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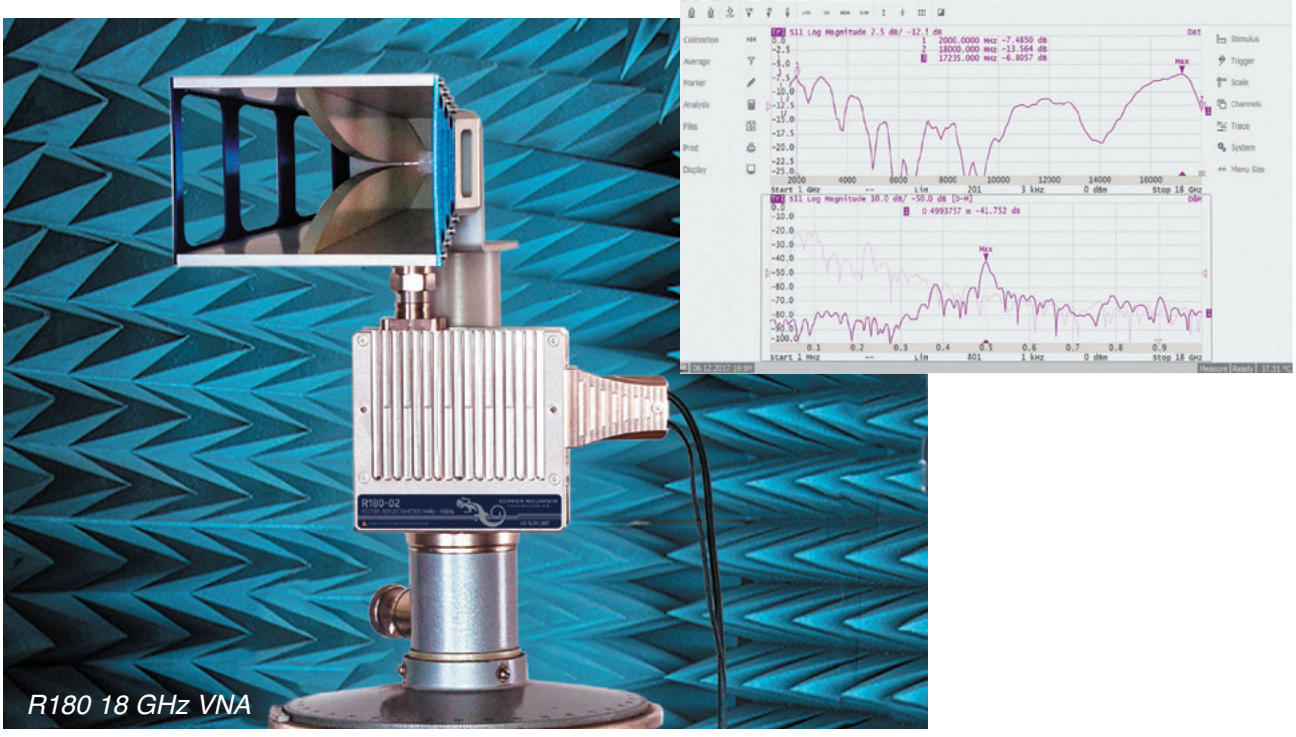

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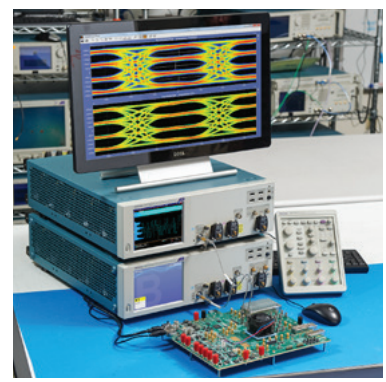

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EDITOR'S NOTE

THE TINKER'S TOOLBOX

The last few decades have been an awesome and interesting time to be in the electronic design and manufacturing industry. Having seen the industry from multiple sides, from days in the early 1980s as a SIGINT soldier on the East/West German border, to running around Europe selling high-end audio and consumer electronics, to now having the privilege to see and report upon the process, it has been a humbling and educating experience.

Coming from an applied-technology background, the first thing that comes to mind when seeing a core technology is how it could be used to address applications. The creation of technology and its application to address issues in society and its infrastructure is one of the paramount differences between engineering and pure science.

In that vein, the ability to take, develop, optimize, and field technology and the tools to achieve it are critical to that task. In one sense, the array of solutions available to the engineers of today create the reality that society relies upon to function. The growth and development of modern tech is not only due to the new core technologies created, but how it has become easier and more cost-effective to implement those technologies to address applications.

This latest explosion of applied technology has been going on for a couple of decades now, and arguably things like the IoT became useful with the application of advanced technology in new spaces, like the advent of digitally controlled power and the replacement of related legacy analog-only systems. These advances were also reflected in the development and prototyping tools available to the engineering public.

A decade or so ago, there was an initiative called "The Tinker's Toolbox," a concept project to develop a prototyping lab in a shipping container. At the time, 3D printing was relatively mature, and benchtop tools had already begun to become the powerful multipurpose devices they are today. Combine that with a board lathe and other prototyping tools, and you have a lab-in-a-box.

Today, a prototyping lab of that nature would fit in a reasonably-sized bedroom. The design and development tools that exist today give designers the ability to create almost anything they can conceive of. Using the latest in design and development support from distributors, many of whom are transforming themselves into development partners, one can create functional products using the latest technologies.

People tinker, and the latest electronic solutions have given every person with imagination the ability to manifest their creativity. The Maker Movement, and the explosion of user-driven groups like the Things Network in the LoRa space for IoT applications and their RF infrastructure, show how empowering access to the ability to create can be.

This empowerment provided by the latest generation of engineering tools also gives small- and medium-sized companies the ability to "punch above their weight" with the same level of precision and performance of a Tier-1 company. Single-purpose testing and evaluation tools that used to cost a fortune are now supplemented by an array of reasonably priced multipurpose solutions.

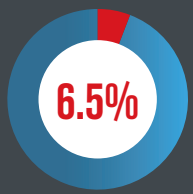
So, the latest iteration of our conceptual "Tinker's Toolbox" can almost be likened to a cornucopia of engineering tools, ready to be applied to an application by anyone with the imagination and skill to use the plethora of solutions provided. Combined with the latest generation of advanced components and subsystems, we have access to all the tools we need to get the job done, no matter the situation presented. EE

Alix Paultre,
Editor

BY THE NUMBERS

439 BILLION

Global Semiconductor sales in 2020

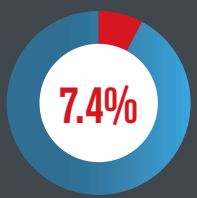


Revenue increase over 2019

Source: SIA

42.48 BILLION

Predicted global flexible electronics market by 2027

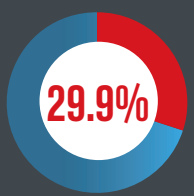


Predicted CAG 2020-2027

Source: Allied Market Research

3.04 BILLION

North American semiconductor equipment billings in January 2021



Billings increase over January 2020

Source: SEMI

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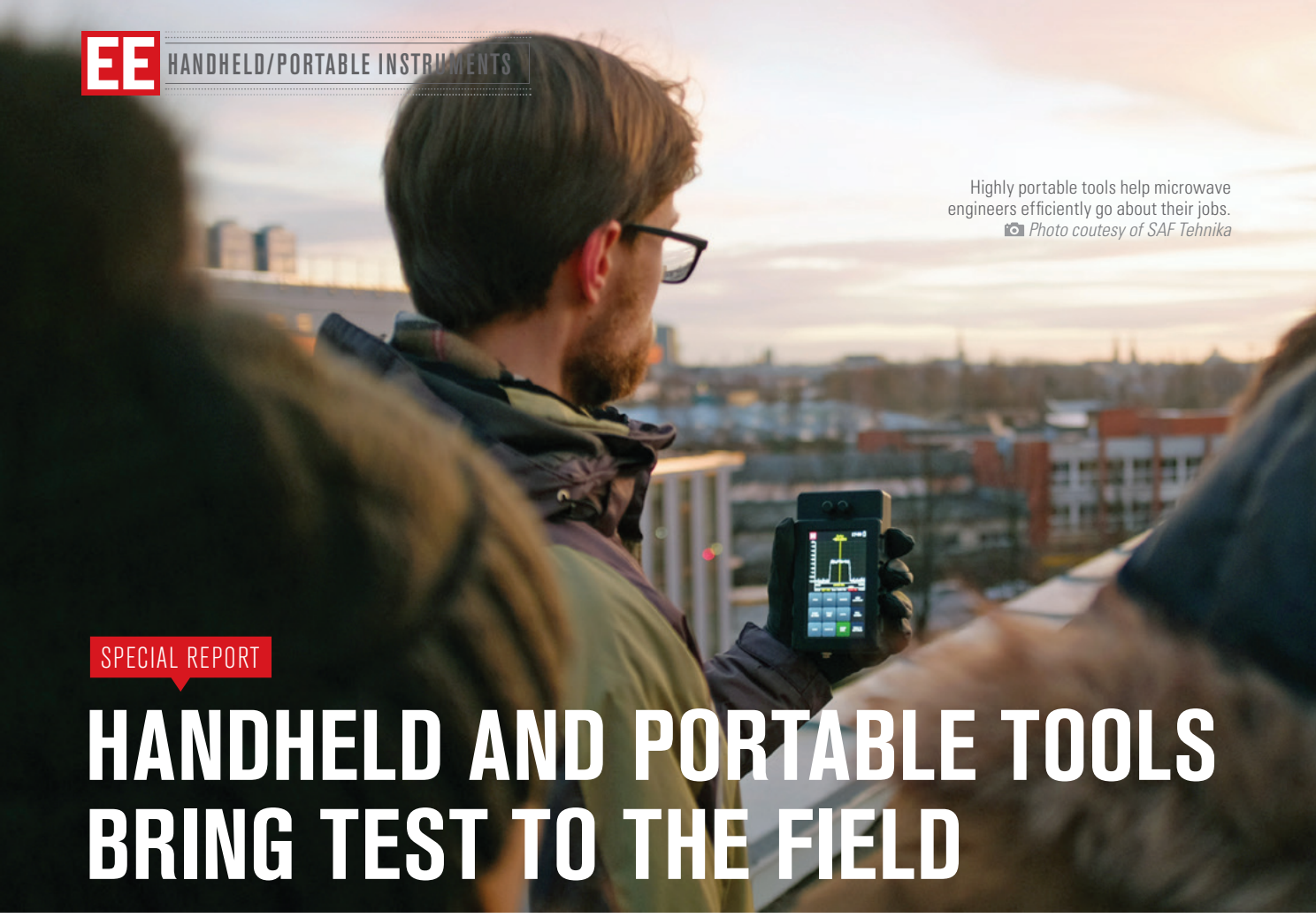


Highly portable tools help microwave engineers efficiently go about their jobs. *Photo coutesy of SAF Tehnika*

SPECIAL REPORT

HANDHELD AND PORTABLE TOOLS BRING TEST TO THE FIELD

by **Alix Paultre,** Editor

The latest in portable test & evaluation equipment puts a lot of free-range functionality into the hands of engineers and technicians.

As long as electronic devices and products have existed, there has been a need to test and evaluate them for performance, safety, compliance, and reliability. Portable equipment to perform this function has grown in functionality and ability, along with the devices and application areas addressed. Here is a collection of some of the most recent releases in the portable device space.

Performing in the Cloud

Being able to connect and operate in a Cloud-enabled environment is becoming more and more important to devices that need to operate in the field. When we reached out to Anritsu about their efforts in the space, Danny Gonzalez, the company's market sevelopment manager, gave us their Network Master Pro MT1040A 400G, a compact, battery-operated, field portable, handheld 400G Ethernet Transport tester with full cloud-based remote-control options to test any part of the network (Figure 1).

The MT1040A offers dual-port 400G support with available OSFP and QSFP-DD enabled hardware. It can be used to verify network equipment and interconnect performance, including throughput, latency, Bit Error Rate (BER), service and application performance. It also has real-time RS-FEC decoding and correctable error monitor features, so it is well suited for

Figure 1: The Network Master Pro MT1040A 400G, a compact, battery-operated, field portable, handheld 400G Ethernet Transport tester.

verifying Forward Error Correction (FEC). It is extremely versatile, as OTDR, OLTS or Fiber Inspection capability can all be added to a single unit.

Angus Robinson, Anritsu's product marketing manager, brought up the company's recently launched Field Master Pro MS2090A, a high-specification field-portable spectrum analyzer that covers up to 54 GHz (Figure 2). The hardware has been designed to support over 100 MHz of measurement bandwidth to enable 5G New Radio (NR) measurements, as well as high-speed IQ streaming at full bandwidth for detailed post processing of all signals by government agencies and security services.

▲ **Figure 2:** The Field Master Pro MS2090A can support more than 100 MHz of bandwidth to enable 5G New Radio (NR) measurements.

The MS2090A includes a full-span spectrum analyzer and a 110 MHz real-time spectrum analyzer (RTSA). With an RTSA, users are able to see signals never-before captured in a field environment because their duration was too short, or they were buried underneath other higher-powered signals. Other measurements supported on this instrument include automated radar pulse analysis, coverage mapping and EMF measurements.

Addressing issues

When it came to some of the key challenges their customers were facing, the team explained that service providers are all deploying field-ready, high-speed computing devices deeper into the Edge, to reduce latency and distribute data resources for Mobile Edge Computing (MEC), Virtual RAN (vRAN), Open RAN (ORAN) and OTT streaming resources. The portable MT1040A Network Master Pro 400G enables field installation, turn-up, performance verification, and troubleshooting of high-speed computing devices deployed anywhere in the network, from Core to Edge, and anywhere in-between.

As the spectrum becomes more crowded with new frequency bands allocated to cellular and LMR networks, interference between networks becomes a bigger challenge. Monitoring for interference and then locating its source and mitigating it requires a range of tools. When spectrum is re-assigned by the government, such as the recent 600 MHz spectrum migration from broadcast TV to cellular, the new spectrum owner needs to validate that all legacy users have shut down.

Continuous spectrum monitoring is required to identify new sources of interference that will degrade network performance. If new interferers are found, tools are required to pinpoint their location and identify the most likely source. Typically, this will require directional antennas, signal demodulation, RTSA for finding signal-in-signal interferers and even IQ capture for offline analysis of the most evasive signals. The MS2090A is an example of such a solution that meets all these needs.

When asked about what the company was seeing in the area of handheld & portable instruments, the response was about the drive to support cloud-based remote control and monitoring capabilities. This includes products like tablets and smart devices, regardless of deployment environment. There is also a need for built-in automation capability to develop custom test procedures unique for each customer application.

Security is becoming a necessity, as well. Handheld instruments are being built on Linux OS platforms with built-in security and firewall measures to prevent tampering or unlicensed user access, malware or virus corruption. Finally, they need an all-in-one approach with a scalable platform which can be hardware-configured in the field without service or manufacturer support required.

In the field

When it came to primary application areas served, Gonzalez pointed out how the MT1040A is used by service providers for complete Fiber to the Antenna (FTTA); mobile fronthaul and backhaul; Metro and Core network installation and maintenance, while having benchmark testing capabilities. Multi-Access Edge Computing (MEC), co-lo and hyperscale data center operators are using the MT1040A for interoperability field testing for AOC, DAC and L2/L3 network hardware environments. It is also Tier 1 wireless and wireline operator-approved for 5G CRAN/ backhaul I&M with formatted closeout package reporting.

Robinson brought up that as a spectrum analyzer, the MS2090A serves a wide range of field applications, like cellular and LMR transmitter performance validation, with 5G and LTE modulation analysis built in. It also offers network coverage mapping, with a drive test for signal strength plotted onto digital maps fully integrated into the platform. It also provides pulse and radar measurement analysis, compliant to IEEE pulse specifications. Interference hunting, with RTSA,

demods, and direction-finding all built in. IQ data capture provides a 110 MHz bandwidth that can be continuously streamed in real time for offline post-processing.

Digital circuitry is moving closer to the instrument RF input. This is enabled by advances in ADC/DAC technology. The need for exceptional RF performance, however—especially spurious free dynamic range—limits how close to the RF front-end digital technology can be designed. High-performance FPGAs are now required in handheld instruments to enable features such as RTSA and 5G demodulations. Instruments are becoming more multifunctional, as users demand more capability from their field and handheld test solution. Performance previously reserved for benchtop instruments used in a lab environment is now available in handheld field portable instruments.

Portability for high frequency test

Subbaiah Pemmaiah, application engineer lead for Copper Mountain Technologies (CMT), was very bullish on the addition of the S5243 Vector Network Analyzer (VNA) to the Compact family. This metrology-grade analyzer covers frequencies up to 44 GHz and yet is very lightweight and compact, making it a suitable portable instrument for high-frequency measurements (Figure 3).

Some of the key features of the VNA include a frequency range: 10 MHz to 44 GHz, an output power range from -50 to 0 dBm, a measurement speed per point of 17 µs (at 1 MHz IFBW), a dynamic range of 130 dB typical (at 10 Hz IFBW), and a maximum frequency points per sweep of 500,001.

As modern testing requirements continue to evolve, there is a need for a wide frequency VNA to perform measurements on various bands, for example in the 5G space. The recently introduced S5243 VNA addresses this need by being one instrument to cover wide frequency tests. This VNA also comes with frequency offset (for scalar mixer measurement), and a vector-mixer calibration method, as standard features to support mixer and converter measurements, which are essential in modern designs.

The modular approach of having USB-based equipment is trending in the test and measurement industry, pivoting to the use of low-cost single-board computers to run the software, thereby reducing the overall footprint of the test systems. Another example can be found in the Compact and 1-Port (Reflectometer) series of CMT VNAs that are versatile solutions well-suited for specialists working in the field, as well as laboratory and production testing in industries from medical devices to aerospace.

All CMT VNAs are USB-based without a built-in computer, separating the measurement module (VNA) from the processing module (PC), allowing the user to take advantage of the latest processors available in them, and yet not compromise on the measurement accuracy. With the elimination of the built-in PC, these analyzers are also much smaller and lighter compared to legacy analyzers.

Useful in both lab and field

For some, being able to afford both portable and lab instruments is a high hurdle to jump. Chris Gibson, VTI Instruments' senior product manager, highlighted one of the company's latest product families, that currently includes two instruments that operate rack-mounted in a traditional test-and-measurement environment, or as a more portable instrument able to operate in a wide variety of situations. The EX1401 is for isolated voltage and thermocouple measurements, and the EX1403A is for strain, bridge, and voltage/resistance measurements (Figure 4).

▲ **Figure 4:** The EX1403A is for strain, bridge, and voltage/resistance measurements.

Both use Ethernet/LXI as the control interface, but provide for several options for power, which includes AC, DC, or POE+. This lets users distribute the instruments, reducing setup time, cabling cost, and clutter. Both instruments also support IEEE 1588/PTP to provide instrument-to-instrument synchronization, as well as highly accurate data time-stamping.

Addressing challenges

Gibson pointed out that connection challenges are an industry issue, and that providing a solution that is easy to connect to, with tools to help troubleshoot connection issues, is critical. Cabling and connectors continue to be a large recurring expense, so using lower-cost easy-to-use connectors can reduce overall testing costs. Eliminating terminal blocks also allows direct connection to allow last min changes quickly and easily. TEDs can also be used to reduce connection issues and speed setup.

▼ **Figure 3:** This metrology-grade analyzer covers frequencies up to 44 GHz.

The company believes that devices will continue to become smaller in size and more portable without sacrifice in performance. In addition, they see a change in the way instruments communicate that information back to the user. While ethernet allows users to move data via standard wired TCP/IP protocols, it also allows for the ability to move data wirelessly using standard wireless ethernet protocols. Customers are also asking for newer IoT-type communication protocols

like DDS (Distributed Data Services), to address challenges with data latency and determinism, while improving the ability to distribute measurements.

Gibson explained that the primary application areas he sees in handheld & portable instruments serve include desktop laboratory measurements, test cells, wind tunnels, dynos, and traditional rack/stack applications. The company also encounters a lot of automotive test-cell applications as well as in-vehicle testing, along with structural and fatigue testing, wind and turbine-test tunnels, and civil structures testing.

As the industry migrates forward, VTI Instruments is leveraging a variety of technologies and standards, such as LXI/Ethernet for instrument grade communications, IEEE 1588/PTP for timing and synchronization, and POE to make it easier to be able to distribute measurements. Built-in intelligence is also provided to provide Engineering Unit conversion in real-time on the measurement instrument, along with TEDs or Smart Transducer support.

Multitasking in the field

Oliver Rovini, technical director at Spectrum Instrumentation, was pleased to describe their recently introduced hybridNETBOX, a family of portable instruments with the ability to create as well as acquire electronic signals at the same time. 14 models are available, with 2+2, 4+4 or 8+8 matched generator (AWG) and digitizer channels, in the speed range of 40 MS/s to 1.25 GS/s, all 16-bit (Figure 5).

▲ **Figure 5:** The hybridNETBOX is a family of portable instruments with the ability to create, as well as acquire electronic signals simultaneously.

The products are great for measurement systems that need to perform automated closed-loop or stimulus-response type testing. For example, they can reproduce and capture "echo" signals such as those found in radar, sonar, lidar or ultrasound. With their multichannel capability, they can test these systems even when arrays of transmitters and receivers are used.

One big challenge the company sees today is that analog and digital signals must be measured at the same time. To offer such mixed-mode situations, they launched a digital option with 11 digital inputs for the portable digitizer NETBOX-products, along with 8 analog channels. All 19 channels work fully synchronously. The digital option is also available for most of their PCIe digitizer and AWG cards, so more than 50% of Spectrum Instrumentation's products are ready for mixed-mode.

Rovini explained that Spectrum products are general-purpose instruments, used in nearly every application area, with customers using their portable digitizers and generators for everything from lidar, radar, and sonar, to astronomy, quantum science, and big physics experiments like particle accelerators. Universities are a big user area, with different test-and-measurement requirements, but like all customers they want high quality and fast support.

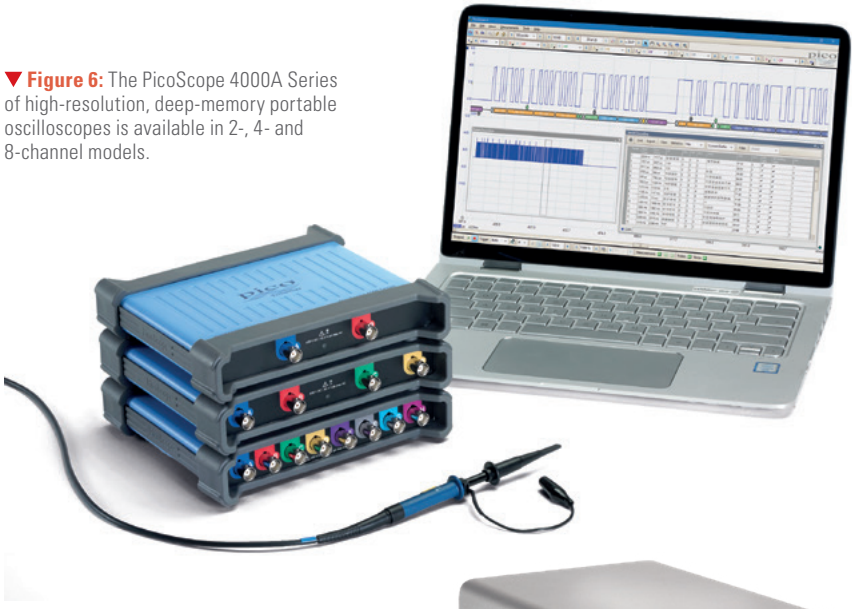
Spectrum's portable instruments follow the LXI standard to allow a maximum interoperability with other measurement equipment and software. The standard Ethernet interface allows control of these instruments from any laptop or desktop PC via the company LAN or via a direct connection.

High-resolution test

When we talked to Trevor Smith, Business Development Manager at Pico Technology, he touted their latest PC-based PicoScope series products. Their PicoScope 4000A Series of high-resolution, deep-memory portable oscilloscopes offer 2-, 4- and 8-channel models (Figure 6). The PicoScope 4000A Series boasts 12-bit hardware resolution (to 16 bits with Resolution Enhancement), 256 MS deep capture memory, and a 20-MHz bandwidth with an 80 MS/s sampling speed, up to 70 dB SFDR, a built-in 14-bit triggerable signal generator, and 80 MS/s AWG.

The PicoScope 9400 Series 5 GHz and 16 GHz SXRTO (Sampler eXtended Real Time Oscilloscopes) 2-channel models to the 4-channel models previously announced. Each channel has 12-bit resolution, real-time sampling to 500 MS/s per channel, and up to 1 TS/s (1 ps) equivalent-time sampling (ETS).

The diversity of measurements that need to be made by electronics engineers



▼ **Figure 6:** The PicoScope 4000A Series of high-resolution, deep-memory portable oscilloscopes is available in 2-, 4- and 8-channel models.

creates a huge challenge in today's environment. An engineer debugging high-speed logic signals one day might be called upon to run a long-duration soak test the following day and check for immunity to power harmonics the next. They need tools that span the range of tasks they are expected to address with the minimum of fuss.

Smith brought up how lockdowns of regular workplaces caused by Covid-19 have made those challenges more difficult, as conventional benchtop test equipment doesn't fit comfortably on a dining room table (And is unpopular with other people in the household who want to use the table for schoolwork or ... dining!). With engineers forced to work from home in some degree of isolation, it is also difficult to share the equipment. Versatile low-cost PC-based instruments are affordable per-engineer, enabling teams to share results and continue their work at-pace.

The Covid-19 pandemic has further accelerated the adoption of PC-based instruments such as PicoScope, Pico dataloggers, and Pico RF test equipment. The PicoScope 9400 Series 5 GHz and 16 GHz oscilloscopes enable serious signal-integrity work to be done in the home-work environment (Figure 7). PicoScope PC-based instruments are used across a huge range of applications, including digital design debug, analog circuit behavior, power analysis, transfer function characterization, and many other electronic design verification applications.

▲ **Figure 7:** The PicoScope 9400 Series 5 GHz and 16 GHz oscilloscopes enable serious signal integrity work to be done in the home-work environment.

Portability with customizability

When we asked Kaitlyn Franz, test and measurement product manager at Digilent, about their latest handheld & portable instruments, she told us about their Analog Discovery Pro line of products, the ADP3450. While the Analog Discovery focuses on portability, the Analog Discovery Pro enhances customizability, and enters a higher specification level, to better meet the needs of engineers being forced out of the labs and into their homes.

Linux Mode provides an on-device operating system that, when combined with WaveForms SDK, is a flexible jumping-off point for all kinds of custom tests and applications. As a classic demonstration of each operation Mode of the device, there are two test and measurement takes on the classic LED blink example: an automated test of an ADC, and a very simple power measurement demonstration.

The ADP3450 defaults into Standard Mode, which allows you to connect via USB or ethernet to a computer running WaveForms to take quick measurements as you would on any standard USB oscilloscope or logic analyzer (Figure 8). Booting into Linux Mode is as simple as changing the boot mode setting. Once booted, a terminal application can be used to connect to the serial port of the device. For this example, Python can be used to write, although several other languages can be used as well to write scripts.

In today's working environment, having access to an entire lab's worth of test equipment, and being able to use it whenever and wherever they need, is a big challenge. With the removal of access to the lab in many areas, these portable instruments are being required to function on a higher level to address the entire design and test cycle. Things like noise, mixed-signal systems, and resolution will need to be addressed by portable instruments. The ADP3450 introduces a hardware bandwidth filter in addition to the many software filters, uses high resolution ADCs and DACs, with dedicated triggers and digital I/O to address these challenges.

Figure 8: The ADP3450 allows you to connect via USB or ethernet to a computer running WaveForms to take quick measurements.

According to Franz, one of the trends they've noticed is that standalone devices increasingly have software interfaces available, often as an extra purchase. The ADP3450, while larger than the Analog Discovery, introduces an on-device terminal-based operating system, enabling tests to be run standalone on the device. One of the key issues with this trend is ease of use, consistency, and reliability among the interfaces, keeping them separate and stable, but easy to switch back and forth.

Digilent's instruments are flexible and portable multi-instrument devices, easily configured by software to meet a wide variety of needs. For example, on the Analog Discovery 2, the power supplies can be configured as additional AWGs, and the triggers can be configured as inputs or outputs, as the application demands. This also provides the ability to provide ample Digital I/O making the devices true Mixed signal oscilloscopes.

The company's next generation of devices, the Analog Discovery Pro, will take that to the next level, with SoCs from Xilinx, adding a processor and the ability to run an on-device operating system on the devices. Franz emphasized that their design ensures that the addition of the operating system does not sacrifice the core functionality of the instrument.

Keeping the data

David Holt, Senior director of sales and marketing at B&K Precision, reminds us that with all the emphasis on data capture, that information must be rapidly and extensively stored so it may be properly used. Recently the company announced two additions to their portable data recorder line with the DAS1700 and 8460. These configurable data acquisition systems feature a fast sampling interval of 1 µs (1 MSa/s) and four types of measurement boards. A wide input range (±5 mV to ±1000 V) and a large internal solid-state memory of up to 2 TB are also included.

▼ **Figure 9:** The DAS 1700 features an optional extension module for up to six boards.

The boards include universal, high-voltage, strain gauge, and multiplexed input types. The 8460 supports any combination of up to three boards, while the DAS1700 (Figure 9) features an optional extension module for up to six boards. The 8460 also offers a built-in printer for permanent data records. Customers often need an instrument that can measure and record over an extended period, typically with several channels and sensor types.

The ability to quickly configure the instrument while in the field is critical, and all their data recorders feature on-screen interactive guides to help the user. The DAS240 Series can support up to 200 field sensors, and addresses the dressing and landing wires for sensors each time the recorder is moved by offering a passive connector module that can be prewired and left at multiple locations (Figure 10).

▲ **Figure 10:** The DAS240 Series can support up to 200 field sensors.

▼ **Figure 11:** The 8460 offers a built-in printer.

Users of portable instruments working in process control and data acquisition gather hours of field data that can require additional post-processing using complex math. The DAS1700 recorder includes math functions that can be modified with the onscreen editor. The resulting complex math function product is displayed on what B&K Precision calls a "virtual channel." This makes it easy for the operator to optimize the recordings while in the field. The built-in math functions and onscreen editor can save customers hours of post-processing time and return trips.

Holt pointed out that B&K Precision data recorders are excellent for capturing data where several sensors are needed. Multichannel capabilities are often used in aerospace, energy, railroad, and environmental research. In some industries, regulatory agencies require event recording with printed hard copy. The 8460 serves this application with a built-in printer (Figure 11).

Data recorders require periodic improvements in hardware and software to meet changing industry demands, and David said their design team leverages

the latest semiconductor technology in power devices and signal processing. Opportunities in new energy will require data acquisition solutions ranging from battery operated recorders like their DAS220 to high-speed and configurable DAS1700 data acquisition systems for single and multiphase analysis with user-defined math functions.

Cost-effective solutions

At Rohde & Schwarz, we spoke with Matt Maxwell, spectrum and signal analyzer product manager, and Rich Markley, distribution product manager. Their R&S ZNH handheld 2-port VNA has capabilities that can often only be found in benchtop VNAs, like 16,001 measurement points, while being competitively priced (Figure 12). Maxwell mentioned how in October 2018, the company launched the microwave versions of their R&S FPH handheld spectrum analyzer, with size, weight, power, and durability advantages. At 5.5 lbs., with an 8-hour battery life and a fanless design, it covers up to 31 GHz.

One of the biggest challenges customers face when using handheld equipment is battery life. They're often out in the field for an extended period of time, and nothing is more painful than having a battery die on you when you're at the top of a tower making measurements. Markley said that's why they pay special attention to delivering a long battery life. Ease of use is another challenge. Having a device that requires a dozen button pushes to make a measurement is a challenge. R&S designed their interfaces in a way that in many cases, the most common measurements used by customers are easy to access and fast.

▲ **Figure 13:** At 5.5 lbs., with an 8-hour battery life and a fanless design, R&S FPH handheld spectrum analyzer covers up to 31 GHz.

In the area of trends, Markley said that in test they were similar to trends in other areas, with bigger, higher-resolution touchscreen displays, while also maintaining the ability to use gloves via buttons if needed. RF performance that has often been reserved for benchtop instruments is also making its way into handhelds. Maxwell added that they also see a trend for higher frequency ranges and improvements in size, weight and power.

Among the application areas R&S instruments serve, Maxwell used satellite monitoring as an example, as a high performance, low-cost spectrum analyzer is suitable to help monitor satellite signals up to 31 GHz. In interference hunting, a lightweight, high performance spectrum analyzer helps identify signals of interest and resolve interference issues. Maximum operating time, sunlight viewable screen and light weight help make sure there is enough time to find the root cause of signal interference issues.

EMI Troubleshooting is one area where there are times when a benchtop instrument won't work, as finding EMI issues on a device in a testing chamber or in the field can sometimes be invaluable to getting to find the root cause. For example, the high-performance R&S FPH has a dedicated receiver mode with Quasi-Peak detector to help you detect and isolate the source of EMI problems in real world operating environments (Figure 13).

◀ **Figure 12:** The R&S ZNH handheld 2-port VNA offers 16,001 measurement points.

A variety of offerings

A distributor like Newark is another way to find the right solution. For example, they are the exclusive distributor of the Multicomp Pro line of products, and they sent us information on two of their latest handheld and portable instruments available. The Multicomp Pro USB Oscilloscope (MP720646 US) is a 100MHz, 2 Channel portable PC Oscilloscope with a built in 5 MHz signal generator with a 500 MS/s sampling rate, 8-bit, 12-bit, and 14-bit vertical resolution, as well as a maximum 10M record length. This portable oscilloscope can be a cost-effective solution for students studying from home and engineers working in the field.

Figure 14: The datalogging and Bluetooth options in the MP730026 DMM is well-suited for remotely monitoring temperatures in potentially hazardous environments.

Newark's Multicomp Pro range also includes the MP730026 US handheld digital multimeter with thermometer, datalogger and Bluetooth function. The MP730026 is a true RMS DMM that measures AC/DC current up to 20 A, AC voltage up to 750 V, DC voltage up to 1 kV, capacitance, diode, duty cycle, frequency, resistance, and temperature from -50°C to +400°C. The datalogging and Bluetooth options make this DMM suitable for remotely monitoring temperatures in potentially hazardous environments (Figure 14).

This past year, the key challenges for test equipment used have been primarily related to the COVID-19 pandemic and the subsequent restrictions that have been put in place. The restrictions have challenged customers to find test equipment that is both laboratory grade and compact enough to be used in the lab, factory, at home and other remote test sites. University technical educators and students have been especially impacted as their learning must now be done remotely.

This is a challenge for the educators in ensuring their lessons remain accessible and informative, but also for the students that now require the equipment they would usually have at the campus labs in their own home. Newark is helping both students and their teachers address these challenges by providing handheld and portable instruments that are rugged and compact for remote use while also ensuring they are cost effective for students or teachers on a budget.

The market for handheld and portable instruments is demanding increased battery capacity, miniaturization of circuits to allow for smaller form factors and additional features, as well as more rugged instruments. Environment changes, safety concerns, and green engineering are driving demand for portable environmental testing as well as the addition of contemporary environmental testing features on the more traditional equipment.

The impact of the COVID-19 pandemic has led to a change in approach for almost all businesses, customers, and sectors. The changes to the way engineers test has meant that the way Newark supports them in their test needs has had to change, too. Now, Newark is focusing even more on providing portable test instruments for education; ensuring that students, teachers and educational institutions are able to continue the vital task of teaching and learning while meeting the requirements of the present day.

Reducing repetitive work

When we approached Megger about their latest devices, Applications Specialist Brian Hammerschmidt, told us about the DLRO2 (Ducter Low Resistance Ohmmeter), a hand-held, 2-A low-resistance ohmmeter with a "Difference Meter" for quick data comparisons (Figure

▲ **Figure 15:** The DLRO2 is a handheld, 2-A low resistance ohmmeter with a "Difference Meter" for quick data comparisons.

15). This allows repetitive measurements to be easily compared with an initial reference measurement.

The DLRO2 has a dedicated long test-lead mode that optimizes the insrument to work with very long test leads, and can be used with long leads at 1 A without compromising test speed. It also has an inductive test mode with a new automatic stop when the inductance is fully charged, and can safely test the resistance of inductive loads at 1 A. It also has greater than 600 V active protection against inadvertent live connections, without blowing a fuse.

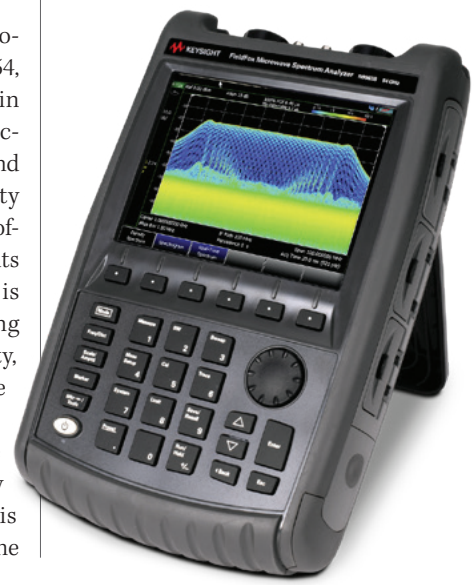
Well-suited for outdoor use, with protection against dust and moisture to IP54, the company's instruments are used in places such as testing lightning protection on wind turbines (wing tip to ground at base resistance), which presents safety and technical challenges. This testing often involves working at significant heights (average height of U.S. wind turbines is approximately 300 feet)—so, providing lighter-weight equipment increases safety, the DLRO2 is only 2 pounds and can be clipped to a work belt.

Technical challenges include the use of very long test leads (necessary for reaching required distances)—this can limit the maximum current that the instrument can produce. The DLRO2 has a dedicated test to optimize the output for applications with long test leads. It can apply 1A in a total resistance of up to 3 Ω, allowing potentially over 490 feet (150 meters) of test cable to be used.

Hammerschmidt emphasized the DLRO2 difference meter, which makes it easy to identify connections with slightly higher measurements that could indicate a latent fault, as small increases in resistance in a joint can lead to a future fault, with a plus and minus percentage scale along the top of the display. The first measurement becomes a 0% reference measurement, and each subsequent measurement will cause a pointer to move to indicate the percentage difference from that reference measurement. Each measurement leaves a marker on the scale, allowing an easy indication of the measurement, and noisy measurements leave a red marker.

The DLRO2 can display three test results at the same time (the current measurement and the previous two resistance measurement results) allowing fast and simple comparison of the resistance measurements of the three phases. This aids testing resistance of inductive loads such as motors, compressors, transformers, inductors, and power generators, especially in production environments.

▼ **Figure 16:** FieldFox spectrum analyzers and combo analyzers that support frequencies up to 54 GHz with 120 MHz of bandwidth.



We did say 'portable'

Dan Kacerovskis of SAF North America emphasized the utility of their highly-portable RF spectrum analyzer for the field engineer. (Lead photo) The cost-effective solution from SAF Tehnika is a 6-20GHz addition to its series of ultra-portable hand-held microwave spectrum analyzers.

In addition to their industry-leading portable E-band (70-87 GHz) and V-band (56-71 GHz) handheld spectrum analyzers, these tools help microwave engineers efficiently go about the jobs of link planning, installation, site acceptance, maintenance, and troubleshooting.

The 6-20 GHz spectrum analyzer boasts a rugged, ultra-compact form factor with a simple, intuitive interface, high sensitivity (-110 dBm at RBW=30 kHz), long battery life (up to 4 hrs), and instant-on functionality. It is a must-have tool for anybody who deploys and maintains licensed microwave links. Compared with laboratory-grade equipment, Spectrum Compact devices differ both in portability and affordability.

The portfolio consists of seven devices, each covering a specific frequency range. Teams can be equipped with the frequency ranges they require instead of investing in a full range lab grade spectrum analyzer. Spectrum Compact devices serve mobile operators, carriers, and tower installation crews deploying 5G networks, as well as service providers, local institutions, and critical network infrastructure owners.

Addressing site survey, radio parameter verification, antenna alignment, interference detection, line-of-sight verification and interference hunting. Every aspect of SAF's toolset has been designed with field use in mind, including a resistive touch-screen for operation with gloves, beefy thumbscrews for the SMA and waveguide connections, and high-contrast and fill display modes for easy readability in bright light situations. 8 GB of memory allows you to save thousands of spectrum traces for offline analysis, investigation, and reporting using the included PC software.

Multipurpose, multifunction

Sarah Gross, the Product Marketing Manager for FieldFox at Keysight Technologies, talked about their recently introduced

FieldFox spectrum analyzers and combo analyzers, which support frequencies up to 54 GHz with 120 MHz of bandwidth (Figure 16). The company presents the combo analyzers as the only handheld analyzers available, that can perform over 25 different measurement functions—including spectrum analysis, network analysis, base station testing, cable / antenna analysis, and more—with mmWave coverage.

High frequencies and wide bandwidths are driving the technologies of tomorrow, like multi-gigabit mobile, satellite communications, and autonomous vehicles. For these applications, customers need handheld, portable, battery-powered units that they can carry into the field and perform all the necessary tests in one trip. Having a mmWave-capable handheld analyzer that performs measurements besides just spectrum and network analysis helps to speed up troubleshooting in the field and minimize network downtime.

Gross said Keysight is seeing a shift to higher-frequency handheld devices because of the challenges posed by mmWave deployment. Especially in the network operator industry, companies are offering higher frequency coverage with wideband analysis to capture, demodulate, and test 4G, 5G, and future 6G technologies in the field.

In the field, in the home

Because FieldFox performs a variety of measurements in one portable, cost-effective form-factor, it can address almost any RF and microwave test environment. The company primarily sees it used in aerospace and defense applications (radar, satellite, etc.) and telecommunications (5G deployment, base station testing, etc.), but it has its places in many other industries as well. In current COVID times, Gross sees engineers working from home and using FieldFox in lieu of their normal bench-top test equipment found in their lab at work.

Keysight has advanced RFIC design technologies integrated into FieldFox, to give its small footprint multifunction capabilities like SA, NA, RTSA, etc. These technologies also allow FieldFox to take on much higher RF power without significantly increasing power consumption.

Figure 17: The VNA-0460 is a USB-driven 6GHz 2 port VNA with PC software.

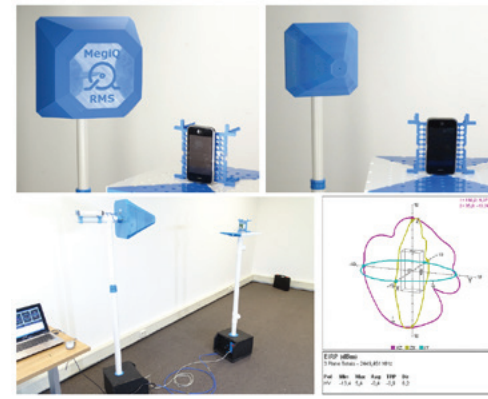


Figure 18: The MegiQ RMS-0660 portable antenna radiation measurement system performs 3-axis radiation pattern measurement in non-anechoic spaces.

Altogether, these innovations enable them to offer a mmWave instrument with almost four-hour battery life that you can hold in one hand.

For 5G-specific base station testing, FieldFox integrates with a phased-array antenna for beamforming verification and power measurements. It is also presented as the only handheld on the market that offers phased-array antenna control to visualize beams emitted by phased-array antennas at the cell site.

Testing in a COVID world

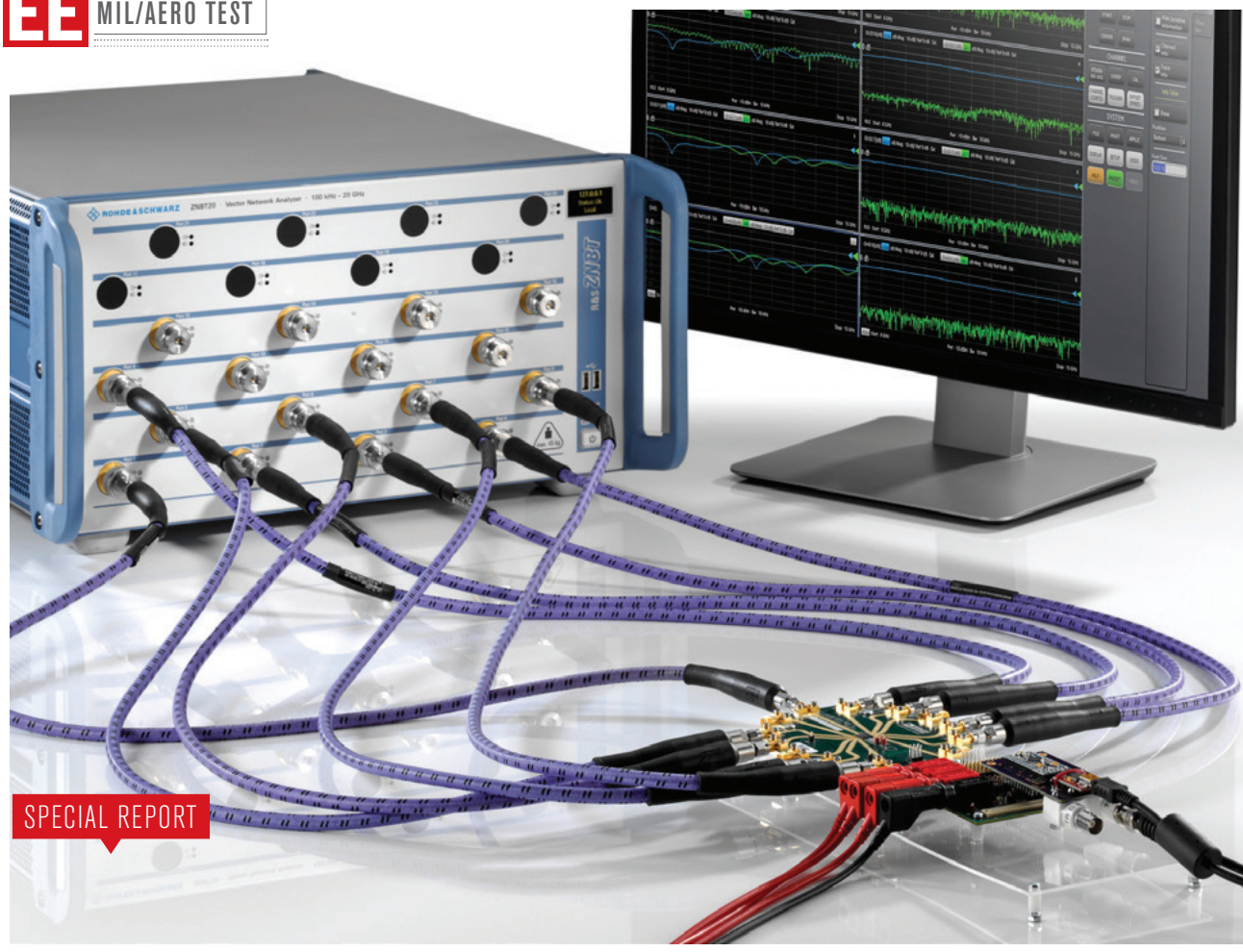
Roger Denker, the CEO of MegiQ, reinforced the other people who responded about the COVID pandemic, and how working from home requires portable instruments. MegiQ provides compact and complete VNA measurement solutions in a carrying case.

The MegiQ VNA-04x0 / VNA-04x0e families are compact vector network analyzers that are used for professional antenna and network measurement and optimization. The MegiQ VNA-0460 is a 6GHz 2 port VNA that is USB-driven with PC software (Figure 17). The MegiQ VNA-0460e is a 6GHz 3 port VNA, with built-in Bias-T and Bias voltage/current generator.

With a frequency range of 400MHz to 4GHz and 6GHz respectively, they are well-suited for characterization and measurement of 1-, 2-, and 3-port networks such as antennas, matching networks, amplifiers, filters, power splitters etc. They cover all popular communication bands used worldwide. They can also characterize the wireless devices of today, like IOT devices, routers, phones, domotica products, electronic gadgets, tablets, laptops, and RF-modules.

The MegiQ RMS-0660 portable antenna radiation measurement system covers 600MHz to 6GHz, performing 3-axis radiation pattern measurement in non-anechoic spaces (Figure 18). With a frequency range of 370 or 600MHz to 4GHz or 6GHz, they are well suited for characterization and measurement of antenna radiation patterns, antenna gain, ERP, TRP, and field strength. Denker said that extensive evaluation has shown that—with reasonable setup—the accuracy of the RMS is similar to that of anechoic test labs.

Denker stressed that MegiQ products focus on the measurements and the results, not merely on the equipment, with a main market in the development of wireless applications in IoT and 5G. The company's VNA-Sandbox with tutorial makes it easy to get started with VNA measurements, and it provides a starting point for wireless product development. EE



SPECIAL REPORT

MIL/AERO APPS DEMAND SPEED AND ACCURACY IN TEST

by **Alix Paultre**, Editor

▲ **Figure 1:** The R&S ZNBT is presented as the first multiport vector network analyzer to offer up to 24 integrated test ports.

The need to create, develop, field, and support reconfigurable multipurpose radar, EW, and military comms creates system-level architectural and I/O concerns. Serving a networked infrastructure with high data-throughput and low latency is critical.

Today's military and aerospace systems rely on a high-speed I/O to support the high data rates used with these devices, as well as that among sensor, memory, storage, and graphics subsystems. Advanced military/aerospace-specified data acquisition and I/O platforms must often be housed in a rugged chassis, and must support virtually any input, any sensor, or any interface I/O.

Secure for Mil/Aero Apps

When we reached out to Rohde & Schwarz, we received responses back from Albert Ramirez, AeroDef market segment manager, and Darren McCarthy, technical marketing manager. Ramirez told us the main interface control solutions used by their government customers are the Gbit/s LAN (providing 125 MHz BW) or the USB 3.0 (providing 120 MHz BW)) interface and due to mil-secure restrictions, the recommended protocol is Secure VISA or HiSlip 2.0 from the XLI consortium.

At the core of HiSLIP 2.0 is the ability to encrypt connections with the Transport Layer Security (TLS) protocol. Each HiSLIP 2.0 compatible device has to be able to identify itself with an X.509 certificate. This certificate needs to be part of a chain of trust. LXI devices supporting the Security Extended Feature get equipped with an X.509 certificate, which is signed by a trustworthy LXI root certificate. The device certificate is checked when establishing the TLS connection.

Application areas such as satellite communications (SATCOM), radar, EWS sensors, as well as 4G and 5G military communications, are all increasing in frequency and bandwidth. Secure VISA-compatible instruments can provide a reliable, secure, and fast interface to control the instrument remotely. The big challenge is the backwards link, where

the amount of data that the instrument can transfer back to the controller device (usually a computer) is the bottleneck. Nowadays, it is not possible to transfer complete digital waveforms over 1 Ghz or 120 Mbits BW.

R&S offers a combined solution to control the instruments through Secure VISA and capture waveforms in specific instruments such the R&S IPR Data Recorder, which enables real-time recording of up to 100MSamples/s and issues a statement of volatility—a very important requirement for military customers.

High-Speed I/O

Ramirez explained there is interest in evolving the Gigabit LAN interface into a 100Gbit LAN interface. However, these are plans for the future, as there is not yet enough demand justifying investment of such magnitude on the military or defense market. However, we might see instrument evolutions driven by the commercial wireless market that will be leveraged by the defense industry. One of the biggest demands is connectivity, addressed by such products as the R&S ZNBT, a multiport vector network analyzer offering up to 24 integrated test ports (Figure 1).

McCarthy said that, aside from I/O connectivity for command and control, for early development and R&D, their customers need access to digital IQ data with wide bandwidth, high fidelity, and low latency. Commercial industry standards for mechanical/electrical plugging are several generations ahead of military I/O standards. Interfaces such as the Quad Small Form-Factor pluggable (QSFP+ and QSFP28) can provide data rates from 40 Gbps to 100 Gbps today.

To enable access for digital IQ data, Rohde & Schwarz offers commercial QSFP family plugging interfaces to meet customer needs along with options for streaming unencrypted digital IQ data. To address the need for more bits and bandwidth, R&S continues to offer development platforms with wideband capabilities internally, such as signal generation with bandwidths to 2 GHz and signal analysis to bandwidth of 8.3 GHz.

Digital I/O

However, getting digital IQ signals corrected and data out of these platforms with minimal latency tends to be a challenge, and will lag the development of the internal tools. This is due to the development of the digital I/O interfaces as well as the need for more powerful DSP to perform the real-time signal conditioning. They have customers that use digital IQ data through high-speed I/Os in both signal-ended applications and low-latency loopback applications with hardware-in-the-loop (HIL).

Single-ended applications include capturing signals into deep memory or streaming signals from memory into a signal generator for scenario replay and receiver testing. The low-latency HIL applications range from the development of regenerative satellites and radio links to radar echo generation and electronic countermeasure development such as Digital RF Memories (DRFMs). For high-speed digital IQ data streaming applications, Rohde & Schwarz uses the QSFP (QSFP+ and QSFP28) family of mechanical/electrical plugging standards. One of the main advantages of this compact implementation is the low latency (< 1us).

Emulate and test

Jon Semancik, director of marketing at Marvin Test Solutions, brought up their GX5296 Dynamic Digital I/O with per-channel timing, programmable logic levels, and PMU PXI Card. It enables you to set timing per pin, with multiple time sets and a flexible sequencer, offering 32 input/output channels with PMU per pin and a 125 MHz vector rate (Figure 2). Additional features 64 M Vectors per channel (64 Mb per channel vector memory) and a per-channel drive/sense voltage range of -2 V to +7 V, with four additional control/timing channels with programmable levels & PMU.

The GX5296 offers advanced dynamic digital I/O performance and capabilities

▲ **Figure 2:** The GX5296 offers 32 input/output channels with PMU per pin and a 125 MHz vector rate.

in a single slot, 3U PXI format. The 32-channel, GX5296 features timing per pin, multiple time sets, data formatting, and an advanced sequencer—providing users with the capability to emulate and test complex digital buses for system, board or device test applications. Offering sub-nanosecond edge placement resolution per pin and a PMU per pin, the GX5296 has the ability to perform both DC and AC parametric testing.

Each digital channel can be individually programmed for a drive hi, drive lo, sense hi, sense lo, and load value (with commutation voltage level). In addition, each channel offers a parametric measurement unit (PMU) providing users with the capability to perform parallel DC measurements on the DUT (device under test).

The GX5296 supports deep pattern memory by offering 64 Mb per pin of vector memory with dynamic per-pin direction control and with test rates up to 125 MHz. The board supports both stimulus/response and real-time compare modes of operation, allowing the user to maximize test throughput for go/no-go testing of components and UUTs that require deep memory test patterns. The single-board design supports both master and slave functionality without the use of add-on modules.

16-bit Digitizer

GX2482 series high performance, dual differential channel, 16-bit digitizers offer high dynamic range and excellent SFDR (Figure 3). The module's differential inputs, coupled with its low distortion, makes it a suitable instrument for analyzing high-performance or low-level analog signals. Each channel offers 3 selectable low-pass filters, a 16 bit, 180 MS/s ADC, and 64 M words of memory for each channel.

A PLL clock generator is combined with dedicated clock dividers for each digitizer channel, providing independent clocking and flexibility for each channel. The sample rate can be programmed from 1 MHz to 180 MHz. The module is available as a PXI hybrid slot compatible (GX2482) or PXI express compatible (GX2482e) instrument.

The GX3722 is a user configurable, FPGA-based, 3U PXI card which employs a multifunction, analog/digital, I/O daughter board. The module offers multiple analog and digital source/measure capability. The daughter board interfaces to the GX3700 FPGA baseboard, which employs the Altera Stratix III FPGA. The square wave generators can support frequencies up to 8 MHz and feature high bandwidth signal performance. The time-interval analyzers employ high-bandwidth comparators, and can operate to 10 MHz. The function generators provide sinewave and arbitrary-waveform capability. Maximum frequency of operation is 20 KHz. The two-channel, 12 bit, 10 MS/s digitizer includes signal conditioning.

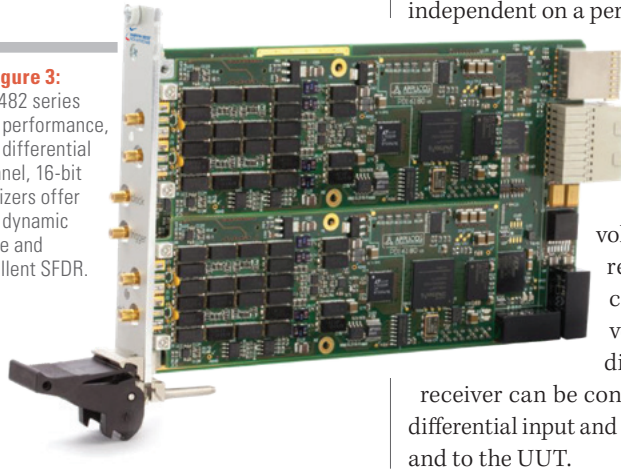


Figure 3: GX2482 series high performance, dual differential channel, 16-bit digitizers offer high dynamic range and excellent SFDR.

The demand for data

Semancik pointed out that independent pin resources are also essential for many applications. For example, the GX5295's pin-assigned electronic resources are independent on a per-channel basis and include a full-featured PMU for DC characterization of DUTs. The PMU can operate in a force voltage/measure current mode or force current/measure voltage mode. In addition, the driver and receiver can be configured to support differential input and output signals from and to the UUT.

Sequencer flexibility is also a common request. The GX5295's sequencer can halt or pause on a defined address or loop through the entire memory as well as loop on a defined address range or through a defined block of memory. Two modes of digital test are also supported: a stimulus/response and a real-time compare mode. The stimulus/response mode is used for driving and capturing data. Alternatively, for digital tests requiring long test vectors, the real-time compare mode can be used to significantly shorten overall test times by comparing in real-time, expected test results and logging only failed vectors and resultant test results (pass or fail).

The company offers an O-Level and I-Level military tester portfolio that includes many testers for launchers, pylons, bomb racks and other armament systems, including the MTS-3060A Universal O-Level Armament Systems Tester. Production acceptance and depot-level testers combine COTS and custom products to provide the most cost-effective solutions to our customers. These testers are based on the open architecture, card modular, PXI standard and incorporate the ATEasy Test Executive software.

Most instrumentation and high-speed I/O solutions, as well as test system solutions offered by MTS are based on the open architecture, card modular, PXI standard and incorporate the ATEasy Test Executive software. MTS also offers a complete line of high-performance FPGA-based solutions with mezzanine cards providing specific functionality, including digital I/O and analog interfaces to the device under test.

Moving data

Keysight's response, provided by John S. Hansen, Aerospace & Defense Strategic Planning, was from an RF/IQ data transport perspective, using high-speed interfaces in TE, rather than testing them. Requirements for transporting massive amounts of data are continuously more rigorous to address the use of wider and wider bandwidths with more dynamic range (Figure 4).

This, coupled with the need to manipulate or analyze the data in real time, can

Figure 4: The N5194A UXG agile vector adapter addresses the need for fast and capable military test to address the use of wider and wider bandwidths with more dynamic range.

quickly stress the I/O infrastructure of the system. In addition to the performance parameters of the I/O architecture, the solution must be interoperable at all its interfaces. In general, for connections of more than just a few centimeters, an optical solution must be utilized. This creates a pressure to use more optical connections, and the need to use standard interfaces for interoperability.

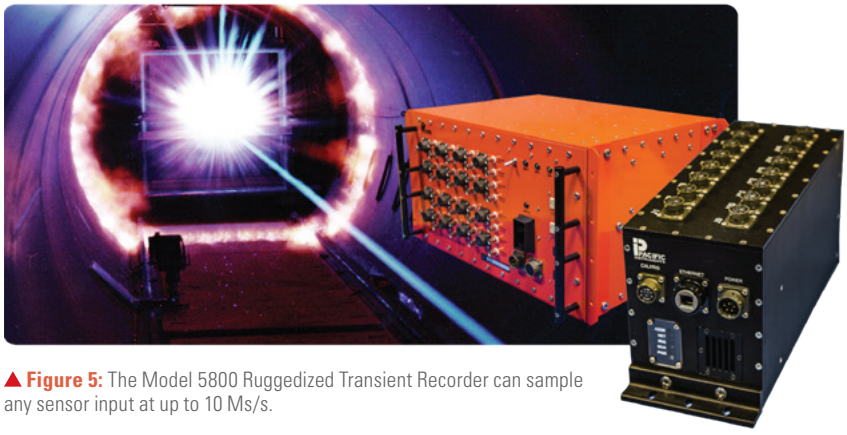
At the physical level, optical fiber connections are often needed to handle the magnitude of the data. Common protocol standards like 10GbE and 100GbE are preferred for many applications but other less common interfaces may be better suited for their higher throughput, timestamping capability, and the type of transport

supported such as VITA-49. The RF bandwidth requirements are increasing; thus, driving the need for higher data throughput for the test system.

Fast Acquisition

Patrick Rule Sr., sales manager with Pacific Instruments, a VPG brand, told us about their Model 5800 Ruggedized Transient Recorder, which can sample any sensor input at up to 10 Ms/s (Figure 5). Nonvolatile memory is stored directly inside the hardened DAQ, to be debriefed later. This removes reliance on any rotating hard drives or operating systems that can fail, resulting in assurance that data will be recorded during destructive and nonrepeatable tests.

Multiple sample rates during very precise timing increments set by the operator allow for higher sampling and lower



▲ **Figure 5:** The Model 5800 Ruggedized Transient Recorder can sample any sensor input at up to 10 Ms/s.

sampling to take place at predefined time slices with high resolution. For example, sampling can be set to 500ks/s prior to a predefined triggered event from T -.05 seconds to T 0 and set for sampling of 10Ms/s at T 0 to T .5 seconds. This allows for a mix of high- and low-speed sampling in a single data file for more precise time control to capture desired data and not be overwhelmed with massive amounts of undesirable data.

Data Redundancy is often a concern with high-speed tests, as these types of test are typically fatal to the test article and cannot be run more than once. Assurance in data capture is paramount. Pacific Instruments' systems offer multiple recording points for data recording redundancy. The amount of data from high-speed tests can be overwhelming. Pacific Instruments provides the ability to decimate data by a factor of x, both during and after recording.

Rule explained that rocket engine testing generally requires data before and after the test event for certain durations. Pacific Instruments allows the operator to decimate on the fly at desired time increments. For example, 2 ks/s for all channels prior to rocket firing, 200 ks/s during rocket firing, and 200 s/s during rocket engine cool down. Enabling the test technicians to modify the sample rates as desired during the test, instead of having to take data at the full high-speed rate, allows for a much more manageable data file.

Remote operation of the DAQ is often necessary in high-speed tests as personnel cannot be located anywhere near a type of test usually requiring high speed, such as in jet turbine, rocket engine, explosive, and wind tunnel applications. The ability to either have the data acquisition system located far away from the test area for operator control or near/on the test article for remote control is very important to mil/aero customers.

More and faster

Rule mentioned that many test environments are asking for more and more channels at faster and faster sampling speeds, significantly increasing the amount of data. The ability to decimate data on the fly for longer duration high-speed tests, or accurately determine specific times in which to sample, is becoming a highly desired capability in order to significantly cut down on the amount of data.

Being able to use more than just Analog and Digital inputs and to leverage newer technologies such as Digital Image Correlation (DIC), fiber optic strain gage systems, wireless sensors, and load control systems is becoming more and more desirable. Pacific Instruments can input any of these third-party data streams and record, display and broadcast data in parallel to analog and digital data.

Pacific Instruments provides high-end signal conditioning and data acquisition system solutions to rocket engine, jet and gas turbine, wind tunnel, and explosive testing environments for both military and aerospace applications. Pacific Instruments offers the unique ability to input any type and number of sensors, and allows for each input to be set up independently, for example, sample rate, gain, filter, excitation, etc. Systems are available from 1 to 8,192 channels and can sample at up to 10 Ms/s per, along with digital I/O for real-time control with a turnkey software package.

Rule brought up that the company uses true analog signal conditioning ahead of a high-speed digitizer in the same system, allowing for very clean signals in a single turnkey transient data acquisition system. Onboard nonvolatile memory per channel allows for data to be recorded inside the system at up to 10 Ms/s. A ruggedized enclosure housing channel input I/O modules allows for the system to be placed on or near the test article and enables it to withstand violent testing applications. Data is debriefed from the system to any Microsoft Windows-based PC post-test for analysis.

Current trends in high-speed data acquisition in the military and aerospace environments are to have more and more data, either from adding additional channels to a test, or increasing the sampling rate, or both. While more data is not a bad thing, unless you're the one analyzing all of that data, the key is to not just have more data that is inaccurate, but more data that is precise and tells you accurately what transpired during the test.

Takemi Iguchi is a technical advisory manager at Kikusui America, and he told us about how as the development of the More Electric Aircraft (MEA) increased, Kikusui set out to create a power supply for testing bidirectional converters connected between the AC bus and HVDC bus. For example, the PCR-WE2 series is adaptable with both buses and can be used as a power source for development and evaluation tests (Figure 6). Three outputs can be set independently so that different voltage combinations (including AC and DC combinations) are possible.

For testing AC-connected equipment this means 115V/230 V (one-phase) and 200V/400 V (three-phase) at frequencies of 400 Hz, 360 Hz to 800 Hz, and up to 5 kHz. For DC bus-connected equipment, this means 28 V DC or ±270 V (540 V). Because the PCR-WE2R is a bidirectional power supply, it supports four-quadrant regeneration in all output modes up to 100% of the power rating. This is a huge benefit when testing high-power bidirectional converters.

▼ **Figure 6:** The PCR-WE2 series can be used as a power source for development and evaluation tests.

Iguchi reminded us that conventional AC power supplies are unable to sink power, requiring a resistive load and an electronic load device to be connected in parallel. In addition, since these load devices convert the absorbed energy into heat, there are challenges treating the heat exhaust. With a regenerative AC power supply solution, the source and sink can be covered by a single power source. In addition to reducing equipment installation space, energy is not processed as heat, but regenerated to the grid, creating an environmentally friendly test system.

Creative design

Brandon Treece, principal solutions marketing manager at NI, was quick to point out that the company takes an interesting approach to high-speed I/O for digital interfacing applications. By combining customizable FPGA-enabled COTS hardware, with powerful software and IP libraries both from NI and their network of partner companies, they are able to help customers create a high-performance solution, while reducing risk typically seen with the traditional approach.

▲ **Figure 7:** NI offers a reconfigurable I/O line of PXI modules with up to 128 FPGA controlled digital lines in a single PXI slot.

NI has many different models available, in three categories, each with a user-programmable FPGA that varies in speed and customizability. For example, in high-density single-ended digital applications, NI offers a reconfigurable I/O line of PXI modules with up to 128 FPGA controlled digital lines in a single PXI slot, each capable of speeds up to 80 MHz (Figure 7). For high-speed serial communication, they have high-speed serial instruments offering speeds up to 28 Gbits/s.

Treece said their most customizable option is what they call FlexRIO, which has an interchangeable I/O module mounted on the front of the device, which can be purchased or custom-designed using the module development kit. This is suitable for applications where a DUT not only uses a custom or nonstandard protocol, but also has a custom physical interface as well.

Traditionally, to address these applications, engineers would need to develop this type of capability from scratch using traditional FPGA development tools. With this platform, you can design reconfigurable, high-performance testers that meet custom requirements from a higher-level starting point, directly out of the box, reducing engineering needs in the creation of the solution.

Treece also said there are several challenges when it comes to digital-interfacing applications in mil/aero applications that often center around flexibility and performance. On the one hand, if an application requires simple communication over a common interface bus such as MIL-STD-1553 or ARINC-429, there are a plethora of options available on the market to address this need.

However, if the application requires a customized version of a protocol; a complex high-speed protocol such as Fibre Channel, Serial Rapid IO (SRIO), or ARINC-818; or in some cases a customized version of a complex protocol COTS, hardware and software often isn't available so custom design is required. NI addresses these challenges by providing customizable FPGA-enabled COTS hardware, with powerful software and IP libraries, both from NI and its network of partner companies that provides a higher-level starting point for engineers to use, and avoid all of the risk that comes with custom design across the design cycle.

Connection migration

Treece explained they are seeing a move from parallel digital buses to complex, high-speed serial protocols like ARINC-818 and Serial Rapid IO (SRIO). This is causing challenges for engineers and test teams as they are faced with implementing these protocols while still holding to their schedule. Even with off-the-shelf IP cores, implementing a custom design introduces significant risk,

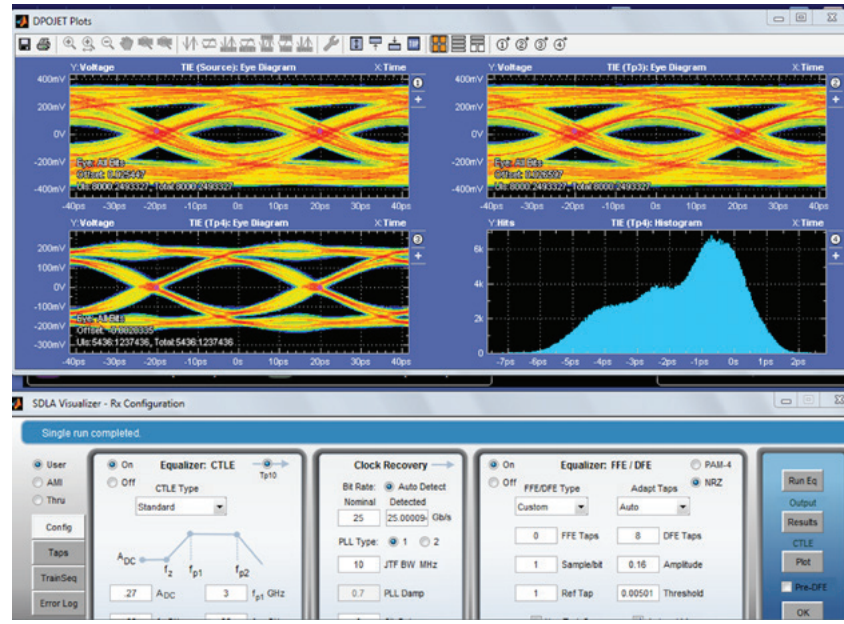
and being able to leverage customizable FPGA-enabled COTS hardware reduces the risks associated with custom design.

He was proud to point out that NI's very first customer back in 1977 was Kelly Air Force Base in Texas, and today provides platforms that include modular hardware like VXI, PXI, and CompactRIO, and engineering software like LabVIEW, LabWindows/CVI, TestStand, and more. Along with these commercial tools, NI has developed a deep knowledge of the challenges test teams face in technical development, requirements changes, and business impact—not only in the aerospace and defense industries, but others as well.

Tektronix's Brad Odhner emphasized how Tektronix offers solutions for the latest high-speed I/O standards, including mil/aero test system favorites like Serial Rapid I/O (SRIO), Fiber channel, ARINC 818, XAUI, as well as custom busses at speeds up to 32 Gb/s. The technical marketing manager pointed out that this is enabled by their high-speed oscilloscopes such as the recently released 10 GHz 6 Series B MSO and the 70 GHz DPO70000SX platform, and their toolsets.

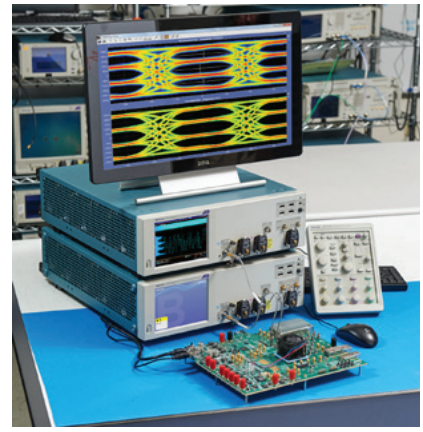
DPOJET software for the DPO70000SX platform provides industry-leading jitter analysis and eye-diagram evaluation, allowing in-depth debug and complete characterization on serial buses to verify signal integrity. The Advanced Jitter Analysis software for the Tektronix 6 Series B MSO is based on, and is very similar to, DPOJET. Serial Data Link Analysis (SDLA) software and the DPO70000SX platform can emulate complex scenarios on real, measured waveforms, in addition to theoretical simulation that relies on idealized signals.

Odhner explained that SDLA provides the ability to de-embed necessary fixtures and cable sets to deliver the signals to the oscilloscope, and allows for embedding channels or cable sets that engineers might not physically have at the time of test, to see how signals will change through different signal paths. SDLA also enables engineers to work through "what-if" scenarios for Tx and Rx equalization settings, to determine how they affect signal integrity (Figure 8).



▲ **Figure 8:** SDLA enables engineers to work through "what-if" scenarios for Tx and Rx equalization settings, to determine how they affect signal integrity.

▼ **Figure 9:** DPO70000SX oscilloscopes can perform BER measurements without the need of an additional instrument.



Commercial adoption

Odhner sees mil/aero engineers adopting more and more high-speed serial buses that have already existed in the commercial space. The challenge for these engineers is that they don't follow the same use models that these buses were intended for; often driving signals over special interconnects and longer than allowed spans. Odhner said that Tektronix toolsets are flexible enough to enable engineers to continue development in these odd environments.

Another common challenge is the need to measure a bit-error ratio (BER) on these special links. Traditionally this requires a single-use piece of equipment, a BER tester or BERT. Their DPO70000SX oscilloscopes have an optional error-detector built into their hardware, enabling them to, alongside their oscilloscope functionality, perform these BER measurements without the need of an additional instrument (Figure 9). Additionally, unlike a BERT, BER testing with the DPO70000SX can be done directly through the oscilloscope's probing interface.

Long-term support and obsolecence issues in Mil/Aero continues to be a key challenge for engineers. Many years, or decades in some cases, of code and protocols have been built for equipment that is now obsolete. To address this, Tektronix recently introduced the Programmatic Interface, or PI, Translation layer for the 5 and 6 Series Oscilloscopes. This firmware-enabled capability allows execution of commands from older oscilloscopes like the DPO/MSO5000 and DPO7000C Series, enabling engineers to replace aging equipment, or build new systems, without changing test code and risking the need for recertification.

In radar, sensors and electronic warfare, we are seeing more standardization in backplane connectors, owing to the new modular open systems architectures (MOSA) program in the U.S. These

standardized connectors are translating into a more specific set of protocol testing needs, which include multi-gigabit ethernet (10 Gbe) and PCIe Gen3 (8Gbps). They've seen higher demand for the ability to characterize, debug and verify high-speed serial subsystems. In terms of protocols, we've also seen a fair amount of DDR.

Tektronix pioneered the use of silicon-germanium-based hardware in order to achieve the performance that customers need. The Asynchronous Time Interleaving, or ATI, technology in their DPO70000SX platform allows the oscilloscope to retain a high signal-to-noise ratio at higher bandwidths. They also develop custom ASICs for their oscilloscopes for high speed I/O. For example, with the Tektronix 6 Series B MSO, a custom ASIC allows engineers to view frequency and time-domain signals simultaneously, with industry-leading low noise and 12 bits of vertical resolution.

Odhner said the company expects the need for increased data and bandwidth throughput through adoption of higher data-rate protocols such as PCIe Gen 4 (16Gbps). Customers expect solutions to be backward-compatible with previous generations, and will demand as much software automation as is possible. They also anticipate more requests for optical solutions.

Captured at speed

When we reached out to Rodger Hosking, a VP at Pentek, he highlighted the company's recently introduced Model 2757 100Gb Ethernet Recorder, which captures full-speed streaming data to SSD drives at sustained rates of 12.5 GBytes/s. It supports UDP Ethernet protocol over optical cable, which is popular for real-time data links because of its low overhead.

Hosking said that interfaces are becoming faster because of increased signal bandwidths, along with the number of channels, as well as requiring higher resolution and dynamic range in virtually all sensor systems.

One technique to solve this is to perform DSP operations closer to the antenna, by extracting or qualifying only relevant information at the source, before sending raw data through system interconnects. Many I/O links are shifting from copper to optical cables for many benefits: higher speed, immunity to EMI, and longer cable spans. Smaller and lighter-weight cables are especially important for UAVs, and secure radiation-free optical cables make eavesdropping difficult.

Hosking said that Pentek supplies many test solutions for radar, EW, countermeasures, and communications systems, including digitizers and recording systems to both capture and generate these signals. Design cycles need to get shorter in spite of complexity, so developers of test systems can benefit by incorporating higher-level elements in their designs—like sub-systems instead of discrete components—to reduce risk and save time. EE

TOF ULTRASONIC MEMS SENSORS UNLOCK THE DOOR TO PROXIMITY AND PRESENCE SENSING

By Ted Karlin, Marketing Director, Chirp Microsystems, a TDK group company

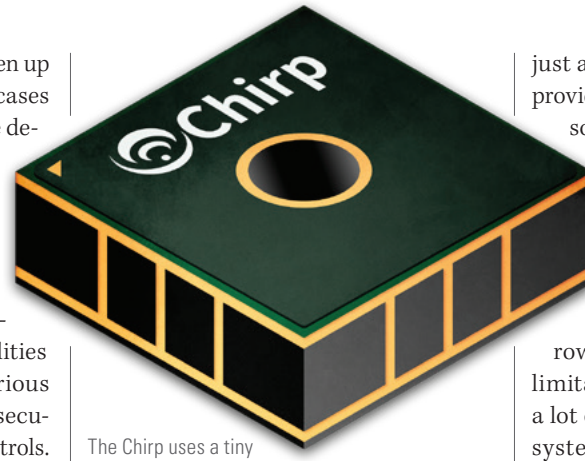
Time-of-flight (ToF) sensors open up new application areas and use cases for proximity sensing and presence detection technologies, and these sensors can add valuable functionalities and intelligence to smart home applications, such as smart door locks.

For many years, proximity sensing and presence detection capabilities have been popular features in various smart home applications, such as security systems, lighting, and HVAC controls. However, sensors traditionally used in these applications are sensitive to varying heating and lighting conditions. They are also power-hungry, sometimes difficult to conceal, provide a limited field-of-view (FoV), tend to be complex in design, and yet provide no intelligence.

A new generation of miniaturized ultrasonic time-of-flight (ToF) sensors enable new application areas and use cases for proximity sensing and presence-detection technologies. These sensors can add valuable functionalities and intelligence to smart home applications, such as smart door locks.

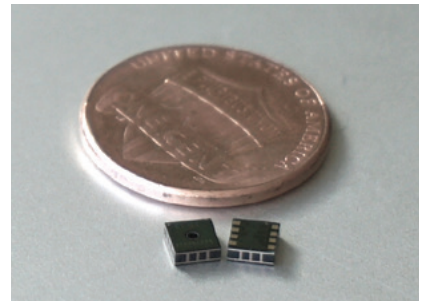
Smart home trends

According to a recent GMI Research report, the global smart homes market is forecast to grow at a CAGR of 11.6% from 2019 to 2027, by which time, projected generated revenues could reach US $166 billion. However, current sensing technologies used to date, such as passive infrared (PIR) sensors, infrared (IR) proximity sensors, radar, and camera vision, are reaching their technical limits.



The Chirp uses a tiny Piezoelectric MEMS Ultrasonic Transducer (PMUT).

PIR sensors have a large Fresnel lens, which is difficult to conceal, making for an unaesthetic design. They are also sensitive to various heating and lighting conditions, offer no range information, are insensitive to minor motion occurrences and have high latency. For example, when used in smart lighting systems, a delay of just a fraction of a second to switch-on provides a poor user experience. PIR sensors also require additional multiple discrete, higher power devices that add to system complexity and power consumption.



Size comparison of conventional ultrasound and Chirp's MEMS-based sensor with integrated ASIC

Similarly, IR proximity and IR ToF sensors consume high levels of power. They have a very narrow FoV and lighting and targeting limitations. Radar technology requires a lot of energy to operate, and the end-system design is complex, bulky and costly. Camera vision is expensive too, and, because it is processing-intensive, energy consumption is high, and there are privacy concerns to consider.

Ultrasonic MEMS-based sensors

Discrete piezoelectric transducer-based sensors overcome most of these challenges. They work using ultrasound to build a dynamic picture of the surrounding environment. The ultrasonic pulse reflects off an object and creates an echo pulse back to the sensor. The ToF is the roundtrip time it takes for the pulse to be sent and the echo to be received, which is used to determine the distance of the object from the sensor.

For example, the Chirp (lead image) uses a tiny Piezoelectric Micromachined Ultrasonic Transducer (PMUT). The sensor's membrane is driven to move up and down, pushing the air back and forth and creating sound waves at ultrasonic frequencies. When combined with a power-efficient digital signal processor (DSP)

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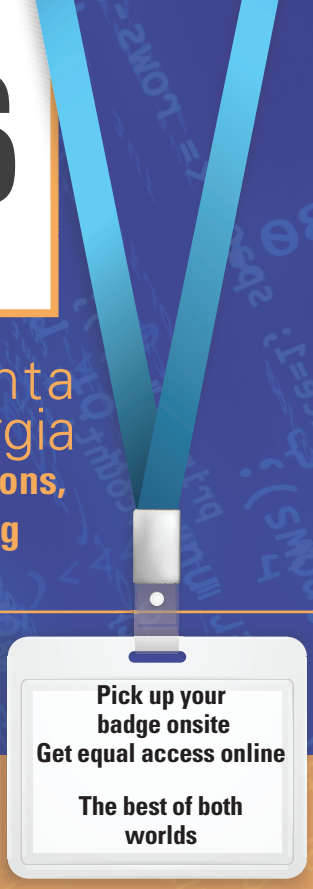

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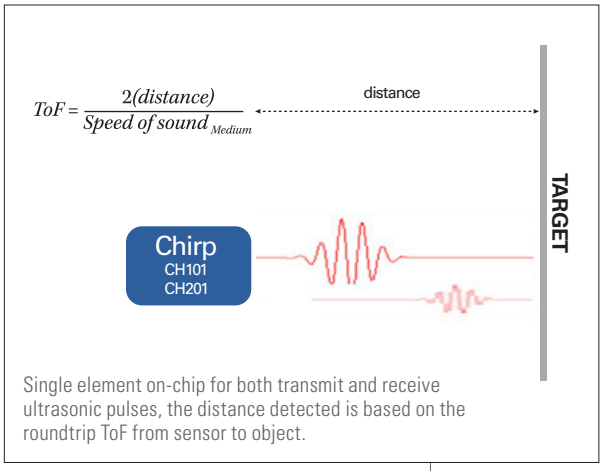


Single element on-chip for both transmit and receive ultrasonic pulses, the distance detected is based on the roundtrip ToF from sensor to object.

ASIC for signal processing and control, the solution fits in a 3.5 mm x 3.5 mm package. It consumes about 15uA, which is around 500x lower than that of IR ToF sensors, making it possible to run battery-powered applications for years from a single battery.

Several features allow for low power operation. The host processor does not need to make any ToF calculations nor does it need to provide any stimulus to the sensor during normal operation. The sensor's ASIC can run firmware algorithms allowing the host processor to shut down into its lowest power mode until the sensor generates a wake-up interrupt when motion is detected.

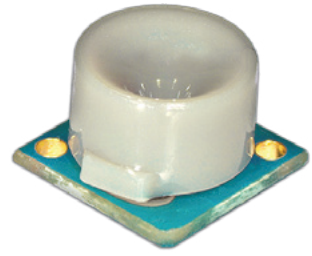
Depending on product choice, range finding is up to 5m for the CH201 and 1.2m for the CH101. They both have the same 3.5 mm x 3.5 mm hardware footprint, ASIC and pin-out. They work in any lighting condition, including full sunlight or complete darkness, and provide millimeter-accurate range measurements independent of the target's color and optical transparency.

Chirp has several small form factor ultrasonic modules with varying fields of views to accelerate evaluation and development of these revolutionary sensors into small product enclosures. The turnkey ready-to-use firmware, which is loaded onto the ASIC, turns the ultrasonic echo data into information that enables many use-case scenarios, including range-finding, presence and proximity sensing, object-detection and avoidance, position-tracking and even floor-type identification in robotic vacuums.

Smart locks

Advances in biometric fingerprint sensors, 3D-facial recognition, touch displays, and 5G connectivity have led to increasingly complex and power-hungry smart lock architectures. Here, the ultra-low power sensor can always be on, so when a person approaches the door, it can initiate a wake-up function to turn on the higher-power biometric sensor, keypad, video display, or camera.

The presence-detection algorithms only detect moving objects, rejecting static targets such as plants, trees, etc. Range measurements provide additional information for the algorithms to reduce false positives. With ultra-low latency, the sensor initiates real-time wake-up as the person approaches the door. On top of the sensor, an acoustic horn modifies the FoV—which can be either symmetric or asymmetric—so, for a door lock, this could be limited from waist to head height, ensuring that passing animals do not wake-up the system accidentally. The sensor also meets the saltwater spray test, a requirement for electronics components in smart locks and can be IP67-protected with a recommended membrane seal.



Ultrasonic ToF 45° FoV sensor module for rapid prototyping and integration into product enclosures.

Comprehensive development platform, with the ability to connect up to four additional sensor modules.

Occupancy detectors and smart speakers

The ultra-low power of the MEMS-based ultrasonic sensor enables it to be always on and, after detecting an occupant inside the home, can automatically trigger an alarm or switch on lights. As the sensor is tiny, it is easily concealed from an intruder and is unobtrusive to the occupant. Again, because this is an ultrasonic sensor, it can sense movement in any lighting conditions, day or night. The low latency ensures lights switch on "instantly," providing a great user experience.

In alarm systems, the sensor's static target rejection firmware ignores non-moving items, such as a table and chairs, and range measurements help reduce false positives. Like the smart lock application, the FoV is fully customizable, for instance, to allow pets to move around the house without detection.

Because of the always-on presence detection capability of the MEMS-based ultrasonic sensor, new use cases also emerge. Smart speakers that wake up as a person approaches to listen for an instruction may run purely from a battery. A faucet with a battery-operated sensor will turn itself on when hands are placed under it. In robotic vacuums, an integrated sensor could initiate collision avoidance or identify the floor type to automatically adjust the height of the brushes as it moves from a hard surface to a carpeted area.

Development kits for prototyping

A comprehensive development platform allows developers to achieve faster time-to-market. The sensor's firmware is loaded into the on-chip memory at initial power-on via the I2C interface. Chirp provides a default general-purpose rangefinder (GPR) firmware, which enables autonomous range finding operation of the sensor. It also supports hardware-triggering for applications requiring multiple transceivers and additionally many application-specific firmwares are available. A wide selection of acoustic horns is also available. EE

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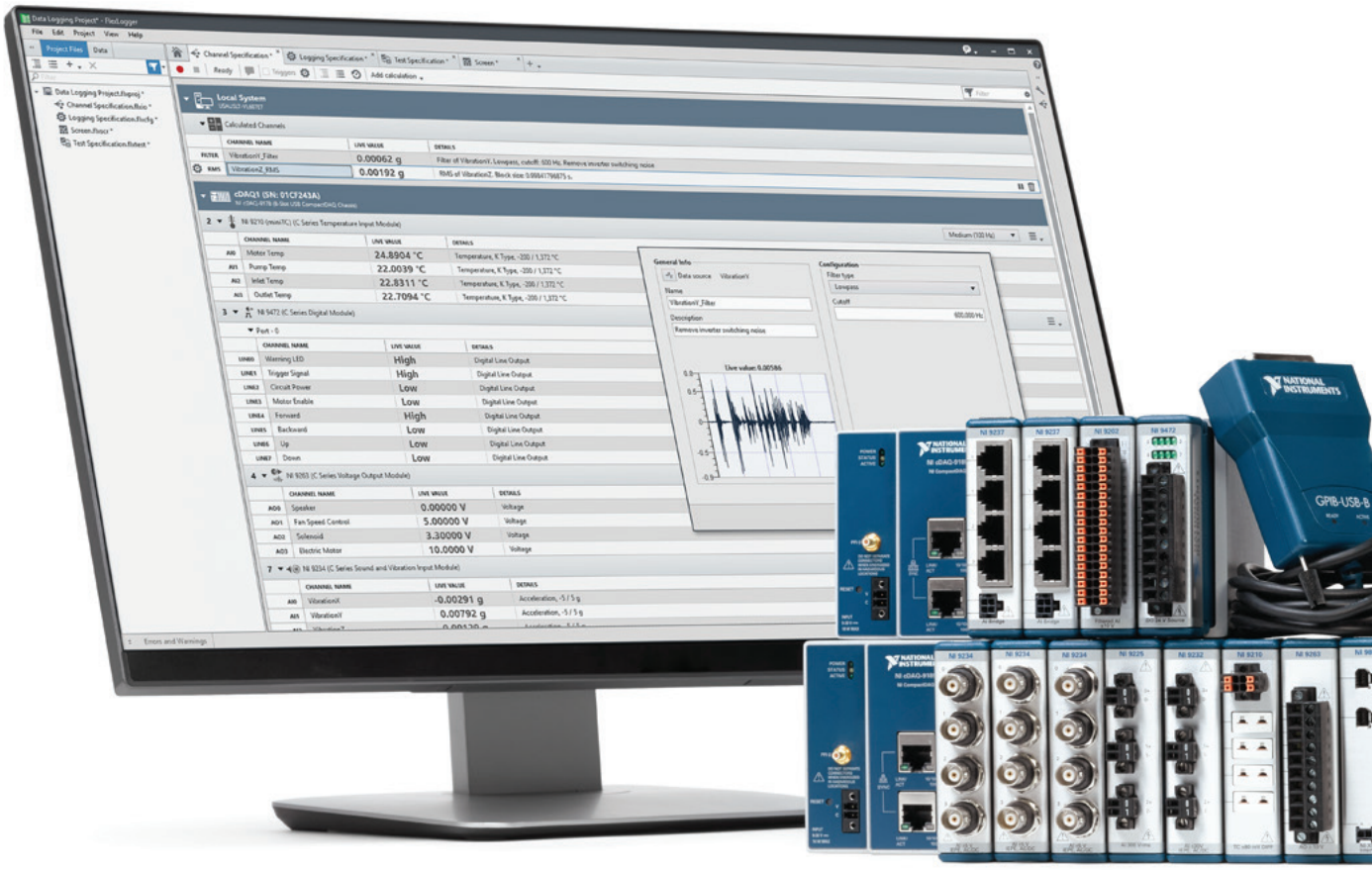

THE FUTURE OF WIRELESS COMMUNICATION STARTS WITH TODAY'S TEST AND MEASUREMENT

By Scott Rust, VP of Product R&D at NI

What foundations will 5G pave for the next generation of wireless communication? And as we build this 5G foundation, what challenges should we expect along the way?

Wireless communication is accelerating the rate in which networks, people, and devices connect to one another. As we progress to the next generation(s) of wireless communication standards, we observe a foundational relationship between each generational standard. Take, for example, foundations laid throughout the 3G era that paved the way for 4G advancements. If 3G had not made mobile internet access possible and reliable, common practices that 4G LTE enable, like real-time video calls, amateur journalism, and mobile payment, would not be possible.

So as we continue to define and refine 5G standards, pioneers in the field already have their sights set on the next generation. What foundations will 5G pave for the next generation of wireless communication? And as we build this 5G foundation, what challenges should we expect along the way?

The 5G Foundation

The 5G standard broke ground in commercial cellular communication standards by introducing and specifying operation within mmWave frequency bands and precise multi-user MIMO beamforming. Wider channels at these frequencies enable greater broadband deployments and network densification, resulting in reliable access for bandwidth-hungry

applications for thousands of users in dense urban areas.

Another significant piece of this 5G foundation is the formation of ultra-reliable, low-latency communication (URLLC) and massive machine-type communications (mMTC). The 4G standard brought to light the many commercial and scientific possibilities of the Internet of Things, so it's safe to expect that 5G's URLLC and mMTC will greatly expand the number of interconnected devices and enable just-in-time applications that make the most out of distributed, off-premise cloud computing.

In response to this rapid increase of connected networks and devices, the search for new real estate across the radio spectrum continues. But finding more space (bandwidth) for more devices isn't the only reason to reach beyond 5G. Another reason is to learn from the 5G standard, including any shortcomings, so that we can resolve and design solutions to these shortcomings in the next standard. This enables engineers with the capability to build upon and improve future applications.

The 6G Possibilities

Curious minds see opportunities everywhere. Ambitious minds saw opportunities to exploit the capabilities of 3G and 4G and build upon those capabilities to progress from one standard to the next. So it should come as no surprise that the engineering community will take advantage of the 6G possibilities afforded by today's 5G standards. Take wireless cognition as an example of where 5G standards build a foundation for 6G possibilities.

Wireless cognition allows remote devices to wirelessly connect to a central computer and offload extensive data sets for which the computer can direct the devices to take complex actions. Imagine a fleet of drones that could replace traditional "wired" cameras for live events. Instead of relying on producers and camera operators to capture the perfect shot, this drone fleet, guided by a centralized computer, makes intuitive decisions to move to optimal positions within a fraction of a second. Thanks to the low-latency and high-bandwidth specifications of 5G, this concept is beginning to take shape.

As we explore the boundaries of wireless cognition within the 5G standard, we are already anticipating the limitations of 5G data rates when developing applications that mass-aggregate and distribute data to centralized computing nodes. So, if this drone fleet does not have the capability to perform contextually aware maneuvers on a 5G network, it may require the speed and reliability of a 6G network before this becomes our reality.

How do we progress to the next generation?

Progressing to the next generation of wireless communication leans heavily on our ability to design, simulate, validate, and test with both speed and accuracy—and within budget. Specifically, we need the right design, simulation, and test tools—both hardware and software—that generate and analyze these wider, more complex waveforms and disruptive improvements to the PHY, MAC, and other protocol layers above.

One of the biggest challenges in testing 5G devices is working with wider signal chains and waveforms with higher complexity. Test and measurement solutions for 4G proved insufficient to address the bandwidth and frequency requirements of 5G, as well as its increased software demands. Consequently, NI is committed to developing wideband test platforms with the right hardware and software that are able to replicate the complex uplink and downlink signals that must be tested within the 5G standard.

Another major challenge in testing 5G comes in the form of fast, accurate, and cost-effective over-the-air (OTA) testing of mmWave beamforming antennas. For engineers designing the latest phased-array beamforming architectures for 5G, traditional methods with chambers and equipment (originally designed for the aerospace and defense industry) are too slow and expensive.

New OTA approaches specifically crafted for improving the workflow of validation and test engineers in charge of these novel 5G devices are vital. As 6G researchers look to expand the frequency of operation toward the THz range, we can expect a greater need for well-designed OTA measurement solutions.

Building Tomorrow Starts Today

The future of wireless communication is connecting everyone and everything. However, progressing toward this future state depends upon the test and measurement community to ensure well-validated performance, cost-effective manufacturing, and reliable field operation for a highly integrated and complex ecosystem of 6G devices.

As 5G lays a foundation for future communication standards, we should also expect that these new aspirations continue to create new challenges for test and measurement. Engineers and research and development (R&D) organizations can overcome these challenges by investing in test solutions that not only meet today's needs but also have the ability to evolve over time.

NI provides researchers and engineers with hardware and software platforms that can adapt as their validation and test needs become more ambitious. Making this investment paves a path toward the next standard of wireless communication. EE

Senior vice president of product R&D, Scott Rust leads the global R&D organization and is responsible for extending the value of the NI platform through the development of world-class software and hardware components and platform product designs tailored to customers across industries. Since joining NI in 1990, Rust has held positions in R&D, strategic marketing, and applications engineering, including vice president of PXI test system products for R&D.

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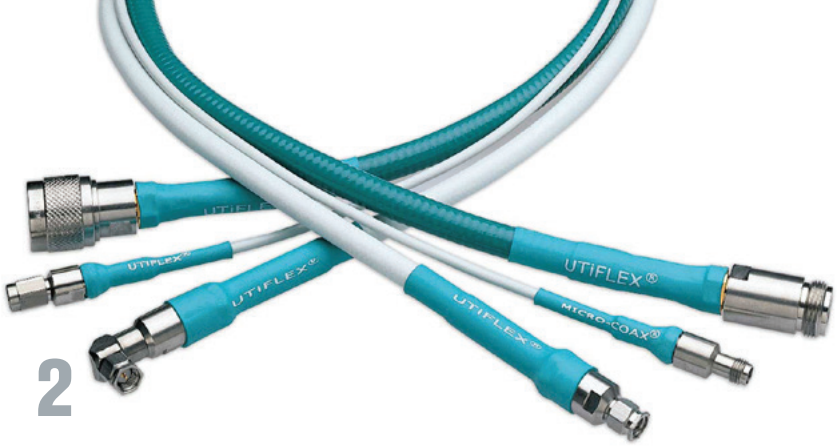

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1. Isolation Tester for Shielded Enclosures

Saelig Company's JRE TVK isolation tester can help to verify the proper shielding isolation of RF enclosure test setups. This test combination, consisting of the **STA-1**, a sensitive handheld spectrum analyzer, and the **HPSS-1**, a high power 2.45 GHz test signal source, can easily and quickly measure enclosure isolation down to less than -100 dB. The TVK Isolation Tester is simple to use since it is completely adjustment free, which eliminates erroneous readings or complex spectrum analyzer adjustment. The HPSS-1 produces a high power 250-500 mW 2.45 GHz signal, which is necessary for sensitive leak detection.

Saelig

2. Microwave Cable Assemblies

Carlisle Interconnect Technologies' UTiPHASE microwave cable assembly series delivers electrical phase stability versus temperature, without compromising microwave performance. UTiPHASE is suitable for defense, space, and testing applications. The vendor says that the series eliminates the PTFE "knee" by flattening the phase vs. temperature response curve, thus minimizing system phase variation and increasing accuracy. Applications for these cable assemblies include commercial and military phased-array radars, as well as aerospace SATCOM and Traffic Collision Avoidance Systems (TCAS), synthetic aperture radars, thermal test sets, and any RF/microwave system operating at or near room temperature.

Carlisle Interconnect

3. Rack Mount Oscilloscope

Rigol Technologies' S8000-R rack-mount digital oscilloscope provides up to 2 GHz bandwidth and the same jitter and real-time eye analysis, power analysis, and serial decode as their MSO8000 oscilloscope. The space-saving oscilloscope is designed for instrument synchronization for small- to large-system configurations. Featuring a typical trigger jitter between instruments of less than 350 psRMS and accessories to synchronize triggering and minimize timing offset among channels, the DS8000-R oscilloscope accommodates demanding system and automation applications. The scope's design allows two to be mounted in a standard 1U rack height.

Rigol Technologies

4. Two-Port Probe Measures Impedance

Picotest has released a new two-port "browser" probe especially designed for measuring power integrity applications including VRM (Voltage Regulator Module) impedance and stability and power distribution network (PDN) impedance. The probe comes with multiple interchangeable sized heads, allowing fast and repeatable power rail testing capability. The P2102A can measure sub-milliohm power rail impedances up to bandwidths of 300MHz (dependent on calibration). The probe comes with four (4) swappable heads (1206, 0805, 0603, and 0402); sizes that match common output capacitor sizes. The probe is compatible with vector network analyzers (VNAs), oscilloscopes, and spectrum analyzers.

Picotest

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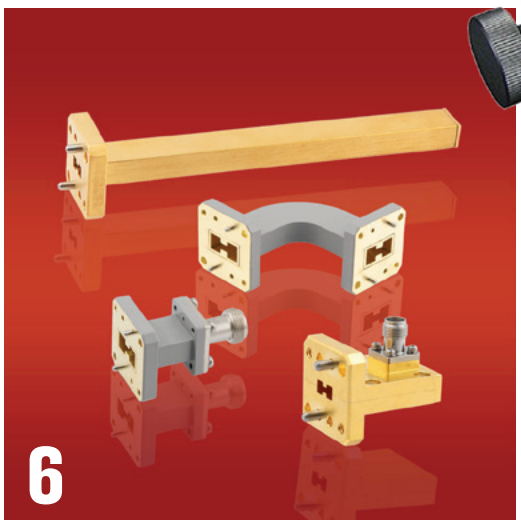

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5. Analog Infrared Thermopile Temperature Sensors

TE Connectivity's noncontact analog infrared thermopile sensors measure temperature by detecting an object's emitted infrared energy from distances a fraction of an inch to several feet away. The sensing element, composed of small thermocouples on a silicon chip, absorbs the energy and produces an output signal. Thermopiles are available with various lenses and filters, allowing for use in multiple applications, including industrial pyrometers, climate controls and medical devices. They measure a wide range of temperatures from -40°C to +300°C. Optical filter options include a standard flat window and a range of silicon lenses.

TE Connectivity

6. Series of Waveguide Components

Fairview Microwave's double ridge waveguide components suitable for radar, wireless and satellite communication, and test and instrumentation. Components consist of 28 models in straight sections, bends and twist configurations. These transmission line components cover wider frequency bands, deliver improved RF performance and offer lower cut-off frequencies compared to conventional rectangular waveguide WRD-180(18-40GHz), WRD-650 (6.5 to 18GHz), WRD-750 (7.5 to 18GHz) sizes. Plus, double ridge waveguide-to-coax adapters are available in WRD-180, WRD-650 and WRD-750 waveguide sizes, SMA, N-type and 2.92mm connectors, UG-style square cover flanges and with typical VSWR performance as low as 1.5:1.

Fairview Microwave

7. High Precision 60 mm Vertical Elevator Stages

The AT10-60-01, AT10-60-02 and the AT10-60-03 motorized elevator stages have been released by Optimal Engineering Systems. These compact, low profile elevator stages feature high-stability 120 mm x 80 mm (4.724 in. x 3.149 in.) tables and 60 mm +/- 2 mm (2.362 in. +/- 0.078 in.) of vertical travel, with a load capacity of 5.0 kg (11.0 lbs). The scissor-lift design combined with precision roller bearings and slide rails ensures smooth motion and very high parallelism throughout the raising and lowering of the table.

Optimal Engineering Systems

8. SMUs Source and Measure Simultaneously

The performance of the new R&S NGU201 and R&S NGU401 SMUs enables simultaneous sourcing and measuring of currents and voltages with high precision. The two-quadrant R&S NGU201 addresses wireless device battery tests and automatically switches from source mode to sink mode at a defined positive input voltage. The four-quadrant R&S NGU401 can also switch at negative voltages, supporting source measurements for a vast range of power supply types. The instruments' innovative current feedback amplifier technology provides both maximum sensitivity and accuracy to reliably measure currents from nA to A in a single sweep.

Rohde & Schwarz

TECH FOCUS

EMC/EMI TEST

What's all the noise about?

Electromagnetic interference (EMI) is the electrical or magnetic energy that degrades or damages a signal's integrity or the components and functionality of electronic equipment. Electromagnetic compatibility (EMC) is when electrical equipment and systems function properly in an electromagnetic environment by the reduction of EMI, through a filter or other component. Here are a few products that address those categories.

FSW signal and spectrum analyzer upgraded

With the R&S FSW-B8001 option, the R&S FSW signal and spectrum analyzer now supports an 8.3 GHz internal analysis bandwidth, offering dynamic range and sensitivity. Design engineers developing the latest radar and wireless communications technologies as well as future satellite systems will benefit from the extended bandwidth available in a one-box solution. Covering an input frequency range of up to 90 GHz, the instrument offers dynamic range, sensitivity, precision, and EVM performance. Applications for the R&S FSW include pulse measurements of A&D radar systems, satellite payload testing and amplifier pre-distortion tests.

Rohde & Schwarz

Spectrum analyzers add VNA mode

RIGOL Technologies' RSA3000N and RSA5000N Spectrum Analyzers extend the flexibility and capability of the UltraReal platform with a Vector Network Analyzer measurement mode. Delivering the same performance specifications and feature set as the current RSA models, the RSA5000N and RSA3000N also feature integrated Smith Charts, Polar Charts, Reflection Coefficient, Impedance, Insertion Loss, Frequency Response, and a host of other measurements. The RIGOL UltraReal Spectrum Analyzer family also supports S11, S21, and Distance-to-Fault Analysis. The RSA5000N and RSA3000N are suitable for antenna sets, searches for communication and cable faults, or characterizing active and/or passive RF components.

RIGOL Technologies

Handheld spectrum analyzers

RF provider Bird expands its SignalHawk family of rugged, handheld spectrum analyzer products with the addition of the SH-60S-AOA Angle of Arrival spectrum analyzer and the SH-60S-TC, offering frequency range of 6 GHz. The SignalHawk SH-60S-TC and SH-60S-AOA provide test coverage for all major wireless systems in an easy-to-use, fully portable test instrument. The SH-60S-TC, RF Analyzer can view RF signals between 9 kHz and 6 GHz and offers intuitive menus, predefined measurements, higher frequency coverage, and a spectrogram (waterfall) display. Additional built-in functions include: FM demodulation, GNSS Signal Quality Test, Field Strength, and Spectrum masking. The SH-60S-AOA, RF Analyzer enables the SH-60S-TC to triangulate the location of an interferer on a map for signals at 9 kHz and 6 GHz. Triangulation allows the user to locate the source within 3 measurements, forming a triangle in the area of the emitter, with a built-in map to find the exact location of the problem.

SH-60S-TC SH-60S-AOA

Bird

ADVERTISER INDEX

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INDUSTRIAL IOT DRIVES PRODUCTIVITY, PROFIT

By Ken Cormier, Managing Editor

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The industrial IoT (IIoT) is the computerized networking of sensors, instruments and other devices in industry settings, including manufacturing and energy management. This setup allows for the collection, exchange and analysis of data in industry, paving the way for advancements in productivity, efficiency and profitability. An evolution of the distributed control system (DCS), the IIot uses cloud computing to attain a higher mode of automation and optimization of process controls. In addition to cloud computing, the IIoT is supported by technologies including Edge computing, cybersecurity, and big-data analytics, as well as AI and machine learning. According to a report by Reportlinker.com, the global market for IIoT is predicted to grow by $421.28 billion during the period of 2021-2025, at a CAGR of 33% during that timespan.[1] Here are some recent news briefs on the subject:

AI and IoT Form Super Team

A recent article on World Economic Forum cites IIoT as one of the four major areas in which IoT is trending, powered by AI, 5G and Big Data. The other areas in the Big 4 include Wearables, Smart Homes, and Smart Cities. Emerging technologies using edge computing, Voice AI and Vision AI include home robots, autonomous vehicles, natural language processing, epayment voice authentication, video analytics on the edge, and super 8K resolution.[2]

Startup Eyes Solving Global Problems

Dutch startup Hiber BV, led by a team of technology entrepreneurs and satellite experts plans to bring IoT solutions to remote areas of the world, bolstered by 26 million Euros in funding from EU and private investment. Founded in 2016, the company is addressing issues like "eliminating food wastage [and] reducing the environmental impact of extracting fossil fuels." "Every year, 30 per cent of food production is lost or wasted and 33 per cent of oil wells experience leakages," said Coen Janssen, CSO and co-founder of Hiber. "Both problems can be addressed by using technology to monitor pressure, humidity or temperature," he added. "These are great examples of how space innovation can solve important global problems and improve lives." The company, which recently launched its fourth satellite, employs low-cost and low-power nanosatellites that orbit 600 km above Earth.[3]

China Wants to Pump Up IIoT Strategy

According to an article in China Today, China is planning to build an industrial internet system to gain a competitive edge in global industrial development. "The country should first establish a national-level open-source alliance on the industrial internet platform to encourage developers to participate in developing open-source codes and systems," said Zhou Yunjie, president of home appliance giant Haier Group. Zhou is advocating the building of common standards in platforms, networks, and security. The Ministry of Industry and Information Technology says that China already has more than 70 industrial internet platforms with regional impacts. It is estimated that 350,000 facilities use cloud platforms.[4] EE

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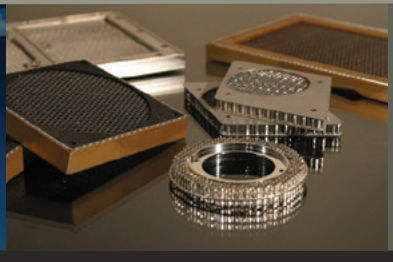

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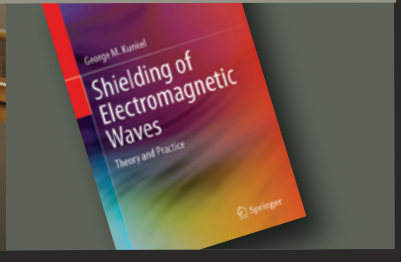

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