SEPTEMBER/OCTOBER 2021
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For Electronic Test & Measurement

SPECIAL REPORTS

MIL/AERO TEST

Keeping the Point of the Spear Sharp

POWER TEST

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ALSO

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CONTENTS

SEPTEMBER/OCTOBER 2021 | VOL. 60, NO. 5

8

14

30

DEPARTMENTS

INSTRUMENTATION

APPLICATIONS

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EE-EVALUATION ENGINEERING (ISSN 0149-0370 Print; ISSN 2694-4618 Online) is published bi-monthly by Endeavor Business Media, LLC., 3918 Montclair Road, Suite 210, Birmingham, AL 35213. Postage paid at Birmingham, AL and additional mailing offices. **SUBSCRIPTIONS** are free to qualified subscribers as defined by Publisher. Rates for non-qualified subscriptions are: U.S. one year—$179.52; Canada/Mexico one year—$193.86; all others one year—$228.89. Single copies—$15.30 each (US) and $20.20 (all others). Subscription inquiries: EvaluationEngineering@Omeda.com. **CHANGE OF ADDRESS** request should be sent to Evaluation Engineering, PO Box 3257, Northbrook, IL 60065-3257. Please provide old and new mailing addresses and allow 4-6 weeks for processing. **POSTMASTER** should send address changes to Evaluation Engineering, PO Box 3257, Northbrook, IL 60065-3257. Printed in the U.S.A.

EVALUATION ENGINEERING
For Electronic Test & Measurement

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EDITOR'S NOTE

DESIGN-WHILE-BUILD IS THE NEW PARADIGM

The dynamic disruption of technical advance isn't finished with the design, development, and manufacturing sectors.

One of the things that we've been exploring and discussing over the last year or so is the impact that modern tech has on how we design, develop, and make things. Although we are used to the introduction of novel core technologies and how they need to be commercialized and integrated into the latest solutions, we are still getting on top of the impact that advances have had on the process.

The last big advance in manufacturing arguably occurred in the last few years, the technical manufacturing migration to what the market has labelled Industry 4.0. This represented the final integration of software- and logic-empowered automation solutions into the physical manufacturing processes. Intelligent tools, driven by advanced logic systems and guided by sensory feedback, have revolutionized manufacturing.

However, it is becoming apparent that there is still a way to go before disruptive technology is done with the product development process. The current world of Industry 4.0 is being evolved further by the integration of collaborative design and development software and hardware that extends the oversight and management of the creative process from the initial idea through manufacture, and even into the field via over-the-air software management.

Originally perceived by many as more of a convenience for widespread development teams than a true development force-multiplier, advanced collaborative software design tools are creating a new creative paradigm. These tools have been available for some time now, but the recent explosion in remote work, leveraged by the ability to integrate them into Industry 4.0, has brought them into the limelight.

Initially used just for file sharing and coordination of the design effort, companies are now discovering how advanced software tools can impact the entire development process. Some of the advantages, at first glance, include the ability to create a Bill of Materials far more easily, ensure proper oversight of tasks within the development process, and the ability for team members to work together, using the same tools simultaneously, remotely.

However, more and more companies are taking the next step in the application of real-time design and development technology and are working on a product's design throughout the manufacturing process. Where once a product's design was pretty much set into stone by the time it got to the manufacturing floor, today more and more companies are using the ability to design on the fly to tweak their product even as it is being made.

This is not a small thing. Often in manufacturing design issues and/or improvements are found, and in the old days it was nearly impossible to integrate the needed changes without completely revamping how things were done. Today, now that everything in the entire process can be tweaked, design changes can be integrated in a smooth and intuitive manner while a product is already being made.

The most visible company developing their products on the fly while they are being created is SpaceX, which has made multiple changes to their rocket designs even as they are assembling them for launch. Old-school development would involve a larger number of prototypes with fewer design iterations between them, while SpaceX often incorporates multiple last-minute design changes in each test flight.

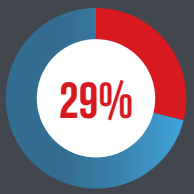
Going forward, the companies that integrate these advanced collaborative hardware and software tools will be able to outperform their competitors. They'll have the speed and flexibility to create more optimized products in a faster and more effective manner than those who don't have an integrated development environment. EE

Alix Paultre,
Editor

BY THE NUMBERS

45.4 BILLION

Global Semiconductor sales in July 2021

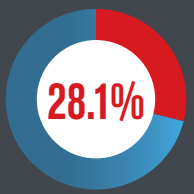


Revenue increase over July 2020

Source: SIA

141.8 BILLION

Predicted market for IoT by 2030

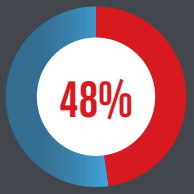


Predicted CAGR 2021-2030

Source: Allied Market Research

24.9 BILLION

Global sales of semiconductor manufacturing equipment in Q2 of 2021



Sales increase over 2020

Source: SEMI

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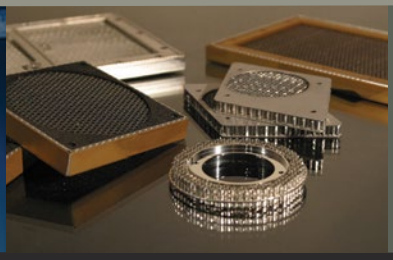

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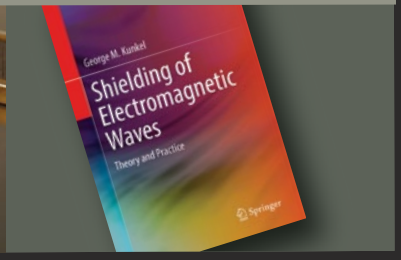

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SPECIAL REPORT

KEEPING THE POINT OF THE SPEAR SHARP

by Alix Paultre, Editor

In order for a military or aerospace system to operate in an optimal fashion when on the battlefield, it is critical to properly test and evaluate the various solutions.

Serving military systems

When we talked to Stephen T. Sargeant, CEO at Marvin Test Solutions, about best practices in the test and evaluation of intelligent military and aerospace subsystems and munitions, Sargeant brought up how implementing active emulation can bridge the functional test capability gap that current O-level handheld test sets have when used to test current Smart/legacy systems. Next-generation handheld Smart weapon technology is critical to consolidation and modernization of legacy test sets (requiring obsolete handheld and large, multi-box test sets).

Addressing the armament test gap that exists across legacy 4th- and 5th-generation aircraft equipped with Smart weapon technology (MIL-STD-1760), MTS' MTS-3060A SmartCan Universal O-Level Armament Test Set enables support for any platform and any Smart or legacy armament system. The SmartCan has replaced legacy passive-only test sets with an advanced active-test methodology in more than 12 countries today.

Sargeant explained that in order to actively test today's fighter aircraft, two conditions must occur: the test set must identify to the aircraft the correct munition on the correct station, and once the aircraft recognizes the munition, the test set must then digitally communicate with the aircraft to ensure proper communication and the arm and release/launch sequence. These two conditions must occur at the required time, and while testing and monitoring the digital systems and the analog interface.

Active testing has major advantages over passive testing, as it can resolve issues effectively and immediately while ensuring that the armament system continues to work efficiently throughout its life. It also validates that the product delivers intended functionality and performance after its delivery. Unlike legacy handheld test sets that are only capable of performing stray voltage and continuity tests, the SmartCan's measurement capability goes far beyond those important

▼ Marvin Test Solutions' MTS-3060A SmartCan supports any platform and any Smart or legacy armament system
Courtesy of Marvin Test Solutions

The long life spans of vehicle-based electronics, along with obsolescence issues, are an ongoing problem.

guvendemir / E+ / Getty Images

tests and eliminates the need for multiple, large two-person-carry test sets when evaluating armament.

Advances in handheld armament test technology have eliminated the need to deploy three or more unique test sets to determine an aircraft's functional status. In addition, in almost all cases, the SmartCan executes test faster than the legacy test sets. The small footprint, highly-capable, rapid test functionality of the SmartCan fits perfectly into the USAF's Agile Combat Employment (ACE) model.

Overcoming the legacy handheld test set capability gap that exists across legacy 4th- and 5th-generation aircraft equipped with Smart weapon technology is one of the biggest challenges facing today's armament maintainers. Innovative handheld O-Level test solutions are poised to transform armament test. Active emulation allows the maintainer to fully check the functionality of the MIL-STD-1760 Bus, ensuring that required functions occur as designed when airborne.

The MTS-3060A capabilities and rapid test feature allows use during Integrated Combat Turns (ICT) that will serve as a bedrock of ACE. Training and logistics requirements can also be greatly reduced using the MTS-3060A SmartCan since it is a universal O-Level armament test set supporting multiple types of aircraft and other vehicles carrying armament. Maintainers could simply be instructed on the SmartCan during initial technical training, and then leverage its capability across every aircraft the USAF flies today and tomorrow.

When coupled with a predictive maintenance AI system, the SmartCan-provided test data can reduce the cost of maintaining armament and reduce airborne failures. Utilizing statistical trend analysis of the test data logs stored in the SmartCan, maintainers can predict and prevent failures, taking maintenance beyond the traditional fail/fix paradigm. Furthermore, a common test solution would reduce the costs associated with test set life cycle management and sustainment.

Solutions such as the MTS-3060A SmartCan have the potential to rewrite the armament test paradigm by advancing test equipment into the digital era, revolutionizing the way units prepare and execute combat missions, and provide more predictable and reliable mission successes for warfighters. Test sets are designed to meet customers' test requirements for maintenance and sustainment of Smart and legacy weapon systems' armament, including that supporting LGB, JDAM, SDB, and Hellfire and Maverick Missiles, etc., for fixed and rotary wing, manned and unmanned, aircraft.

For example, the MTS-3060A SmartCan Universal O-Level Armament Test Set is the most advanced handheld flightline armament test set available, capable of testing all Alternate Mission Equipment (AME) and Aircraft Armament Equipment (AAE). Test time reduction, test set consolidation, standardized training and reduced logistics support were all key concerns voiced by our customers, and the SmartCan addresses all of these needs and more. Battery operated, weighing approximately 4 lbs., menu-driven operation, and the consolidation of most existing flightline armament test sets into one, sets the MTS-3060A apart from all others. The SmartCan enables ACE as soon as USAF is ready to execute the strategy.

Additionally, the company supplies the MTS-235A, the only production and depot level test set deployed supporting F-35 Lightning II AME and AAE. It is both rugged and easy to deploy. We designed the MTS-235A for use at the intermediate maintenance level supporting F-35 AME and AAE, if and when the F-35 program moves beyond the current O- & D-Levels-only armament maintenance test. When coupled with Marvin Test Solutions' Configurable Armament Repair Depot, the MTS-235A allows for regional armament repair, close to the point-of-use, further advancing ACE.

▲ The MTS-235A F-35 Armament Test Set is a rugged, portable test set for F-35 alternate mission equipment.
Courtesy of Marvin Test Solutions

When asked about mil/aero test, Alan Lowne, CEO of Saelig, described how the long life spans of vehicle-based electronics, combined with the inevitable obsolescence issues, are an ongoing problem in the military. Automated test technologies are easing the pain. Keeping obsolete and disparate systems running reliably is a constant task for military planners. Ensuring the reliable and safe operation of a wide variety of military systems often means that electronic assemblies and boards that malfunction or need routine testing are returned to their respective OEMs for evaluation. This creates expensive and inconvenient downtime for equipment out of service.

In order to reduce operating costs, and improve response times and shorten repair cycles, operators often set up a local electronic repair workshop within their own field maintenance centers to test and find faults with the electronic assemblies and PCBs to avoid sending subsystems far out of the field of operations. This not only saves time and money, but also reduces

▼ Keeping obsolete and disparate systems running reliably is a constant task for military planners.

the unavailability of vital transport stock and equipment. Reduced in-service breakdowns and improved fleet capability ensure that transit and field systems run more smoothly.

In former times, numerous separate instruments, manually wired connections and paper test procedures operated by skilled technicians were adequate. These repairs were covered by trained-technician repair shops in dedicated off-site repair centers. Nowadays, with the emphasis on efficiency and reduced costs, universal automated test systems have replaced individual test instruments, but these can be extremely expensive, and some of them come with a steep learning curve.

Automatic test equipment (ATE) products perform automated or computerized test procedures on a device under test, including functional testing of ICs, analog and digital components, complete boards, etc., and they vary in complexity in order to provide repair capabilities with different levels of test capabilities for differing board complexities. Computer-based automated test procedures can run reliably and consistently with test results being captured automatically, with high accuracy, high test speeds and extreme flexibility.

Typical ATEs include: In-Circuit Testers, performing device level tests on components mounted circuit boards; Functional Testers, used to test full functionality of boards and modules via edge connectors; Boundary Scan Testers for products that are JTAG-compliant such as BGA, FPGA, CPLDs, or even complete boards with a JTAG connector. ATEs have given power and independence to military forces when it comes to electronic repair. Becoming equipped with automatic testing means that repair facilities don't have to rely on outside contractors; they can reduce repair time and cost, and even refurbish and repair outdated and old electronics closer to their use.

Factors to consider when selecting a suitable product include cost, ease-of-use, training availability and expandability. Care must be taken to consider if the

system can cope with obsolete and state-of-the-art electronics. Whether you are a military planner, an engineer, or a servicing officer, there are test products to be found that will provide solutions to meet individual requirements to keep transportation electronics working and reduce system costs. While today's ATE systems are modular and configurable to support multiple different test methods, they need to be easy to use and to become familiar with.

Emulation as force multiplier

When we reached out to Dan Walsh, Director, Defense & Aerospace Marketing at Teradyne, he said that the latest, most advanced weapons systems are more complex, and utilize more interconnected subsystems and sensors, than ever before. As a result, the volume of data moving within the system is always increasing. This requires the adoption of new, reliable, high-speed network technologies at a faster and faster rate. Focusing on software-defined, reconfigurable, high-speed instruments and systems is the key enabler to support these new weapons systems.

To be able to provide the most cost-effective test solutions, in the ever-shortening design cycle and faster deployment, it is essential to use test platforms and instruments that can be reconfigured and repurposed as weapon systems evolve. It is essential to use highly adaptive test instruments, which support a wide range of interface speeds and protocols. Utilizing instruments that support test applications throughout the weapon system product lifecycle—from design and evaluation, to production, deployment, and sustainment—provides test system designers the flexibility to support both the needs of today and the requirements of tomorrow.

Walsh also said there are two key issues Teradyne sees: the proliferation of more I/O technologies and the need for faster deployment of new weapon platforms. Gone are the days of an aircraft or weapons system based primarily on a single core data bus technology such as MIL-STD-1553. The systems of today are employing a more diverse set of avionics communications technologies including high speed Ethernet, Fibre Channel, Firewire, InfiniBand, sFPDP, and more.

▲ Open-architecture test platforms and instrumentation provide flexible, scalable, software-configurable solutions.
Courtesy of Teradyne

This complicates the design of robust test systems used to support these new military platforms and drives the need for test instruments that support multiple data bus types to promote, reuse, and extend the test system life cycle. Innovative, open-architecture test platforms and instrumentation provide flexible, scalable, software-configurable solutions which are essential to the design of cost-effective ATE and simulation systems in this environment.

Although the communication technologies have gotten more complex, the military programs today require shorter development and deployment cycles. This drives the need for higher-performance and faster-to-deploy test solutions. We are seeing more and more customers needing fully-integrated and complete test solutions including hardware, software, test programs and other engineering services to solve very complex test requirements and meet their schedule.

Walsh finished by pointing out the importance of addressing the challenges of supporting a more diverse and higher-speed set of avionics network technologies by designing instruments which are more reconfigurable, and therefore capable of supporting a range of network interface protocols over a range of speeds. At the same time, Teradyne is making more intelligent instruments capable of offloading more tasks from the host system to accommodate the increasing volumes of data that must be handled during test and maintenance activities. EE

HARSH ENVIRONMENTS ARE WHY PRODUCT DEVELOPERS SHOULD RETHINK TIMING FOR 5G

By Jeff Gao, Senior Director of Product Marketing, SiTime

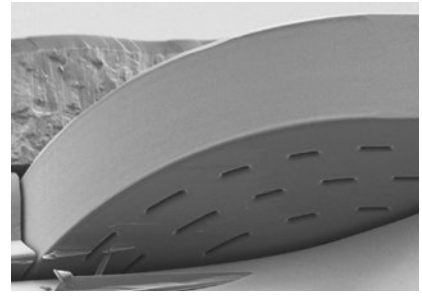
Not simply a faster 4G LTE, 5G is one of the most transformative technologies in the history of telecommunications. In fact, 5G is transforming industries, society and how we communicate and live. This is because 5G is 10 times faster than 4G, supports 10,000 times more network traffic, and can handle 100 times more devices, while enabling one-fiftieth the latency with zero perceived downtime.

***Q:* Have technological changes made is necessary to fully realize 5G capabilities?**

A: Although 5G builds on existing 4G infrastructure, 5G networks deployed at scale will require a complete redesign of communications infrastructure. Industry experts generally agree it may take a decade to completely roll out 5G networks and to realize its full value through the Internet of Things (IoT), automated driving, telemedicine, artificial intelligence, and virtual and augmented reality. Leading carriers have already begun delivering 5G service in major metro areas this year, and we may see up to 1.8 billion 5G connections deployed worldwide by the end of 2021. One of the most important technologies enabling end-to-end 5G is MEMS timing.

***Q:* How does network densification lead to some harsh conditions for 5G deployments?**

A: Network densification to add 5G network capacity requires adding more cell sites to a variety of locations in order to increase the amount of available capacity. To accomplish this, equipment is being deployed in uncontrolled environments, such as in basements, on rooftops, at curbsides and on poles.



Cross section of a MEMS resonator (Scanning Electron Microscopy)

***Q:* What do performance, bandwidth and latency have to do with delivering on the promise of 5G?**

A: Delivering on the full promise of 5G requires performance, bandwidth and latency beyond what's possible with current networks. So far, we have deployed sub-6 GHz networks, and the market needs ultra-fast millimeter Wave (mmWave) technology in the 24 GHz to 40 GHz range. This shift will require widespread deployment of outdoor equipment to overcome line-of-sight, blockage, and coverage challenges associated with mmWave frequencies.

Two significant deployment requirements have emerged with 5G: network densification in which cell sites are added wherever they can be to increase the amount of available capacity and cloudification in which light and other utility poles are used to transform networks and enable 5G-powered services. Due to their exposure to shock, vibration, extreme temperatures and other harsh-environment stressors, these deployments require resilient, ruggedized timing components, and that means MEMS.

***Q:* Is rugged equipment required for 5G deployment?**

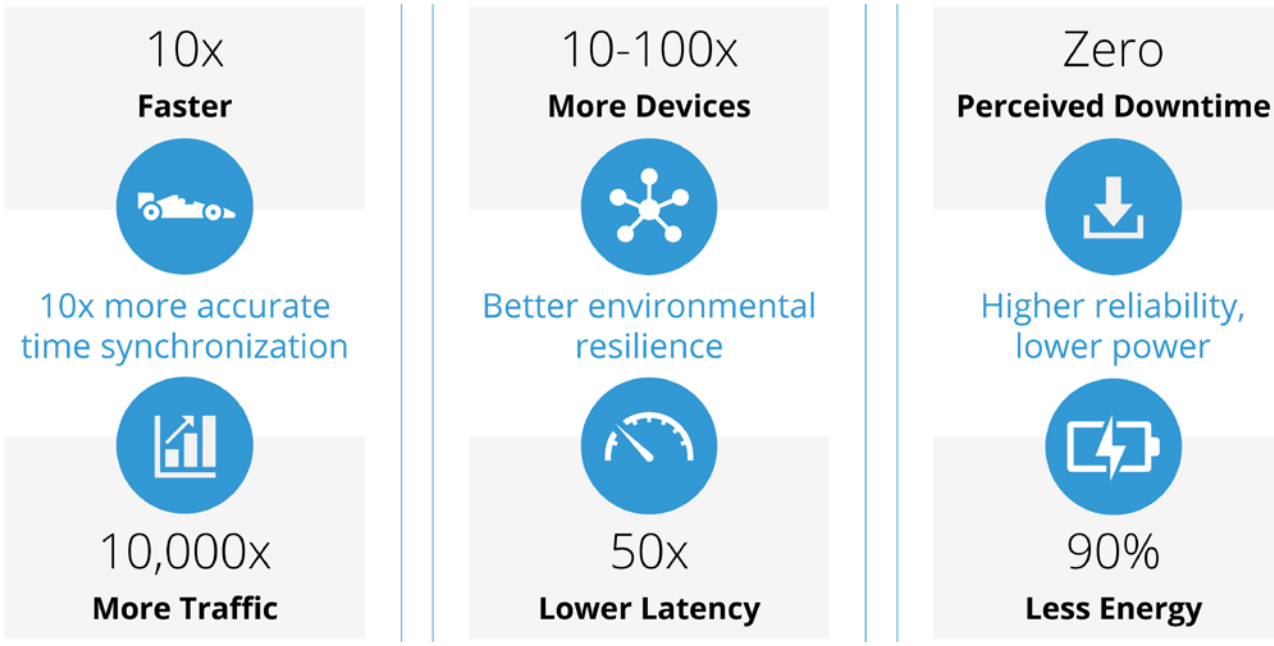
A: Ensuring reliable, resilient 5G mmWave networks may require as much as 100x more equipment (base stations, small cells, relays and repeaters) deployed closer to customer premises such as on lampposts, traffic lights, stadiums, rooftops and exterior walls. Most of this equipment will operate in harsh outdoor environments and must withstand extreme temperatures, wind, vibration, and shock.

***Q:* What technologies do 5G implementations require?**

A: The hardware and software technologies impacted by or involved in 5G implementations include, but are not limited to, optimized RF ICs, antenna arrays, amplifiers, beamforming and beam management techniques. At a recent operator-defined open and intelligent radio access networks (O-RAN) conference, the need for timing synchronization for 5G was a highly discussed topic. This is because many of the fundamental techniques involved in 5G not only require synchronization but, in fact, demand levels of timing alignment beyond anything previously deployed on this scale.

***Q:* Why are rugged timing devices so crucial for 5G deployments?**

A: Timing devices are the heartbeat of all electronic systems including communications infrastructure, industrial equipment, automotive systems and countless



The vision of 5G

electronics products. Think of a timing chip as a metronome used by a piano player, providing the musician with a precise, steady beat for a sharper, clearer musical performance. Despite the prevalence of timing technology in our lives, relatively few people—except for system engineers and architects—are aware of the crucial roles clocks and oscillators have played in communications revolutions over the past several decades. As we enter the 5G era, timing technology is more critical than ever.

Q: **What are the different timing technologies in 5G? Why silicon-based MEMS?**

A: Most electronic systems have historically used quartz-based timing devices, functionally similar to the quartz crystals quietly resonating inside our analog wristwatches. Quartz is a 70-year-old timing technology, and its resonators and oscillators have served us well over the decades. However, there's a quiet revolution underway in the timing industry. New generations of timing devices based on tiny, ingenious micro-electromechanical systems (MEMS) resonators have been replacing quartz in applications that require the highest reliability and resilience to environmental stressors. MEMS technology, combined with analog circuits, provide a complete timing solution that is much smaller and lower power than equivalent quartz-based devices, and is much more resistant to harsh environmental conditions.

Q: **Should we really say that MEMS is the de-facto 5G timing technology?**

A: MEMS timing devices have been perfected over multiple generations and have steadily displaced quartz-based counterparts in many demanding communications and networking applications such as 4G LTE and 5G wireless infrastructure. MEMS-based resonators, oscillators and complete "clock-system-on-a-chip" devices deliver orders of magnitude higher performance, reliability and resilience than quartz solutions. For these reasons, MEMS is an ideal precision timing technology for 5G macro- and small-cell base stations deployed outdoors, helping equipment makers and mobile carriers deliver on the promise of 5G.

Q: **Is 5G implementation worth the investment?**

A: It is not an understatement to say that user experiences enabled by 5G can be life-changing. It is the next revolution in networked technology, not simply an evolutionary upgrade. Because of its revolutionary nature, 5G can enable entirely new, previously unattainable applications as it breaks boundaries in access, bandwidth, performance and latency to open up connectivity on massive scales for instantaneous, reliable communications in entertainment, healthcare, transportation, smart cities and homes, and the Internet of Things.

The success of 5G will depend in part on customer satisfaction, not only in terms of unrivaled wireless performance but also rock-solid reliability. With 5G, there is simply no option for dropped calls or network outages caused by extreme temperatures, excessive vibration or sudden shocks. Whether it's for a self-driving car or remote surgery, operators and users alike must be able to rely on 5G as a failsafe technology. 5G equipment makers have already begun using MEMS-based timing technology in network infrastructure. In fact, more than 10 different 5G applications now use MEMS timing devices.

It's about time: The 5G revolution is well underway, and the latest advances in MEMS timing technology will help energize the coming wireless network innovation and transformation. EE

SPECIAL REPORT

POWER TEST IS CRITICAL TO ENSURE OPTIMUM PERFORMANCE

The more sophisticated power electronics systems become, the more of a challenge it is to properly test and evaluate them.

by Alix Paultre, Editor

Advanced power solutions are at the heart of the current electronics revolution. With all of the advances in areas such as microcontroller design and machine learning, among others, the advent of significantly improved power systems to better drive these functionalities is a major development in the industry. These advances also mean challenges to the power test and evaluation industry. This Special Report on Power Test lists some interesting solutions.

SiC Wafer Qualification

Wide-bandgap materials like Gallium Nitride (GaN) and SIlicon Carbide (SiC) are already changing the world with performance several times better than that of Silicon. SiC, for example, has risen as the material of choice in advanced power systems such as those found in next-gen electric vehicles and industrial systems. One of the important enablers of this transition is that SiC chips are transitioning to larger, 200 mm wafers that enable the chip counts to meet growing global demand.

When we approached Sundar Ramamurthy, Group Vice President and General Manager of the ICAPS group at Applied Materials, he talked about their latest products that are aiding the transition from 150mm to 200mm wafer production, which will approximately double the die output per wafer. Advanced materials engineering is needed to optimize raw wafers for production and build circuits with minimum damage to the crystal lattice. Sundar pointed out how the industry is now in the early stages of the SiC power revolution and will benefit from Applied's expertise in materials engineering on an industrial scale.

The company has been working with Cree, an SiC manufacturer, as things like electrification in transportation are rising trends. According to Gregg Lowe, President and CEO of Cree, Applied's support in helping speed qualification of 200mm processes using technologies

▼ The Mirra Durum CMP system which integrates polishing, measurement of material removal, cleaning, and drying in a single system
Courtesy of Applied Materials

▲ EA's PSB-series Programmable Bidirectional DC Power Supplies offer two-quadrant operation combining up to 30 kW sourcing and loading.
Courtesy of Elektro-Automatik

being developed by Applied's ICAPS team, such as hot implant, are also increasing our technical collaboration while helping accelerate Cree's power technology roadmap."

Sundar pointed out that since SiC wafer surface quality is critically important to SiC device fabrication, it is important to address defects on the surface of the wafer, as they will migrate through the subsequent layers. To produce uniform wafers with the highest quality surfaces, Applied has developed the Mirra Durum CMP system which integrates polishing, measurement of material removal, cleaning, and drying in a single system. The solution results in a 50X reduction in final surface roughness as compared to mechanically ground SiC wafers and a 3X reduction in roughness compared to batch CMP processing systems.

The process of ion implantation places dopants within the material to help enable and direct the flow of current within the high-power-producing circuits. The density and hardness of SiC makes it very hard to inject and accurately place and activate the dopants while minimizing damage to the crystal lattice. Applied's VIISta 900 3D hot ion implant system injects ions with minimal damage to the lattice structure, resulting in a more than 40X reduction in resistivity, compared to legacy processes at room temperature.

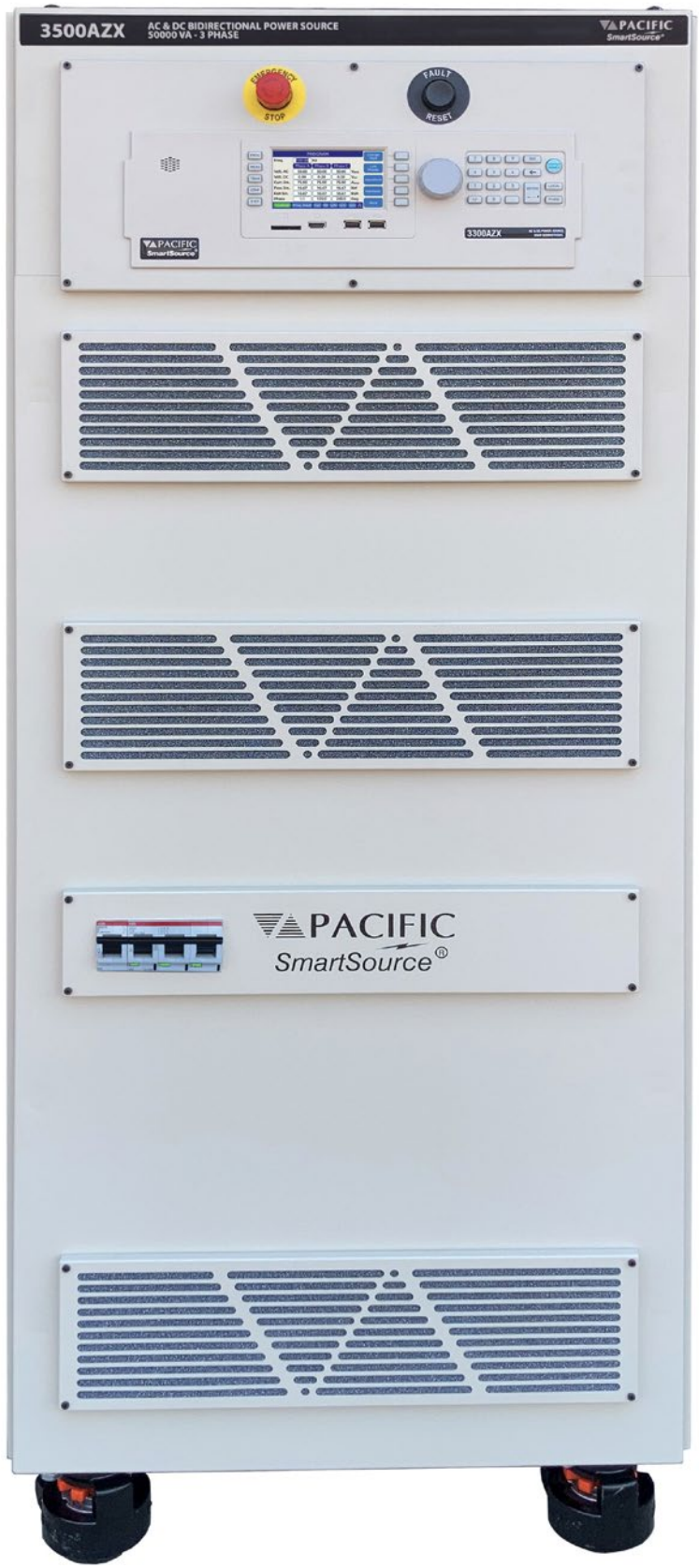
Addressing higher voltages and loads

When we spoke with Zeke Pietsch, Customer Success Manager at EA Elektro-Automatik, said that a major challenge for testing high-power consumer products today is working with higher voltages and load currents. As end-product power levels rise, manufacturers need to contend with higher power supplies and loads. Traditionally, a high voltage supply was a 1,000 V supply. Now test engineers need to work with power supplies and loads with voltage ratings of 2,000 V and higher.

With products operating at high voltages, manufacturers must contend with simulating disturbances such as noise on DC supply lines for thorough testing of product circuitry. Also, loads that can simulate dynamically changing outputs allow complete testing of products that output power. Conventional signal generators to simulate noise in high-voltage supply lines or dynamically changing loads are neither safe nor feasible. An alternative method is needed. One solution is a supply or load with built-in signal generation.

In addition, test engineers have the challenge of minimizing test system cost and space. Supplies and loads with autoranging characteristics enable use of one supply or load to source or sink a much wider range of voltages and currents than a conventional supply or load with rectangular output characteristics. An autoranging source or load can reduce the number of high-cost, high-power supplies and loads. Furthermore, use of regenerative loads can save utility costs. If the source and load can be combined, then fewer devices are needed in the test rack, saving space and reducing control complexity.

Wideband semiconductors incorporated in new power supplies and loads have the potential to enhance testing of legacy systems and improve reliability with improved detection of defective and borderline defective products. Designs can be stressed more in accelerated life testing with power sources with higher voltage and current supplies and loads. The wide-bandgap power components permit increased power density in enclosures that housed lower power, less-efficient sources and loads. Use of wideband semiconductors enables more thorough testing with function generators that can operate on top of high voltage supplies and loads. The



▲ AZX Series regenerative AC & DC Source with optional load combines multiple test capabilities in a single product
Courtesy of Pacific Power Source

function generators can simulate conditions on DC power lines and simulate varying conditions on electronic loads.

EA Elektro-Automatik offers dense, high-power supplies and electronic loads that have 30 kW capacity in only 4U high by full-rack width enclosures. These power handling devices can easily scale with as many as 64 parallel units to manage up to 1,920 kW total power capacity. The ELR-series Programmable Electronic DC Loads are regenerative devices that provide 95% efficiency to both reduce power consumption and save utility costs. Reduced energy consumption saves on cooling infrastructure since much less energy is converted into the heat generated by a conventional load.

Reduced energy consumption saves on cooling infrastructure since much less energy is converted into the heat generated by a conventional load.

EA's PSB-series Programmable Bidirectional DC Power Supplies offer two-quadrant operation combining up to 30 kW sourcing and loading. When a test system needs sourcing and loading at different times, the PSB-series two-quadrant supplies can save costs and test system rack space with use of a single instrument.

Both the PSB- and ELR-series instruments have a built-in arbitrary function generator that can enable test engineers to create load profiles to simulate loads such as solar cell inverters and loads for battery discharge testing under different conditions. Test engineers can simulate batteries, solar cells, and fuel cells with the power supply functionality of the PSB. Test engineers can also simulate noise and voltage variations on DC source lines.

The PSB-series and ELR-series instruments employ autoranging to permit test engineers to use a wider range of current and voltage compared with conventional rectangular-characteristic supplies and loads. This allows a wider range of DUTs to be tested with a single power supply. Furthermore, these instruments allow full

power output or loading across a wide range of voltage and current settings. These instruments have a wide range of standard and optional interfaces which give the test engineer maximum flexibility to interface with PLCs (ModBus, Profibus), PCs (USB, Ethernet), and automotive controls (CAN bus).

Empowering the EV charging infrastructure

Herman vanEijkelenburg, Director of Marketing Pacific Power, told us about the need to build a better and more expansive electric vehicle charging infrastructure, which increases the need to test on-board chargers, from home Level 1 and 2 chargers as well as Level 2 and 3 public charging stations. Many on-board and in-home EV chargers are bidirectional to support peak demand shaving through V2G or V2H type use. This is pushing test requirements for power levels and voltages ever higher, both AC and DC.

Examples of the latest test solutions can be found in the company's regenerative AZX Series of programmable AC, DC and load combination testers which address this growing need by offering power levels starting at 30 kVA/kW and parallel operation to 400 kVA/kW. They also offer AC output voltages for 440Vac rms Line-to-neutral and 762 Vac rms line-to-line and 1300 Vdc.

He also pointed out that wide-bandgap semiconductor devices like GaN and SiC allow designs with higher energy efficiency and are able to handle higher device temperatures but do not fundamentally change the way power products are tested. The same programmable AC and DC power sources and electronic loads are generally capable of testing power products using conventional silicon as well as wide bandgap-based designs.

PPST Solutions offers a wide range of power test equipment spanning power levels from as little as 500 VA all the way up to 400 kVA and higher as needed. This includes both programmable AC source, DC power supplies and electronic loads. The range of product types and power levels allows the company to tailor optimal power test solutions for their customers, which range from small startups to large established consumer and industrial companies.

For example, to address the need for range extending higher power battery packs for electric vehicles, we now offer regenerative AC power, DC power and electronic load power test equipment in a single unit. The new Pacific Power Source AZX Series regenerative AC & DC Source with optional load combines multiple test capabilities in a single product offering maximum flexibility to our customers. Starting at 30 kVA/kW, these units are easily scalable to 400 kVA/kW and offer advanced transient programming and high-speed data acquisition features as well as support for Power Hardware in the Loop (PHIL) applications. EE

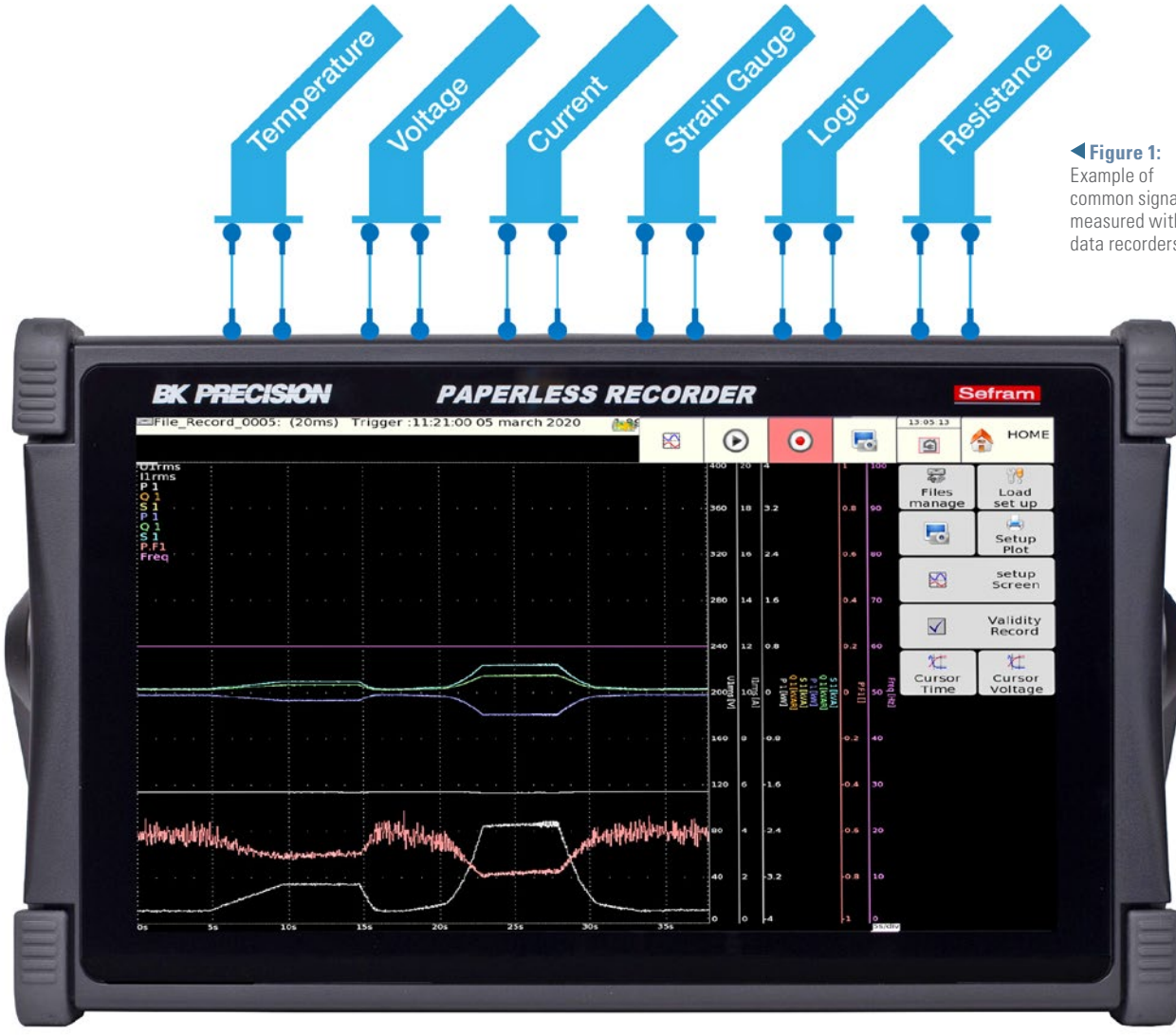


Figure 1: Example of common signals measured with data recorders

THE IMPORTANCE OF DATA RECORDERS IN ADVANCED TEST

By David Holt, BK Precision

Data recorders have a long history and continue to advance, to keep pace with the applications of today.

Data recording instruments have a history that dates back to the 1800s, when Charles Babbage incorporated a mechanical instrument into a railcar to record over a dozen parameters. Babbage described his prototype as a roll of paper 1,000 feet in length that slowly unraveled itself upon a long table. The model had roughly a dozen pens connected with a bridge crossing the center of the table, each marking an independent curving ink mark. Technology has since advanced to the point where we can record an extensive number of sensors on a small portable instrument.

Older data recorders tended to be limited to only recording signals with values that changed relatively slowly. That was because they had response times limited by the electromechanical pen and paper system used to archive data. Today, such limitations are no longer in place, particularly for the latest generation of recorders. Today's electronic data recorders

feature fast sampling rates, large internal memory, touch displays, and a wide range of input capabilities. Data recorders can replace several instruments and provide additional options such as thermal printing and communication bus analysis.

DMMs, DSOs, and Data Recorders

Digital multimeters (DMM) are used primarily for measuring voltage, resistance and current. Data Recorders, on the other hand, are capable of measuring the same parameters, but can also monitor temperature, humidity, vibration, strain, and rotation, to name a few. Unlike typical DMMs, recorders excel in performing these measurements on multiple channels simultaneously. The data can be analyzed on-screen, with built-in cursors to select specific waveform details, or the data can be transferred to a computer. Recorders also support more complex operations such as writing of custom equations for performing mathematical calculations between two or more channels.

Digital storage oscilloscopes (DSO) have become a widely used means of capturing and storing waveform data and have evolved to include triggering capabilities along with fast sampling intervals. In comparison, data recorders offer more channels, greater vertical resolution, and more memory, which allows recording and comparing of more signals over a longer period of time. When using a DSO, the trigger event might be missed, but a data recorder will capture it because it is recording continually. For example, B&K Precision recorders feature a pre-trigger option to set a percentage of time to capture before the trigger event, ensuring valuable data is not lost.

It is not unusual for data recorders to feature similar triggering mechanisms to those available on scopes, including triggers based on the leading and falling edges of the signal being recorded. Additionally, it is relatively easy to find recorders providing the same kind of analysis available on specialized instrumentation such as powerline quality monitors. Other functionality like X-Y displays, as long found on oscilloscopes, are also available on data recorders.

Addressing Applications

Users who need to acquire data for longer periods of time across multiple channels, or from a variety of input signals, will benefit from using a data recorder. These instruments have been designed to enable direct input and measurement of a wide variety of voltage, current, frequency, temperature, strain gauge, and logic signals with voltage inputs ranging from millivolts to kilovolts (Figure 1). This allows a single instrument to simultaneously measure small sensor signals and high voltages in an electrical system, while reducing the challenges configuring several instruments.

A common application for data recorders is in environmental testing, where several sensors are required to monitor parameters such as temperature, humidity, wind speed and direction, as well as barometric pressure at a weather station. These environmental tests may also be performed in an environmental chamber to verify how the device under test responds to changes in environmental parameters while monitoring the DUT voltage and current (Figure 2).

Recorders are also widely used in the automotive industry. Motor vehicles contain numerous sensors, electronic controls, and systems which the instrument can monitor simultaneously (Figure 3). Key measurements include voltage and current, force, pressure, stress/strain, speed, and temperature. Many recorders offer the additional capability to monitor and analyze traffic on the CAN or LIN bus, which are widely used interfaces in this industry.

Data recorders are capable of monitoring systems in industrial settings. Portable recorders aid in preventative maintenance measures which, in turn, help maximize productivity. They can be used to monitor voltage, current, temperature, strain, and vibration signals of industrial equipment, to detect

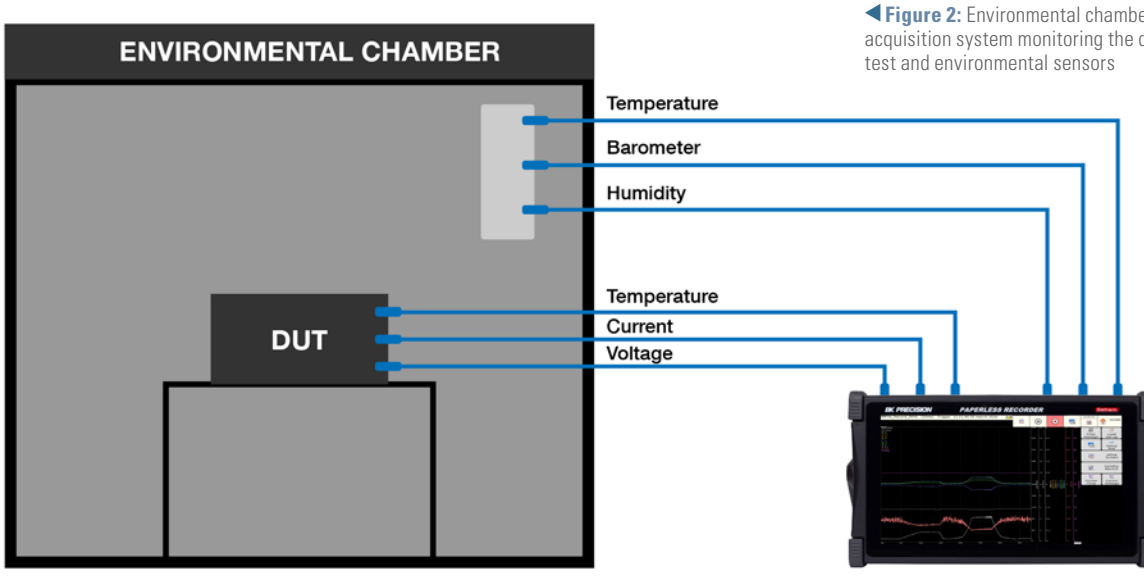
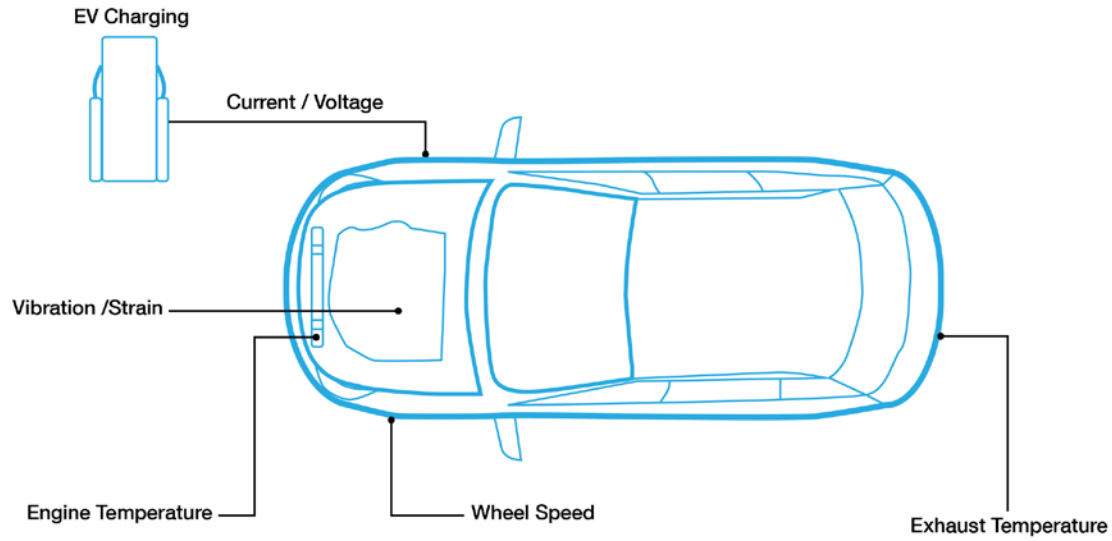
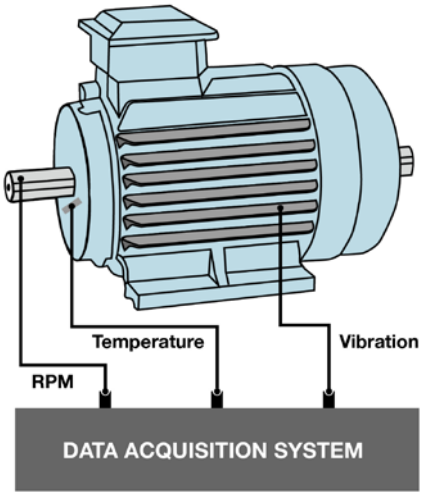


Figure 2: Environmental chamber with data acquisition system monitoring the device under test and environmental sensors



▶ **Figure 3:** Example of motor vehicle measurements



▲ **Figure 4:** Data acquisition system monitoring typical electric motor parameters

abnormalities and to record data that will allow conveniently scheduled maintenance (Figure 4).

Specifications and features

When considering data recorders, the high-level specifications include the number of input channels, the measurement types (i.e. voltage, current, frequency), the minimum and/or maximum input voltage, the sampling rate, memory size, and the modes of operation. These specifications help determine which instrument(s) will meet individual needs. The number of channels is a trade-off with portability. As the number of channels increases, so does the weight of the unit.

Measurement types and voltage input ranges are fixed numbers that need to be met, but sampling rate and memory size require more consideration. Although a faster sampling rate may seem desirable, it will reduce maximum recording time, given a fixed memory size. For this reason, it is important to have a good understanding of the nature of the signals to be captured when selecting a data recorder.

Many data acquisition systems have multiple modes of operation: One mode for recording over longer periods of time at a lower sampling rate and another mode for recording at a higher sampling rate for a shorter period of time to capture intermittent events. Additionally, some recorders provide the ability to synchronize to an external time base such as IRIG (Inter-range instrumentation group) time codes or GPS signals.

The latest data acquisition recorders and loggers offer features like large touchscreen displays, built-in batteries, and channel counts. For example, the lightweight and portable DAS220-BAT and DAS240-BAT data recorders have built-in batteries for up to 15 hours of continuous recording, where power sources are unavailable, from 10 to 200 channels with a sampling interval of 1 ms, 16-bit vertical resolution and 100 V DC maximum input voltage.

Other examples can be found in the DAS30/50/60 series, which has a sampling interval of 1 µs in memory mode, and up to 9.5 hours of recording time, with an optional thermal printer. An included power analysis application allows for recording and analysis of single- or three-phase power networks. The DAS1700 is a configurable data acquisition system, featuring four types of measurement boards that can be installed in any combination of up to three in the base unit of the recorder or up to six with an optional expansion.

The DAS1700 can stream measurement data directly to the internal solid-state drive at a 1 µs sampling interval and is also capable of recording two files simultaneously. It also includes a power analysis tool along with a function editor. This user interface allows building custom functions to perform mathematical calculations between multiple channels. The result is displayed on a separate virtual channel for easy analysis.

Conclusion

Data recorders have a long history and continue to advance, to keep pace with the applications of today. It is clear that these instruments are essential tools in many industries, and it is important to select the proper data recorder solutions for your applications and industries. EE

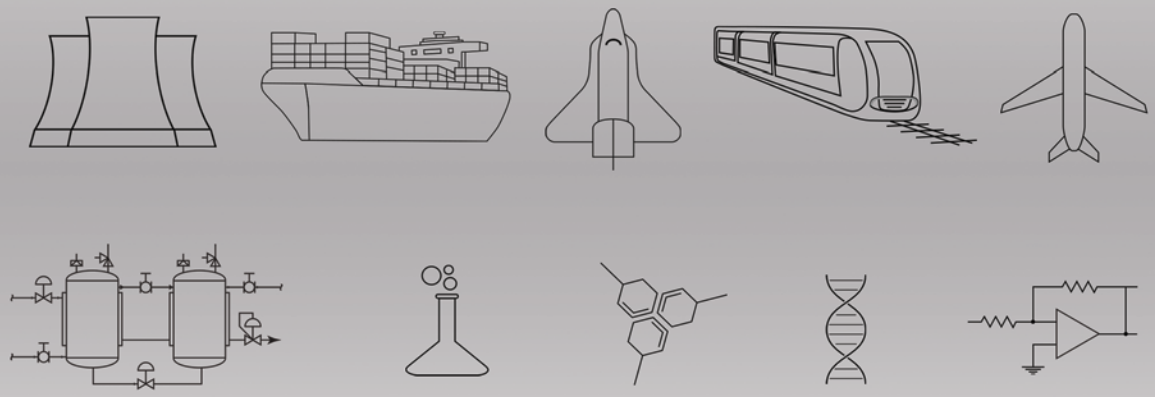
B+K PRECISION

Introducing

Data Acquisition Recorders

B&K Precision offers a full range of data acquisition recorders and loggers from powerful portable instruments to full-featured configurable systems. Features like high speed recording, large channel count, deep memory, remote connectivity, long battery life make these instruments ideal for many applications ranging from small sensor signal logging to electrical power analysis.

Process monitoring and verification for a wide range of industries



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HOW ETHERNET-BASED EVALUATION BOARDS AND MODULES CAN ENABLE SECURE INDUSTRIAL WIRELESS CONNECTIVITY

By Tinu Oza, Product Manager L-com

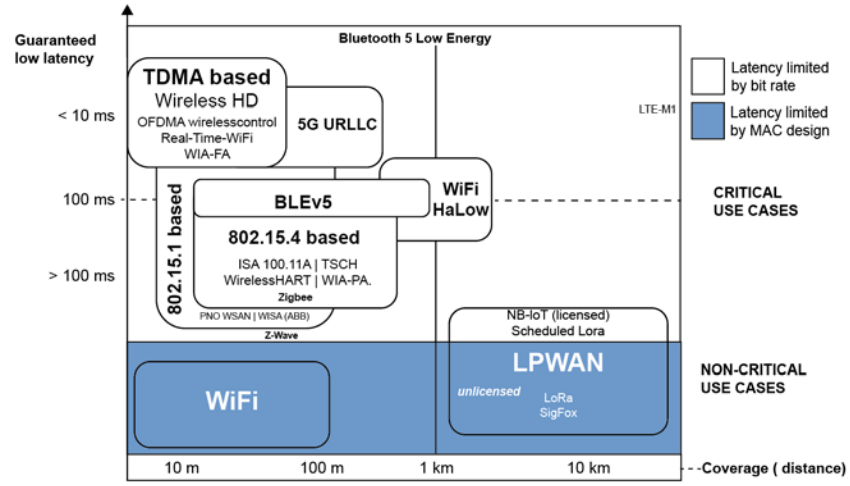
The use of IoT to connect everyday devices has, in turn, created a massive ecosystem of wireless protocols, application-specific radio chips/modules, and prototyping/development boards. There are already nearly 9 billion IoT devices globally—a number that is anticipated to nearly triple to 25.4 billion by 2030. The massive array of these wirelessly-connected sensor networks all have with it varying payloads, data capacities, link distances, determinism, security, and latencies in varying topologies that can be point-to-point, point-to-multipoint, star or mesh, to best suit its respective IoT use case.

This article focuses on evaluation boards for implementing an industrial wireless connection for the far-reaching IoT nodes within a facility. A discussion on the considerations for these types of wireless nodes, as well as their applications, is considered in order to equip the reader with a better understanding of electrically and mechanically ruggedized IoT devices for high-reliability wireless applications.

A Look at wireless protocols for high reliability IoT

There are many non-industry-specific IoT networks such as Zigbee, Z-wave, and 6LoWPAN that are often used in low-powered indoor mesh networks for home automation and general automation purposes. However, high reliability applications require a level of guaranteed determinism, security, scalability, and range for extendibility. Protocols that are specifically geared towards industrial applications such as WirelessHART and ISA10.11a potentially offer this with nominal data rates and relatively low-latency communications. However, there is less adoption of these technologies, as they are not as commonly used. There are therefore far less commercial options for the implementation of such IoT networks, and the lack of vendor diversity can drive up the cost, scalability, and potential continuity of supply when employing these solutions. Protocols such as Bluetooth, Bluetooth low energy (BLE), WiFi, and cellular-based IoT protocols such as NB-IoT and LTE-M already have a large operating base, due to the

Figure 1: Common IoT wireless technologies and their latencies with respect to maximum link distance[2].



	IWSN	
Parameters	WirelessHART	ISA 100.11a
Operating Frequency	2.4 GHz	2.4 GHz
Maximum Range	~200m	~200m
Maximum Transmit Power	Must comply with FCC EIRP regulations	Must comply with FCC EIRP regulations
Throughput	250 kbps	250 kbps
Latency	10ms (direct to gateway), 30 ms (1 hop) to 50 ms 3	~ 100 ms
Bandwidth	3 MHz	5 MHz
Security	AES Encryption	AES Encryption
Battery Life	several years	several years
Capacity (Number of connected devices)	30,000	unlimited
Network Topology	star + point-to-point + Mesh	star + Mesh
Licensed or Unlicensed spectrum	Unlicensed	Unlicensed

ubiquity of cellular networks. Newer, low power wide area networks (LPWANs) have filled a unique niche in connectivity by using the sub-GHz spectrum in combination with narrowband (NB) and ultra-narrowband (UNB) modulation schemes to achieve large link distances with low-powered devices. This allows distant nodes to be connected without the need for battery changes and maintenance. However, these networks are typically used in applications that require low payloads transmitting infrequently. For instance, for scheduled check-ins in oil pipelines to monitor the health of the pipeline via flow-rate measurements and seismic monitoring. *Table 1* lists the basic differences between some of these wireless networks—this illuminates the slight fundamental differences between the various IoT protocols and how they can best serve their specific applications.

It is apparent that there is really no one-size-fits-all solution for all IoT applications. *Figure 1* illuminates the link distance and latency of some IoT protocols—critical use cases require scheduled, low latency communications in order to ensure reliable monitoring/control of sensor/actuator nodes. However, there are other considerations for these wireless technologies, including their data rate, scalability (capacity), battery life, and security.

▼ **Figure 2:** Industrial automation hierarchy. The amount of wires and devices increases dramatically when going down to the machine-level[2].

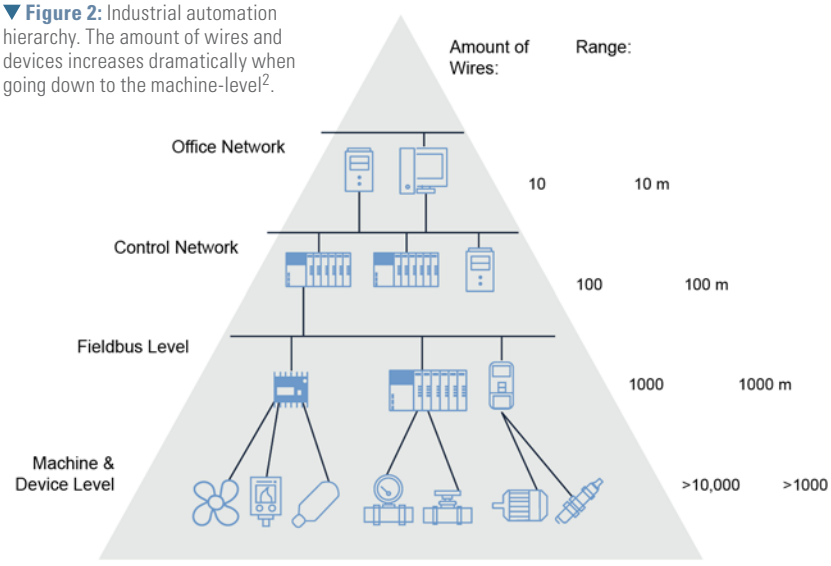


Table 1: Comparing Basic Parameters of Common IoT Protocols

	Low Power Wide Area Network (LPWAN)				Other Common Wireless Protocols				
	LoRA	Sigfox	LTE-M1 (LTE Cat M1)	NB-IoT (LTE Cat NB1)	WiFi	WiFi HaLoW	Bluetooth 5 Low Energy	802.15.4/Zigbee	z-Wave
	915 MHz (US) 868 MHz (Europe) 433 MHz (Asia)	868 MHz, 902 MHz ISM	–	–	2.4, 5 GHz	900 MHz	2.4 GHz	900 MHz, 2.4 GHz	915 MHz
	2–15 km	up to 3 km	–	10–15 km	< 300 ft	~ 1 km	<200 m (PtP), <1.5 km (mesh)	10 to 100 m (LoS)	30 to 100 m
	25 mW (uplink) 0.5 W (downlink)	25 mW (uplink, Europe) 4 W (uplink, US) 159 mW (uplink, US) 500 mW (downlink, Europe)	–	–	100 mW	200 mW	10 mW	> 1 mW	> 1 mW
	0.3 kbps to 50 kbps	100 bps up, 600 bps down	>1 Mbps	20 kbps to 144 kbps	>54 Mbps	150 kbps	1 to 3 Mbps	250 kbps (2.4 GHz)	up to 100 kbps
	1–2 s (round-trip)	1-30 s	10–15 ms	1.6–10 s	1–3 ms	~100 ms	<3 ms	< 140 ms (50 byte payload, up to 6 hops)	–
	7.8 to 500 kHz	100 Hz UL channels 600 Hz DL channels	1 MHz to 1.4 MHz	180 kHz	~22 MHz	2 MHz	~2 MHz	2 MHz (16 channels)	–
	AES Encryption	Devices work predominantly offline	–	–	WEP, WPA, WPA2, WPA3	WPA3	AES-CCM Encryption CSRK	128 bit AES encryption	S2
	10+ years	10+ years	5+ years	5+ years	–	up to 13 years 1.5 years (coin cell)	–	several years	10–year
	100,000+	–	–	55,000 devices per cell	–	8,000 devices per access point	32,767	< 65,000 per network	232 per network
	star-of-stars topology	one-hop star topology	–	most topologies are star-based	mesh	mesh	PtP, mesh	mesh	mesh
	Unlicensed/ Licensed	Unlicensed	Licensed	Licensed	Unlicensed	Unlicensed	Unlicensed	Unlicensed	Unlicensed

Reliable IoT communication for fringe IP devices

Industrial automation hierarchy: the various levels of communication in an industrial facility

The typical industrial automation system hierarchy involves various communication levels that involve different requirements on the network (Figure 2). From the top down, this starts at the office level, control level, fieldbus level, down to the machine- and device-level. The node density increases exponentially toward the bottom of the hierarchy, where high capacity, mesh networks (e.g., WirelessHART, ISA 100.11a, WiFi HaLow, 6LoWPAN, etc) are often necessary in order to support the capacity requirements and allow for the centralized collection of data at the control level for potential use cases that involve machine learning (ML) and artificial intelligence (AI) such as predictive analytics and sensor fusion.

Benefits of replacing modest data rate WiFi installations with a secure, reliable ethernet-enabled connection

At the office and control network levels, ethernet-based radios have high utility for the ability to remotely configure a device, regardless of the location of the control/office network. Moreover, ethernet interfaces are increasingly familiar in the industrial setting with industrial ethernet overtaking traditional fieldbus technologies for industrial controls and communications. A high throughput connection opens doors significantly for potential wireless applications, including commercial applications such as digital signage and secure retail point-of-sale (POS) systems and more industrial applications such as surveillance, robotics, industrial automation, and smart grid communications.

The IP addressability of devices has also become a significant concern for massive machine-type communications (mMTC) where there is a massive influx of devices where the option of incorporating a unique identifier becomes difficult to accomplish. However, this is a critical consideration for many industrial automation vendors[1], the ability to tag devices with a global address enables its remote management where devices can be linked/delinked and data can be authorized/deauthorized remotely. Ethernet-to-RF modules enable the wireless connectivity of IP devices on a network without the wired ethernet connection. There is, however, the major consideration of link distance and security of the wireless connection. The encryption available in standard WiFi devices is often inadequate to protect against any malicious attack. Therefore, more flexible industrial wireless ethernet-based solutions with custom coding can protect sensitive data for a more secure and reliable connection.

Potential use cases for securely connecting fringe IP devices

IoT applications can vary between indoor-use cases within the plant floor with link distances of tens of meters, to outdoor applications connecting distant devices at tens of kilometers—sometimes with both indoor and outdoor devices connected on the same network. These each have with it respective link budget considerations. Industrial IoT and other high reliability applications including military, medical, and surveillance applications require securely connected devices with an ensured quality of service (QoS), and remote firmware upgrades to minimize the costs associated with node maintenance/repairs. Ethernet-to-RF modules can provide a robust and secure, wireless control for a mobile robot (*Figure 3*). These applications are increasing in usage for industrial applications with autonomous guided vehicles (AGV) and their respective vision systems utilizing navigation algorithms (e.g., simultaneous location and mapping (SLAM)) and various vision technologies (e.g., LiDAR) for movement in dynamic environments. This can also be seen with autonomous mobile robots (AMRs) for inventory transport, order picking, and sortation, allowing for cooperative human-machine interactions. These types of machines require a seamless, high throughput, low latency connection, regardless of environmental obstacles, in order to enable maximal control and responsiveness.

More traditional use cases for an ethernet to RF module involve the connection of office IP devices such as IP access control readers, remote printers, remote PCs, VoIP phones, point-of-sale devices, digital signage or industrial control devices. In these cases, it is helpful when multiple clients can be monitored/controlled via a singular, secure access point.

A government agency or private industry sectors (e.g., healthcare, energy, financial, etc) are often required to encrypt sensitive data with a method that conforms to the National Institute of Standards and Technology) NIST standard FIPS 140-2—a US government security standard that is leveraged to certify both the hardware and software components of cryptographic modules. This involves at least one approved algorithm/security function (e.g., 18 bit AES encryption) as well as either tamper-evident coatings/seals that make apparent any malicious tampering to obtain physical access to the plain text cryptographic keys and critical security parameters (CSPs), or

Figure 3: Mobile robots require a high integrity wireless connection.

pick-resistant locks on covers or doors to the enclosure.[3] This type of standard for instance, applies to surveillance video, access control, and perimeter sensor communications at a secure facility. Other use cases include digital signatures for the banking industry or outdoor payment systems such as a fuel center.

Prototyping a secure wireless system for reliable communications

Constraints around the link budget become increasingly important when attempting to replace previous WiFi and other medium- to high-throughput IoT systems that were rendered ineffective due to insufficient range or excessive interference. As shown in *Equation 1*, link budget relies on a number of critical parameters.

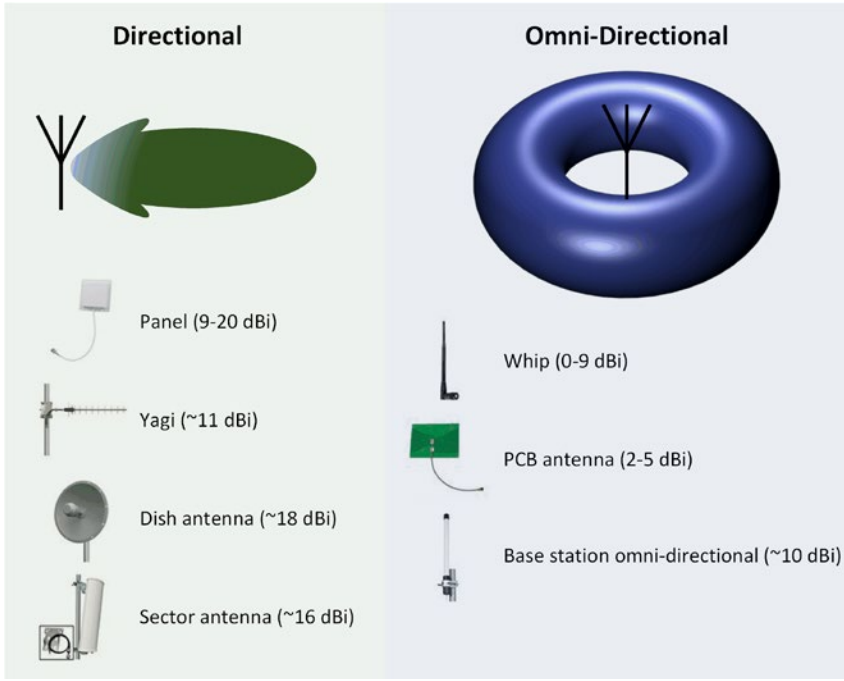
$$P_{RX} = (P_{TX} + G_{TX} + G_{RX}) - (L_{TX} + L_{RX} + L_{FS} + L_M)$$

Equation 1

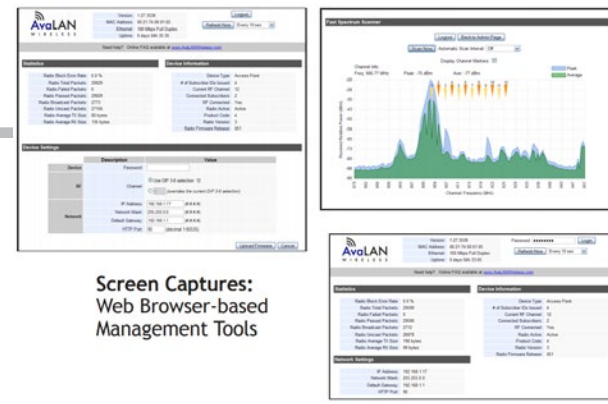
In this equation, PRX/PTX is the power received and transmitted, GTX/GRX is the gain of the transmit/receive antennas, LTX/LRX is the loss of the transmitter/receiver, LFS is the free space loss, and LM are the miscellaneous losses (e.g., fading, multipath, foliage, wall penetration, etc). In order to optimize the power received, the power transmitted must be optimized as well as the gain of both the transmit and receive antennas. The benefit of leveraging the unlicensed band (e.g., 900 MHz, 2.4 GHz, 5 GHz) is the cost-effectiveness of not requiring an FCC license to operate or install nodes. However, there is the additional consideration of FCC regulations on the equivalent, isotropically radiated power (EIRP)—the maximum amount of power radiated from an antenna considering both antenna gain and transmitter power. In order to maximize the link budget it is important to achieve the maximum legal radiated power, this allows for orders of magnitude greater range than traditional WiFi devices.

Antenna gain can be maximized over a point-to-point link between directional antennas as the bulk of the electromagnetic energy is positioned on the main lobe (Figure 4). This diverges from the traditionally leveraged omnidirectional, whip antenna that allows for nominal gain over 360 degrees on the horizontal plane. Vertical beamwidths can vary between 10° and 50°. Omni-directional antennas are ideal for mesh topologies with point-to-multipoint network where nodes are located in relatively close proximity to each other.

Another consideration to maximize the link budget is the free space path loss. The lower the frequency, the lower the free space path loss. As an example, this factor is a major consideration for 5G millimeter-wave technology where the high-frequency signals are unable to adequately penetrate and diffract around obstacles and therefore require a high density installation of small cells in order to seamlessly connect user equipment (UE) to the



▲ **Figure 4:** Directional and omni-directional antennas



▶ **Figure 5:** Sample of web browser-based diagnostics monitoring, link analysis, and remote configuration.

5G core network (5GC). However, at sub-GHz frequencies, this becomes far less of a consideration—the signal is inherently able to travel much further. Therefore utilizing a signal in the 900 MHz ISM band may offer much more design flexibility than a 5 GHz radio.

Considerations when troubleshooting a wireless system with evaluation boards

While there are some basic hardware considerations to take into account in order to maximize the reliability of a link. It is also important that the evaluation board utilized can illuminate potential failure modes and help mitigate them. Modules with the ethernet to wireless connectivity allows for plug-and-play capabilities with native IP devices such as laptops, door access control readers, and VoIP phones. On the other hand, modules with high speed SPI or UART interfaces will more readily connect to sensors for a WSN instead of readily connecting native IP devices. Some development platforms come with a custom web browser interface to manage remote diagnostics, monitoring, and link analysis (*Figure 5*)—this is typically acquired through a vendor with a customized GUI. Features such as link analysis can be accomplished via a built-in spectrum analyzer that would readily identify interference issues while monitoring. For some development kits compliance and certification is critically important, especially when utilizing established protocols such as Bluetooth or modules with cellular connectivity. When using the unlicensed spectrum, however, the most critical design consideration is typically conforming to FCC EIRP regulations. Ethernet-based nodes can both readily connect to each other as well as the cloud for the centralized integration of collected data. More often than not, firmware updates are required after the first release of an IoT network as well as periodically in order to upgrade and futureproof the native system. Remote firmware upgrades typically require a relatively high throughput connection, making them less viable for battery-constrained devices such as those in LPWAN installations. However, ethernet-to-RF modules can accomplish this without the need for a multi-radio platform supporting multiple low and medium throughput IoT protocols (e.g., LoRa+WiFi, sub-GHz+BLE, etc.). For outdoor environments, additional ruggedization is often required. This can be accomplished via weatherproof enclosures with lightning protection to buffer sensitive internal circuitry from power surges.

Securing your wireless IoT network

There are many aspects to ensuring the reliability of an IoT network. This includes the security/encryption algorithms utilized, tamper-proof considerations protecting keys, a high enough data rate to encourage remote firmware upgrades and more remote monitoring options, as well as ensuring the hardware is optimal in characteristics, location, and environmental protection. This level of ruggedization is not typical to most well-known IoT applications (e.g., home automation, smart city, etc). However, it is necessary for many private sectors including specific industrial applications, finance, and medical use cases. This includes the secure connection of wireless IP devices in geographically distant locations on the plant-floor or a secure facility. EE

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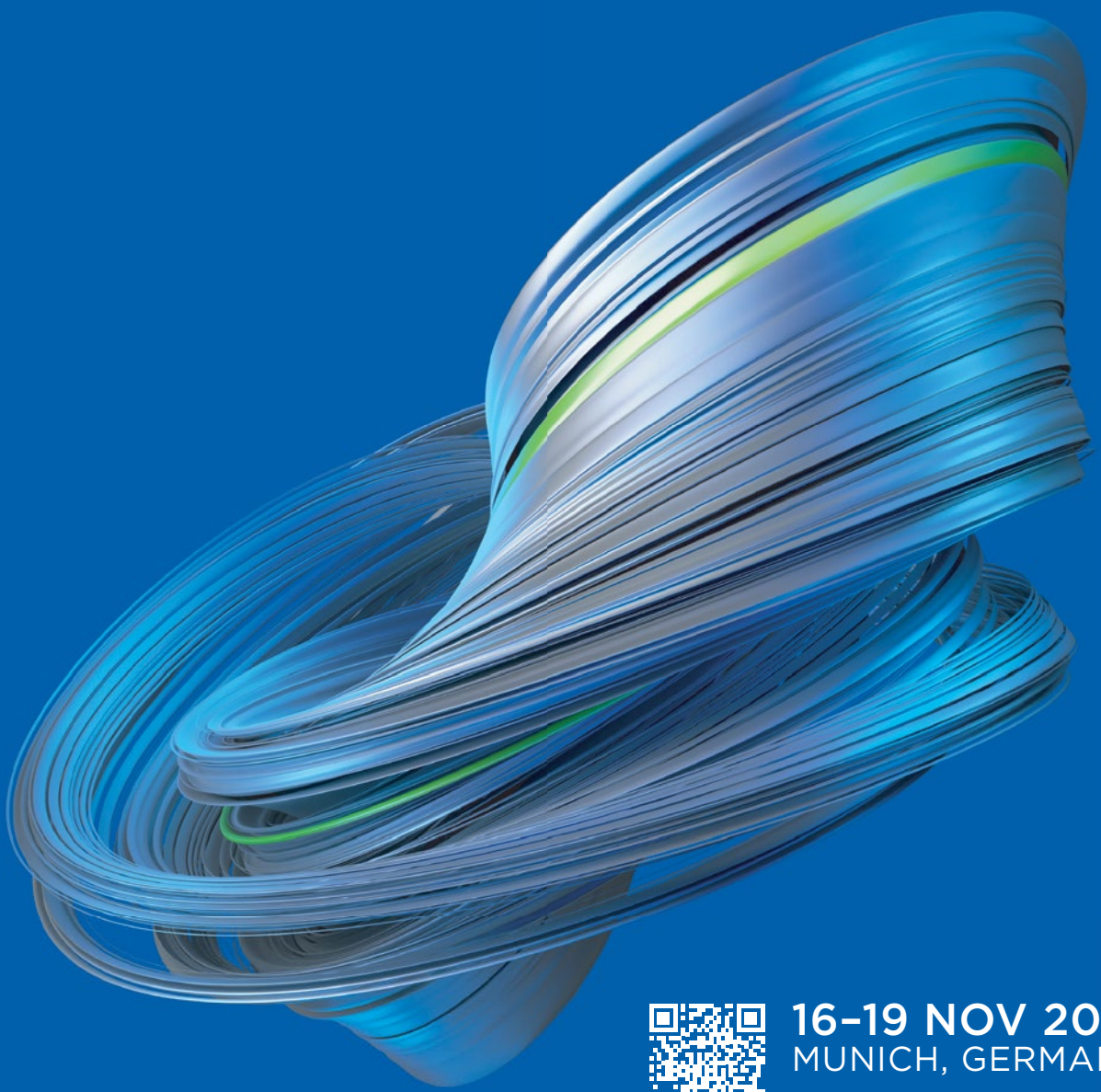

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MANUFACTURING SOFTWARE PREPARES STUDENTS FOR SKILLED POSITIONS

By Alix Paultre, Editor

The University at Buffalo (UB) this fall, along with the Siemens Digital Industries Software Academic Program, will provide the university an in-kind software grant of tools for computer-aided design, simulation, manufacturing planning, robotics, product lifecycle management, and other application spaces. The partnership will provide UB students from the School of Engineering and Applied Sciences, School of Management, and the School of Architecture and Planning in-depth, working knowledge of the latest software tools, preparing for highly skilled positions.

TommL / E+ /Getty Images

"We are immensely grateful to Siemens for this generous and impactful gift to our university community," said UB President Satish K. Tripathi. "As we prepare our students to lead in the 21st century, our collaboration with Siemens will enhance our students' competitiveness and equip them with cutting-edge knowledge and skills, enabling them to meaningfully serve industries and communities across the region, the state and the world. The University at Buffalo is committed to contributing to the economic development and vibrancy of our region and beyond, and we deeply appreciate that Siemens—as demonstrated by this important partnership—shares in that commitment."

"At UB, we provide outstanding educational experiences for our students," said A. Scott Weber, Provost and Executive Vice President for Academic Affairs at UB. "This grant will provide students with access to industry-leading software tools that are used by manufacturing and industrial companies around the world, enabling students to immediately take their knowledge from theory to practice, furthering their skills and preparing them for future success."

"Siemens strongly believes that partnering across the educational ecosystem is critical to best prepare a future workforce, and we're excited to expand our efforts in the New York region by making this grant to University at Buffalo that will help ensure companies here in Buffalo and around the world have access to a diverse and incredibly skilled talent pool," said Barbara Humpton, CEO of Siemens USA.

"We are seeing a true shift change across the manufacturing sector, where companies are embracing digital tools to scale, innovate and compete on a global stage. But, these tools are only as powerful as the people behind them, so it continues to be our mission to best prepare the next generation of individuals who will propel manufacturing even further into the future," said Del Costy, Senior Vice President of Siemens Digital Industries Software.

Western New York companies boast a large number of UB graduates in their workforces, like Moog, a 65-year-old Buffalo area design, manufacturer, and integrator of precision control components and systems, who will benefit from the Siemens and UB venture. This grant to UB is one of more than 1,000 partnerships in the Siemens Digital Industries Software Academic Partner Program, an initiative built to empower the next generation of digital talent.

"As a world leader in developing motion controls for mission critical applications, Moog understands the important role that cutting-edge engineering tools play in development and production processes," said George Small, Moog's Chief Technology Officer and a University at Buffalo graduate. "We have 20 years of experience leveraging Siemens tools in providing solutions to our customers' most complex technical challenges. And as a longtime partner with UB, we appreciate the value of Siemens' grant and the positive impact it will have both now and in the future."

"We value the partnerships of forward-looking companies like Siemens and Moog," said Kemper Lewis, Dean and Moog Professor of Innovation in UB's School of Engineering and Applied Sciences. "That companies of this caliber recognize the benefits of collaborating with our students and faculty to drive work force innovation is an honor and a tribute to the talented and driven faculty and students in our UB community."

SUNY Corning Community College has partnered with Siemens to establish the College's STEAM Innovation Center, as well as implement a campus-wide effort to reduce the college's carbon footprint, improve energy efficiency, and raise student awareness about the importance of environmental sustainability. EE

For further information on Siemens Digital Industries academic partnerships and suite of software tools, please visit www.plm.automation.siemens.com/global/en/our-story/partners/academic/.

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- **Toward Zero-Downtime, Zero-Defect Manufacturing** | Mo Abuali, IoTco LLC
- **Digital Transformation and the Factory of the Future** | Sachin Lulla, EY
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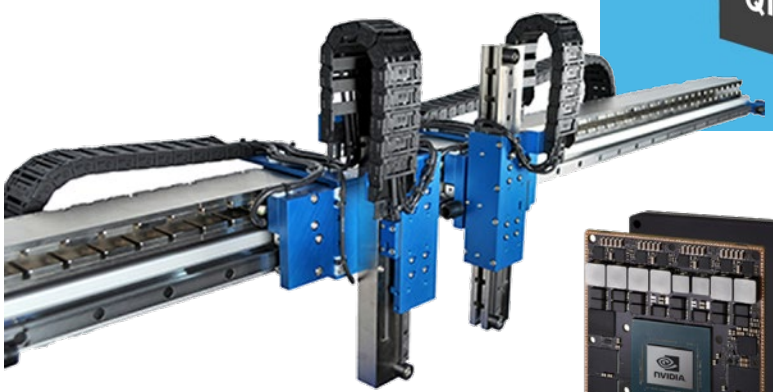

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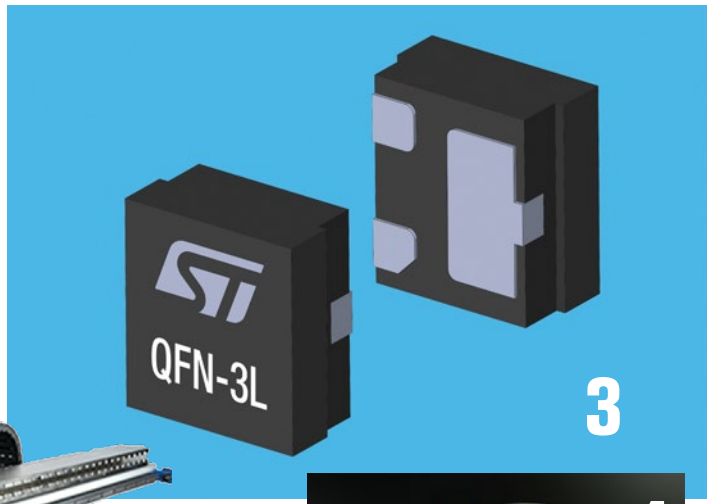

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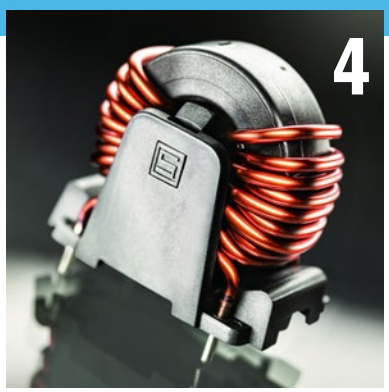


4

1. Compact, Four Axis YY'ZZ' Linear Motor Driven Stage

The Four-Axis Gantry (YY'ZZ') is a four-axis positioning stage that consists of two SRS-007-03-006-01 brushless linear motor stages; each vertically mounted to two independently moving horizontal linear axes. It is suitable for applications that require multiple independent motions on a single travel plane. Each horizontal linear axis uses a BLDM-D04 H2W brushless linear motor to generate a continuous/peak force of 16.5 lbs. [73.6 N]/49.0 lbs. [220 N]. Each table has a non-contact 1.0-micron resolution encoder head reading a single encoder scale allowing for precise positioning.

H2W TECHNOLOGIES

2. AI at the Edge Set to Deploy in Industrial Environments

NVIDIA has unveiled its latest Jetson module that brings AI at the Edge for harsh industrial environments. The Jetson AGX Xavier industrial module allows developers to build advanced, AI-enabled ruggedized systems and is built for intelligent video analytics, optical inspection, robotics, computer vision, autonomy and AI. The module features an 8-core ARM v8.2 64-bit CPU, 512-core NVIDIA Volta GPU with 64 Tensor cores, a pair of NVDLA accelerators, and 32 Gb LPDDR4x RAM. The Jetson AGX Xavier also has 32 Gb of eMMC storage.

NVIDIA

3. Transient Voltage Suppressor

STMicroelectronics' ESDCAN03-2BM3Y dual automotive-qualified low-capacitance transient voltage suppressor (TVS) is designed to protect CAN and CAN-FD interfaces. The TVS meets the automotive industry's need for miniaturized and high-performing protection devices for the increasing numbers of high-density ECUs, including ADAS, autonomous driving controllers, and automotive gateways. Using this device, designers can save 75% or more of the PCB space needed by typical TVS in SOT23-3L and SOT323-3L packages. The ESDCAN03-2BM3Y offers transient protection with clamping voltage as low as 33 V (8/20µs at 1A) and 37 V (transmission-line pulse (TLP) at 16A).

STMICROELECTRONICS

4. Current-Compensated Choke for High-Current Applications

SCHURTER has added the DKIV-1 series to its range of current-compensated chokes, for 1-phase high-current applications on printed circuit boards. The series is designed for rated currents from 10 A to 50 A and requires only a tiny footprint on the PCB. The chokes comply with IEC 60938, and with a rated voltage of 300 VAC or 450 VDC, they are suitable for almost any application. The DKIV-1 series is also certified for current ratings from 10 to 50 A, 300 VAC according to IEC and UL and 10 to 50 A, 250 VAC according to CSA.

SCHURTER

5

6

7

8

5. White light interferometer

Mahr, a global manufacturer of precision measurement equipment used for dimensional metrology, introduced its MarSurf WI, a white light interferometer, developed in cooperation with NanoFocus, that enables high-resolution 3D measurement with ease of use. The system features evaluation technology based on artificial intelligence (AI), which allows high accuracy to be achieved with increased robustness. The system offers a resolution of down to 0.1 nm, making it suitable for use in the production of semiconductor devices or optical components, as well as automotive, aerospace, medical and more.

MAHR

6. Stepper Motor Motion Control Systems

Optimal Engineering Systems' ADAGIO-X-STPR Series of rack mounted stand-alone stepper motor controllers are cost-effective solutions for controlling and driving single- and multi-axis stepper motor stages, including AQ single and dual axes X and XY series stages, the YPR Series of three-axes yaw, pitch, and roll stages, and the four-axes XYZR has three XYZ linear axes plus a vertical rotary stage. Each 19-inch rack mounted ADAGIO-X-STPR Motion Controller includes a power supply, and motion controller cards for 1, 2, 3, or 4 axes, and micro-stepper drivers for single and two-phase steppers requiring up to 7 amps per phase.

OES

7. T130 Single-Channel Picosecond EOM Driver

Highland Technology's T130, a USB/RS-232 enabled pulse generator drives LiNbO3 Mach-Zehnder and similar electro-optical devices. The T130 output can swing up to 7 V relative to baseline and is capable of driving high Vpi EOMs at low duties down to single shot. A built-in edge-triggered width generator is adjustable for delay and width, spanning 250 picoseconds to 300 nanoseconds across three ranges. The T130 produces fast, low-jitter edge transitions. Output voltage swing is adjustable from -0.5 volts to -7 volts into 50 Ohms. A 10:1 resistive pick-off enables monitoring the drive signal with a 50 Ohm oscilloscope.

HIGHLAND TECHNOLOGY

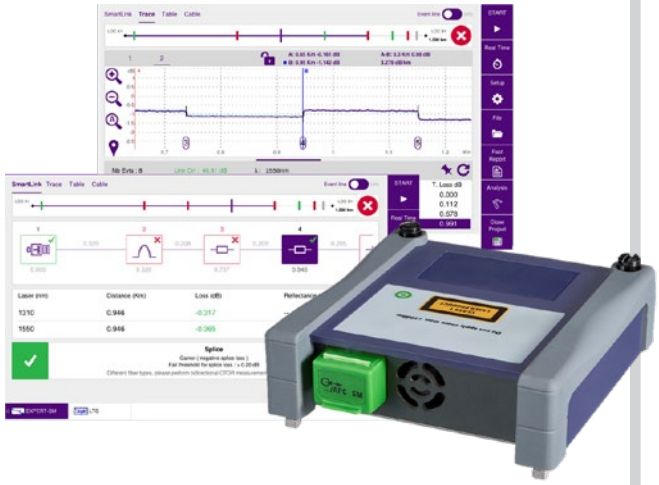
8. Ruggedized Computer Designed for Mission Critical Applications

Micromax's M-Max 400 TBT is a high-performance ruggedized computer for mission-critical applications and is designed around Intel's ultra-low-power, dual-core i7-6600U CPUs. The system is built with a dual 115V AC electrical power system with a wide input voltage range from 90 V AC to 264 V AC and is resistant to high voltages, spikes, and surges. A trio of SBCs and an embedded 16-port switch are encased into an ATR-type sealed aluminum enclosure, which is conductively cooled, and IP66 rated for protection from water and dust.

MICROMAX

TECH FOCUS

OPTICAL SYSTEMS



VIAVI Expands Fiber Test Portfolio

VIAVI Solutions' latest fiber test and measurement solutions expand a portfolio for fiber optic testing. New optical power meters, fiber characterization modules, and an enhanced Optical Time Domain Reflectometer (OTDR) solution enable service providers, colocation and hyperscale data centers, enterprises and contractors to reduce costs, improve quality of service, minimize downtime and speed time to revenue.

As networks expand and transform to meet tomorrow's demands, new processes, tools and solutions are needed to address rapidly changing business and network needs. The comprehensive VIAVI fiber portfolio continues to evolve with a full range of essential instruments, systems and software required to address today's fastest growing technologies and functional needs, providing end-to-end support for the construction, activation, monitoring and maintenance of fiber optic services.

VIAVI

Optical Sensor Detects Particles as Small as 0.3µm

Farnell, an Avnet Company, increased its range of high-quality sensor products with the introduction of the SN-GCJA5, a particulate matter (PM) laser sensor from Panasonic Industry Europe. Designed in response to the increasing worldwide concern for indoor air quality, the SN-GCJA5 is well suited for air quality monitoring, air conditioners, building automation, smart homes, HVAC, air purifiers, Internet of Things (IoT) devices, test and measurement, and environmental monitoring applications.

The SN-GCJA5 Laser Type PM Sensor features an innovative optical assembly to provide reliable operation over a long lifetime while accurately detecting particles as small as 0.3µm. Advanced laser-scattering technology enables the sensor to provide a fast response when detecting smoke, environmental dust, and other unwanted dangerous pollutants. Measuring 37x37x12mm, the SN-GCJA5 can be easily integrated into a wide range of air quality monitoring devices. It offers uncomplicated I²C and UART (TTL) connectivity and challenges conventional LED-based concepts in many areas.

FARNELL

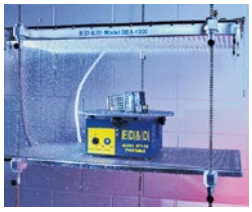
Semtech Addresses 5G Wireless Front Haul With its Latest 50Gbps Tri-Edge CDR IC Solution

Semtech announced sampling of the latest member of its Tri-Edge CDR portfolio, the GN2256. Integrating Semtech's Tri-Edge CDR platform with a differential EML (Externally Modulated Laser) driver, the GN2256 is the industry's first such IC solution to enable 50Gbps PAM4 Fixed-WDM (Wavelength Division Multiplexing), Tunable WDM and Silicon Photonics optical modules. As with all Tri-Edge ICs, the GN2256 offers ultra-low latency, low power and use of low cost 25Gbps bandwidth optics to operate at 50Gbps PAM4.

[Editor's note; we recently talked to Raza Khan, senior marketing manager at Semtech, about the company's 5G front-haul applications here: Integrating 5G into the Wireless Infrastructure. www.evaluationengineering.com/21217326]

The GN2256 combines Semtech's proprietary analog Tri-Edge technology with enhanced laser driver compensation to enable IEEE and Open Eye MSA compliant optical modules over industrial temperature ranges. Semtech's Tri-Edge 5G platform addresses the full range of optical modules needed for all regions by enabling multiple types of SFP56 optical modules operating at 50Gbps PAM4.

SEMTECH



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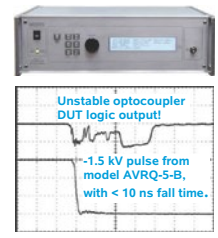

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5G TEST

By EE Staff

5G is rapidly becoming a critical backbone element of the Cloud infrastructure and will also be key to expansion into new application spaces. Proper testing of 5G systems ensures optimum performance under real-world conditions and operation.

5G RF Regulatory Test System

Anritsu released a RF Regulatory Test System ME7803NR solution for regulatory compliance testing of 5G communications systems. The RF Regulatory Test System ME7803NR uses the Radio Communication Test Station MT8000A as a simulated 5G NR base station in combination with a spectrum analyzer and signal generator to implement ARIB/ETSI/FCC-compliant FR1 RF tests.

In addition, the measurement efficiency and quality of 5G terminals are ensured by the easy-to-operate GUI and built-in calibration function for improved reliability. It is a platform that can perform spurious tests and interference tests, which are difficult for customers to build their own test environments for.

The ME7803NR makes it easy to evaluate whether the RF performance of 5G terminals meets regulatory requirements as well as simplifies evaluation of whether radio-waves are being used efficiently or not, helping 5G market penetration. Anritsu expects its ME7803NR to play an important role in deploying commercial 5G mobile network services by facilitating the spread of 5G terminals.

Verifying Antenna-in-Package Design Performance

The mmWave spectrum is being used to deploy 5G services requiring wider bandwidths to support the high data transfer volume required while also exhibiting low latencies. With the goal of accurately verifying mmWave designs for 5G new radio (NR) and satellite applications, TMYTEK, a Taiwan-based mmWave startup, has selected Keysight's development tools to verify antenna-in-package (AiP) designs used in 5G and satellite systems.

Keysight's Open RAN Studio validates a radio unit (O-RU), using its software and hardware to construct, play, capture, and measure O-RAN traffic. Open RAN Studio can leverage Keysight's signal-generation and analysis platforms, PathWave Signal Generation (Signal Studio), and Vector Signal Analysis (89600 VSA) software. This enables TMYTEK to access cross-domain and multichannel O-RAN protocol measurements for both downlink (DL) and uplink (UL).

Keysight's VXG Microwave Signal Generator offers high output power and ultra-low phase noise, and their UXA Signal Analyzer supports wide analysis bandwidth and dynamic range, critical to both mmWave 5G and satellite applications.

Vector Signal Generator Empowers Midrange 5G, Wi-Fi 6E, and Other Advanced RF Test

At the time of its release, Rohde & Schwarz' SMM100A was presented as the only vector signal generator with mmWave testing capabilities in its class. The instrument meets the rigorous expectations for generating digital signals for the most advanced wireless communication devices entering production, as well as for developing future products and technologies. Manufacturers of state-of-the-art 5G devices wishing to test the whole frequency range possible, expect to do so with a single signal generator for both 5G NR FR1 and FR2 frequencies.

The R&S SMM100A vector signal generator displays RF characteristics across the entire frequency range, from 100 kHz to 44 GHz. It covers all the bands used by any wireless standards, including LTE and 5G NR, as well as the latest WLAN standards Wi-Fi 6 and Wi-Fi 6E (up to 7.125 GHz). Wireless personal area networks, such as Bluetooth, are covered also. The instrument's maximum RF

modulation bandwidth of 1 GHz meets requirements to generate the broadband signals used by devices making full use of the most demanding wireless standard specifications, including IEEE 802.15.4z Ultra-Wideband (HRP-UWB).

The R&S SMM100A offers a maximum output power of +18 dBm, which reduces the need for external amplifiers. Excellent modulation frequency response, error vector magnitude (EVM) and adjacent channel power ratio (ACPR) performance result in signal quality for reliable, repeatable test accuracy. The R&S SMM100A comes with six maximum-frequency options from 6 GHz to 44 GHz, and four modulation bandwidth options from 120 MHz to 1 GHz to meet all major device band requirements. Users can upgrade their instrument's capabilities according to their need anytime by simply entering a key code. EE

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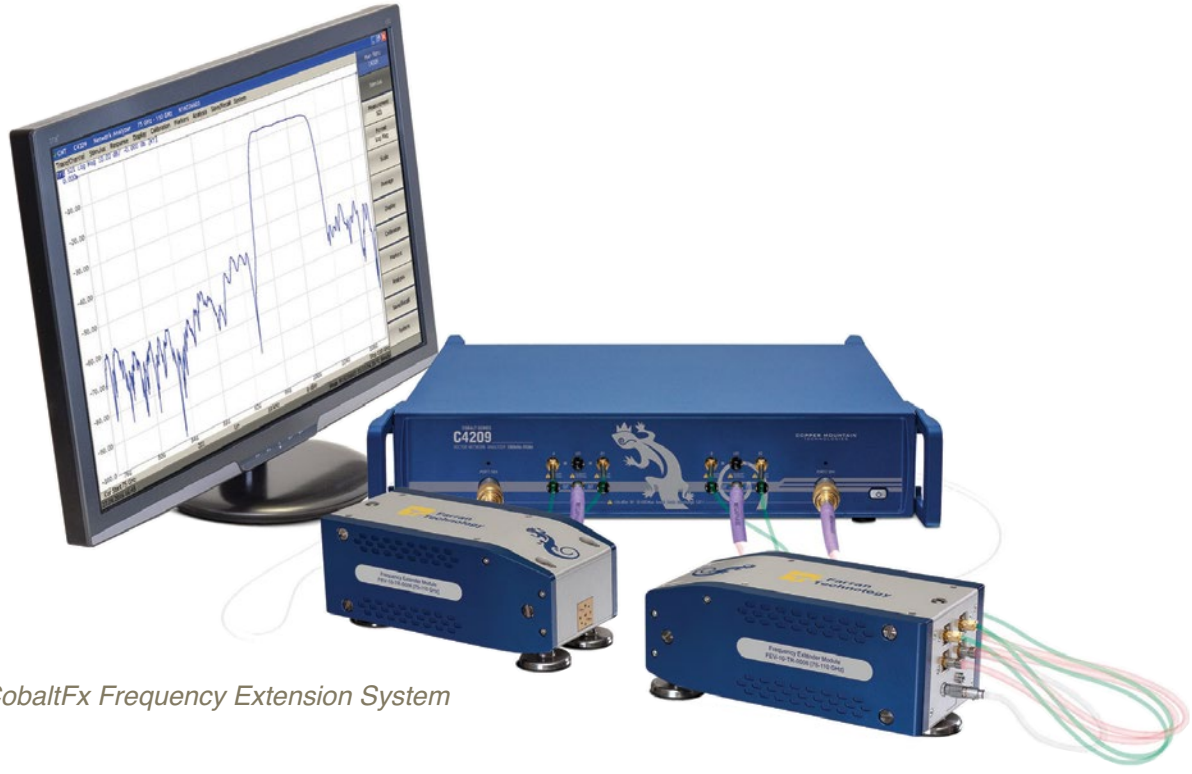

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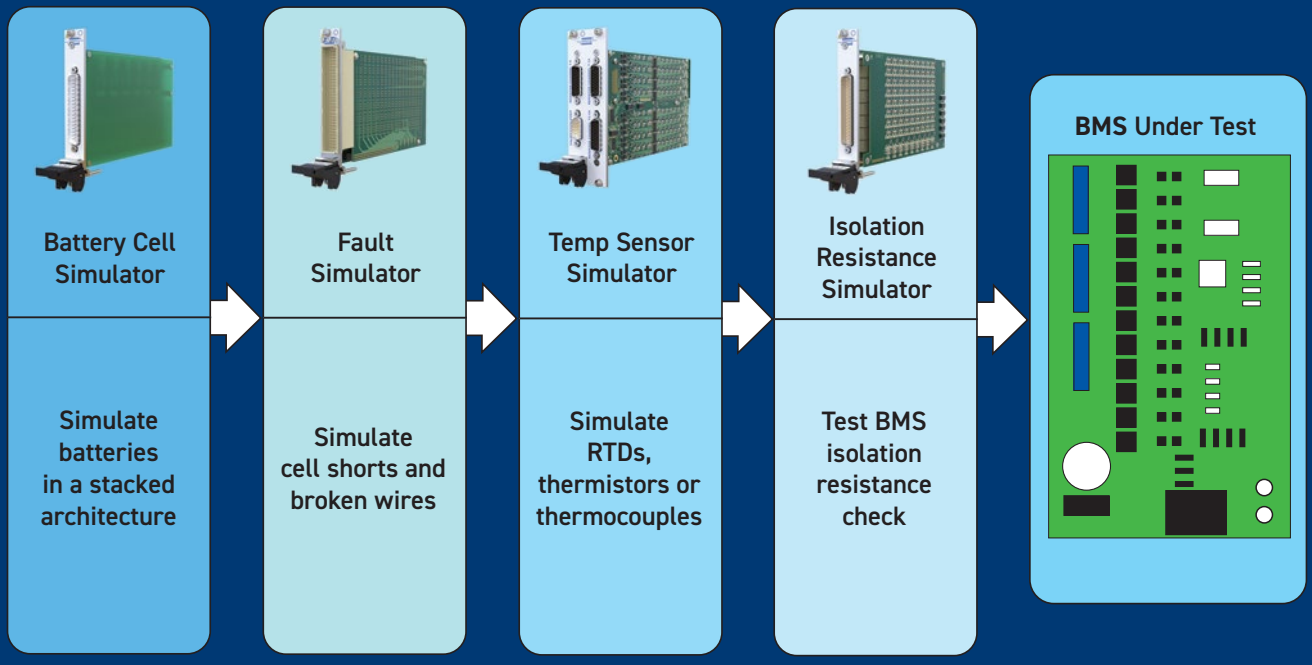

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