

SPECIAL REPORT

INNOVATION DRIVES SCOPE OPTIONS

Performance, formfactor, and software choices adapt scopes to multiple applications

By Rick Nelson, Interim Chief Editor

▶ Oscilloscopes span a range of performance and formfactor options, from a 110-GHz benchtop instrument to a pocket-sized USB model. High-end models target mmWave applications such as WiGig and 5G plus satellite communications and radar, while low-cost models aim to put a lab in the pocket of every engineer—or engineering student. In between, mainstream scopes address ADAS, power monitoring, IoT, embedded-systems design, EMC debug, and bus-decoding applications, among many others.

Targeting mmWave communications

Keysight Technologies has been focusing on the high end with new functionality for its UXR-Series oscilloscopes,

which deliver fast, coherent analysis for wideband measurements up to 110 GHz to accelerate the development of next-generation mmWave communications applications.

Features include the ability to configure optional 5-GHz or 10-GHz analysis bandwidth windows within and above the UXR's natively licensed bandwidth; availability of more than 2 GHz of digital downconversion (DDC) analysis bandwidth that can be used in conjunction with available mmWave frequency extension options to extend DDC accelerated frequency ranges as high as 110 GHz; and hardware-accelerated DDC to decimate oscilloscope captures in real-time to enable deep captures exceeding

several seconds of time and accelerating processing up to 100x faster than non-decimated measurements.

The company said the instrument also offers superior signal integrity with error vector magnitude (EVM) below 0.6% for 5G NR FR2 tests and 1% for 802.11ay technologies—consequently, EVM measurements can reflect the true DUT performance, without impairments caused by the noise of the measurement system. Finally, a bandwidth pricing model matches typical RF equipment, in which the price correlates with the analysis bandwidth needed—eliminating the need to purchase the full frequency range that the oscilloscope hardware supports.

Performance to 16 GHz

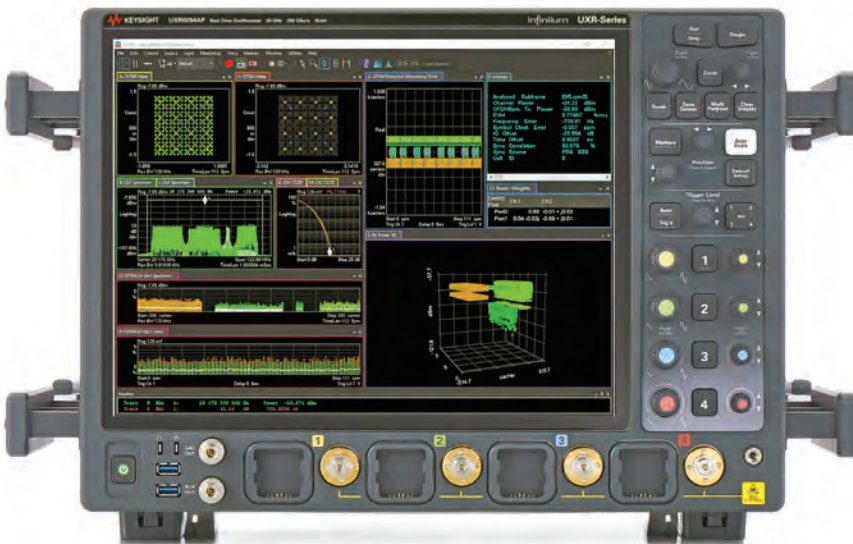
Much recent innovation in the oscilloscope market has been at top frequencies from 2 to 16 GHz. Guido Schulze, product manager for oscilloscopes at Rohde & Schwarz in Munich, commented, “R&S RTP high-performance oscilloscopes combine high-class signal integrity with a fast acquisition rate of 750,000 waveforms/s. The high-precision digital trigger matches the acquisition-system bandwidth, with real-time de-embedding for triggering and acquisition. The new RTP13 and RTP16 models extend the maximum available bandwidth to 16 GHz.”

Asked about unique features, Schulze cited signal-integrity debugging in real time. “Unique features include real-time de-embedding, real-time differential math functions for two input signals, serial pattern trigger with clock data recovery of embedded clocks in real time up to 16 Gb/s, and mask and histogram test supported in hardware for fastest data-eye analysis,” he said.

Schulze also cited what he called the first real-time scope-based time-domain reflection (TDR) and transmission (TDT) analysis systems on a digital oscilloscope. “This enables debugging of signal traces without dedicated test equipment such as vector network analyzers,” he said.

Trevor Smith, business development manager at Pico Technology Ltd., commented, “We introduced the 9400 Series 5- and 16-GHz Sampler Extended Real

▼ Keysight UXR-Series oscilloscope.





▲ Rohde & Schwarz RTP oscilloscope.

Time oscilloscopes (SXRTO) that combine the benefits of real-time sampling, equivalent-time sampling, and high analog bandwidth. We also delivered some important new capabilities for our existing range of PicoScopes, including a decoder/analyzer solution for BroadR-Reach Automotive Ethernet.”

According to Smith, “The 9400 Series SXRTOs have four input channels up to 16 GHz with market-leading timing resolution for accurately measuring and visualizing high-speed analog and data signals. Real-time sampling to 500 MS/s and equivalent time sampling (ETS) to 2.5 TS/s make the products ideal for capturing pulse and step transitions down to 22 ps and clocks and data eyes to 8 Gb/s. Most high-bandwidth applications involve repetitive signals or clock-related data streams that can be readily analyzed by equivalent-time sampling. The SXRTOs quickly build ETS persistence displays with statistics. They have a built-in full-bandwidth trigger on every channel.”

“Our UltraVision II architecture built upon our Phoenix chipset has allowed us to bring three new series of scopes to market,” commented Michael Rizzo, general manager, RIGOL USA. “All of the scopes share a common UI and HW architecture but are differentiated based on performance capability and analysis tools. The MSO5000 (70 MHz to 350 MHz), the 7000 Series (100 MHz to 500 MHz), and the MSO8000 (600 MHz to 2 GHz) provide a seamless portfolio from basic visualization tasks to advanced serial analysis. The Phoenix chipset allows us to deliver unmatched sample rate, memory depth, and

instrument capability across the 70-MHz to 2-GHz market.”

Other recently introduced scopes include the Teledyne LeCroy WaveRunner 8000HD High Definition Oscilloscopes (HDO), which are 8-channel, 12-bit-resolution, 2-GHz instruments. WaveRunner 8000HD leverages the company’s HD4096 High Definition technology and a 15.6-in. touchscreen, high channel counts, and 5 Gpts of acquisition memory for critical applications such as high-power/3-phase power conversion, automotive electronics, power integrity and power sequencing, and embedded control systems.¹

MHz-range value

Jason Chonko, applications marketing manager at SIGLENT Technologies North America, described the company’s SDS2000X-E Series as a higher bandwidth budget scope featuring two analog inputs, 2-GS/s sample rate, and up to 350-MHz bandwidths. “The SDS5000X is our flagship scope with up to four analog inputs, 5-GS/s sample rate, and up to 1-GHz bandwidths,” he said.

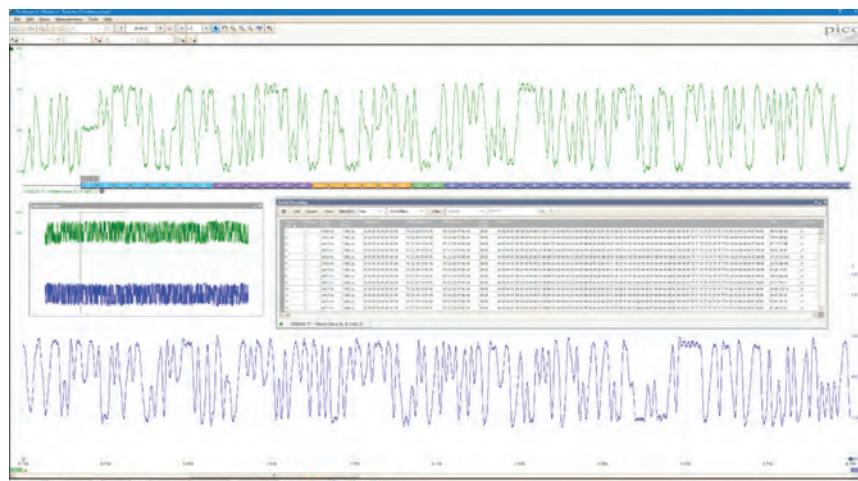
Chonko cited other features, such as web control and intuitive user interfaces plus the inclusion of free frequency-analysis/Bode functionality and a measurement engine that provides statistical trending and histograms on many measurement types. “Coupled with deep memory, you can now see far more detail than ever before with a single trigger event,” he said.

James McGregor, global head of test, tools, and production supplies at Newark, said the company recently launched a new private-label collection, Multicomp Pro, stocking more than 60,000 components, tools, and instruments. The first of two of Multicomp Pro’s newest oscilloscopes available at Newark is the MP720013 MSO/MDO 100-MHz oscilloscope, which has two analog and 16 digital channels with an external trigger and logic analyzer. It has a maximum real-time sample rate of 1 GS/s per channel and a record length of 2 Mpts per channel. “The 100-MHz logic analyzer has a sample rate of 20 S/s to 1 GS/s per channel and a record length of 4 Mpts per channel, enabling users to safely and confidently debug embedded systems,” McGregor said.

The second is the MP72024 100-MHz digital storage oscilloscope, which has two analog channels with an external trigger. It has a maximum real-time sample rate of 1 GS/s per channel, a record length of 20 Mpts per channel, and a 55,000-waveform/s refresh rate. “This scope also has a 12-bit high-resolution ADC, fully restoring the waveform detail with 16 times the vertical resolution of traditional 8-bit ADCs, enabling users to capture the signals of interest while minimizing the effects of unwanted noise,” McGregor said.

When asked about new products, Kaitlyn Franz, test product manager at Digilent, said, “We’re sticking with our Discovery family. To date, we have the

▼ Pico Technology BroadR-Reach decoder screenshot.





▲ SIGLENT SDS5000X oscilloscope in power-analysis application.

Analog Discovery 1 and 2, the Digital Discovery, and most recently, the Analog Discovery Studio, which has been adapted to be breadboardable.”

The Discovery family’s “...versatility and flexibility are second to none,” she continued. “With the Analog Discovery 2, you’re getting 12 benchtop instruments packed into a single 3-in. x 3-in. tool, including an oscilloscope, logic analyzer, spectrum analyzer, waveform generator, and more. With the Analog Discovery Studio, you also get a convenient, replaceable, and breadboardable interface.”

Added functionality

Steve Sandler, founder and CEO of Picotest, said, “We have introduced many new measurement functions for oscilloscopes. Tektronix 5/6 Series oscilloscopes now have the ability to perform the 2-port shunt-through PDN impedance measurements, component impedance measurement, TDR measurements, noise-density measurements, VNA and FRA measurements to 8 GHz, DC-biased inductor measurements, DC/DC negative-resistance measurements, and clock power-supply modulation-ratio

measurements (PSMR). These were all introduced in 2019.” He added that many of the company’s capabilities are unique, citing in particular that the Picotest NISM closed-loop stability assessment will soon be available for the 5/6 Series oscilloscopes.

Asked about software, Schulze at Rohde & Schwarz cited a special signal-integrity bundle to provide customers with unique functions for an attractive price. He also cited complete test solutions for debugging and compliance testing of serial protocols. “These include special software, fixtures, and probes for industrial, embedded, and automotive buses such as USB, SPI, DDR, and Automotive as well as industrial Ethernet.” Finally, he mentioned special spectrum-analysis software, frequency zone triggering, and signal analysis capabilities.

Smith commented that PicoScope 6 PC software is regularly updated and offered free to customers, as new capabilities and functionality are developed. As an example, he said the company last year added decoders for Manchester/DALI as well as a BroadR-Reach solution. “BroadR-Reach is a full-duplex protocol operating on a single unshielded twisted pair (UTP), so users need a tool to separate the traffic in each direction,” he said. “The PicoScope BroadR-Reach decoder/analyzer includes an innovative nonintrusive software-directional-coupler math-channel function that utilizes two probing points a known distance apart and a velocity-of-propagation algorithm to separate the transmitted data waveforms in each direction.”

Rizzo at RIGOL cited integrated power-analysis software as useful for

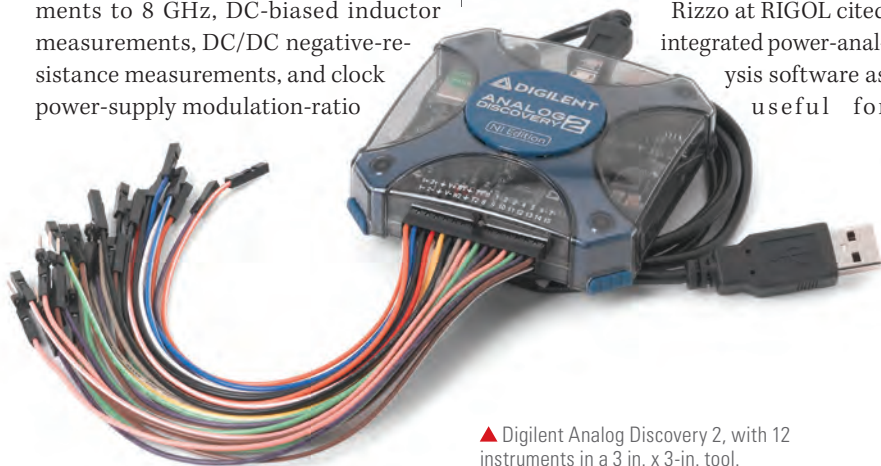
customers implementing switch-mode supplies. In addition, “Our Jitter and Real-time Eye application is a powerful tool for those characterizing serial communications,” he continued. “Protocol Analysis allows complete embedded debug, and a web-browser interface allows for simple remote instrument monitoring and control.

SIGLENT also supports power analysis. Chonko said, “The Power Analysis option for the SDS5000X Series provides multiple measurements that are critical for power-supply designers trying to get the most out of their products.

According to Franz at Digilent, “WaveForms is our powerful multi-instrument software application. It seamlessly connects to our USB portable oscilloscope, logic analyzer, and function generator products such as both versions of the Analog Discovery, the Digital Discovery, and the Electronics Explorer board, with full Windows, Mac OS X, and Linux support. This software, coupled with the hardware instrumentation, brings a powerful suite of instruments to enable analog and digital design on your personal computer. Designed with a clean, easy-to-use graphical interface for each instrument, WaveForms makes it easy to acquire, visualize, store, analyze, produce, and reuse analog and digital signals. And the best part? It’s free.”

Applications

With respect to applications, Keysight cited RF technologies that have pushed frequencies above 100 GHz with bandwidth needs reaching tens of GHz, including technologies such as 802.11ay (WiGig), 802.11ad (gigabit wireless), satellite communications, radar, and 5G. “Keysight recognized the growing need for a cost-effective oscilloscope that supported today’s emerging mmWave-technology wide-bandwidth measurement requirements,” said Brad Doerr, vice president and general manager of digital and photonics R&D for Keysight’s Communications Solutions Group, in a press release. “Keysight’s UXR is the first oscilloscope on the market to address mmWave technologies and advanced applications such multiple input, multiple output (MIMO) with up to four



▲ Digilent Analog Discovery 2, with 12 instruments in a 3 in. x 3-in. tool.

channels for the price of a 25-GHz scope.”

Chonko at SIGLENT said, “We’ve been seeing an increase in embedded designers and software engineers using oscilloscopes for system verification. These are not typically hardware designers, and so oscilloscope ease-of-use is critical to their success.”

According to Schulze at Rohde & Schwarz, “Nowadays designers combine multiple functional cores in one design. Our oscilloscopes cover all requirements for time-correlated analysis supported by the oscilloscope bandwidth—high-speed digital interface, serial buses, RF interface, and low-speed controls.” He added, “Oscilloscopes for automotive and IoT development projects are often used as a standard tool for a variety of applications, so that they need to be complete including EMC debug, power measurements, and bus decoding.”


He continued, “In the field of power electronics, vertical resolution, a low

noise floor, and a deep memory are basic requirements for accurate measurement results. In addition, there is an increasing trend for the oscilloscope to take over more and more measurement capabilities from other dedicated devices. For example, Rohde & Schwarz instruments can use the Frequency Response Analysis function to measure the control-loop response or the power-supply rejection ratio of converter designs, saving the additional costs of a dedicated frequency response analyzer.”

Smith said PicoScopes are used in a range of applications and in many different industries. “Development of ADAS and automated-vehicle technologies have featured quite often in the past 12 months,” he said. “We saw some examples of PicoScopes used to capture real-world signals that are used to accelerate development of collision-avoidance algorithms.”

According to Franz at Digilent, “In addition to learning/academic applications,

we find that our use cases are far and wide. Most engineers use the Analog Discovery 2 as a quick test or monitor so they won’t need to spend much time—power monitoring, embedded systems design, medical, etc.”

According to Rizzo at RIGOL, embedded IoT is an area that brings many applications (such as automotive, communications, power management, military/aerospace, and medical) together with similar debug challenges involving power management, sensor communication, serial data, signal integrity, and RF integration. “Engineers may not be expert in all of these areas but require simple, reliable, and flexible test tools to identify issues, characterize performance, and validate designs,” he concluded. 

REFERENCE

1. “WaveRunner 8000HD oscilloscopes target power, automotive, embedded-systems applications,” EE-Evaluation Engineering Online, Oct. 17, 2019.