on an external PC, while enabling easy documentation and analysis of measurement results using standard applications including Microsoft Excel and Word.

The small size of the TDS3000B Series oscilloscopes also provides a key benefit to the U.C. Irvine Power Electronics Laboratory. With its lightweight, compact size and battery pack, the instruments can go wherever they are needed and free valuable space for additional workstations.

“The Power Electronics Laboratory is very crowded, so the small design of the TDS3000B Series oscilloscopes is significant,” said Dr. Chen. “Tektronix instruments provide the full complement of qualities that we require – advanced power measurements and math functionality, ease-of-use, small size, and affordability.”