

INSTRUMENTS OFFER MULTIPLE FORMFACTORS, FUNCTIONS

By Rick Nelson, Interim Chief Editor

▶ Instruments come in a variety of formfactors, letting you trade-off the performance you need that fits in the space you have available. Typical configurations include benchtop (such as the Rohde & Schwarz SMW200A vector signal generator), portable (such as the portable version of the Tabor Lucid RF signal generator), and PXIe or PCIe (such as the SPECTRUM Instrumentation M2p.65xx Series PCIe waveform generator). Many instruments come with multiple functions—combining an oscilloscope with a signal generator, for example.

While responding to requests for input for last month's report on signal generators,¹ instrument makers also commented on the tradeoffs involved in various formfactors and multiple-instrument functionality.

Multiple configurations

Signal generators come in a variety of configurations, such as traditional benchtop instruments, handheld instruments with display, USB instruments, and PXI modules. What are the advantages and disadvantages of each?

Brandon Malatest, founder and CEO of Per Vices Corp.: The different configurations available each meet unique needs for different applications. Traditional benchtop instruments are still the most common and offer engineers the best overall solution when comparing performance, cost, and usability. These systems are the best option for R&D use where access to high-performance equipment is needed. The drawbacks for these systems are typically a combination of portability, size, and power consumption.

Steve Sandler, founder and CEO of Picotest: Tradeoffs are made in each configuration. The bigger question is about user demand, which is looking to see a



▼ Rohde & Schwarz SMW200A benchtop vector signal generator.

single GUI interface and preferably an all-in-one instrument. You can see evidence of this primarily from the oscilloscope manufacturers, which all now include frequency-response-analyzer functionality using built-in signal generators..

Oliver Rovini, technical director of SPECTRUM Instrumentation GmbH: We see three different main classes here. First, benchtop instruments with a display and full manual control are best for everyday work at the lab with changing and individual demand. Second, modular instruments based on a common bus system like PCIe or PXI are the best fit for integrated devices or OEM products. Third, [we see] external instruments that are operated by a PC via Ethernet or USB.

Simon Ache, director of signal generation product management at Rohde & Schwarz: The number of use cases for signal generators are manifold, and so are the sizes and configurations. Small, self-contained, modular, and faceless signal generators can be operated via USB or LAN, offering space and performance advantages in remote-controlled applications. At the same time, they avoid incompatibilities that might occur when using

PXI-based signal-generation cards of vendor A together with modules of vendor B in a PXI chassis of vendor C. Handheld generators are good for field use, but battery up-time is often low. Benchtop instruments are available in the most diverse sizes and performance classes.

Jon Semancik, director of marketing at Marvin Test Solutions: Interfaces such as USB and LXI are typically used in rackmount box solutions, which do not have the size restrictions found in card-based solutions. This simplifies the task of component placement and shielding but also increases the overall footprint of the solution. PXI certainly reduces the size of the solution, but the added space and size restrictions place demands on the designer to carefully consider component placement and shielding.

Kimberly Cassacia, Sean Lee, and Xiaowei Zhang, signal-generator product managers, and Eric Hsu, signal-generator product marketing manager, Keysight Technologies: Benchtop signal generators are well suited for R&D or design verification, where analysis and troubleshooting benefit from interactive analysis. Modular PXI signal generators are ideal for applications that require

multichannel measurement capabilities, fast measurement speed, and a small footprint.² They also offer scalability and flexibility to configure solutions with a shared processor, chassis, and other modular instruments. Keysight offers both benchtop and PXI signal generators for addressing different product development stages and applications but uses the same software applications, which provides measurement consistency and compatibility throughout the product development cycle. Specifically, Keysight has introduced VXG microwave signal generators in two different formfactors but with same performance and capabilities—the M9384B benchtop model and the M9383B with PXI instrumentation.

James McGregor, global head of test, tools, and production supplies at Newark: First, handheld instruments with display—While portability is the clear advantage, handheld instruments with displays generally suffer from lower performance due to constraints on size and weight as lots of functionality is being squeezed into a single instrument. Second, USB instruments provide great portability but again, performance is restricted, and a PC is required to work with the equipment, reducing flexibility. Third, PXI modules are great for mass-production testing, and users are able to customize with other modules in a single test solution; nevertheless, they do require a PXI rack to work with other PXI modules. Fourth, traditional benchtop instruments can provide all levels of performance depending on your needs but can be bulky and space can be limited on your bench if you choose all equipment in single desktop formats.

Chris Armstrong, director of product marketing and SW applications, RIGOL Technologies: While each configuration has its place, RIGOL focuses on benchtop instruments that are easy to control via USB or Ethernet. This provides the flexibility of stand-alone operation and direct computer control in a platform that does not incur overhead costs for the engineer.

Steve Fairbanks, senior director, marketing, products, and instrumentation at



◀ Keysight Technologies VXG microwave signal generators in PXI (top) and benchtop (bottom) configurations.

Malatest, Per Vices: These multifunctional systems offer greater flexibility without the tradeoff of performance, which was evident in the past. The new systems can utilize the flexibility and performance of SDRs, which offer all of the performance benefits of traditional systems with the bonus

of flexibility, smaller physical footprint, and lower cost.

Astronics Test Systems: The worth of each configuration is ultimately determined by the deployment environment or use case. Having the flexibility, as a supplier, to provide similar capabilities in a wide variety of form factors gives us a better chance to address our customers' challenges, specifically for their application.

Mark Elo, U.S. sales manager for Tabor Electronics: [An optimal] form factor allows an instrument to perform the best job it can in the environment it is deployed in, whether it's R&D, production, maintenance, or somewhere else. Our philosophy is to have a signal-generator platform that we can deploy in multiple form factors—this provides consistency across our customers' product lifecycles.

Multifunction

The trend toward multifunctionality has resulted in modern instruments that incorporate a signal generator, oscilloscope, DMM, and more all in one solution. What are the main benefits of such a multifunction instrument?

Sandler, Picotest: As previously mentioned, there is definitely a one-box desire. I'm not certain, but I think it comes down to usability. A single GUI interface to learn would seem to be the heart of the desire, with next maybe being bench crowding. The response to expensive solutions is good, so I don't believe it is about money. What you lose is the performance in some cases.

Rovini, SPECTRUM Instrumentation: While multifunction devices may be a cost benefit with a trade-off in signal quality and functionality, SPECTRUM's approach here is the modular concept that allows the combination of multiple cards of different functions internally with a synchronization concept called Star-Hub.

Ache, Rohde & Schwarz: Actually, this trend is not new. Radio-communication testers are well-established products that incorporate signal-generator and signal-analyzer functionality in one. Especially in high-volume production, it is common to have such a combined instrument, which offers benefits regarding floor space and test procedures.

Semancik, Marvin Test Solutions: The clear advantage of this approach is a reduced system footprint. However, as with many all-in-one solutions, the overall performance and specified accuracies of the individual functional blocks may be reduced. While this may not be an issue for some applications, it is important for the user to evaluate the performance of each area prior to adopting this type of solution.

Cassacia, Lee, Zhang, and Hsu, Keysight Technologies: The key benefits for a multifunction instrument are precise timing

synchronization, a small footprint, and low cost of test. For example, Keysight X-Series signal generators provide several built-in instruments: a function generator for enabling or controlling devices under test, a bit error rate (BER) tester for receiver sensitivity test, a power meter for flatness correction and general power measurement, a digital signal processor (DSP) for real-time

signal processing, additive white gaussian noise, and real-time fading.


McGregor, Newark: First, a multifunction piece of equipment is more portable, and less connection is needed during setup. Second, users only need to calibrate a single instrument for their test solution. Third, overall cost to purchase

and maintain the test solution is much cheaper than with individual pieces of equipment.

Armstrong, RIGOL Technologies: Multifunctional instruments can save space, reduce cost, and increase usability. Care must be taken to make sure each instrument function is still intuitive. Newer instruments, like touchscreen oscilloscopes, make a great platform for many instrument functions. For performance and noise characteristics RIGOL keeps high-performance RF signal generators in a separate instrument. This maximizes function and capability.

▼ Tabor Lucid portable RF signal generator.



Elo, Tabor Electronics: Multifunction instrumentation is becoming more real in today's test-and-measurement world. The ability to synthesize instrument functionally is much easier to obtain with the modern class of FPGAs and tools for programming. Easily reconfiguring hardware such as A/Ds to provide oscilloscope functionality while also providing DVM or DMM capability can be had in the multiple personalities hosted by the digital logic on the instrument. One design could provide many functions, or discrete instrument functionality. We have taken a slightly different approach, providing the same capability in multiple form factors. In this way, we are providing the best fit for the environment. 

REFERENCES

1. "Generating Value," *EE-Evaluation Engineering*, Nov. 2019, p. 6.
2. One Size Does NOT Fit All: Choosing the Right Instrument Form Factor, Application Note, Keysight Technologies, Dec. 1, 2017.