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The Rise of Wideband Wireless

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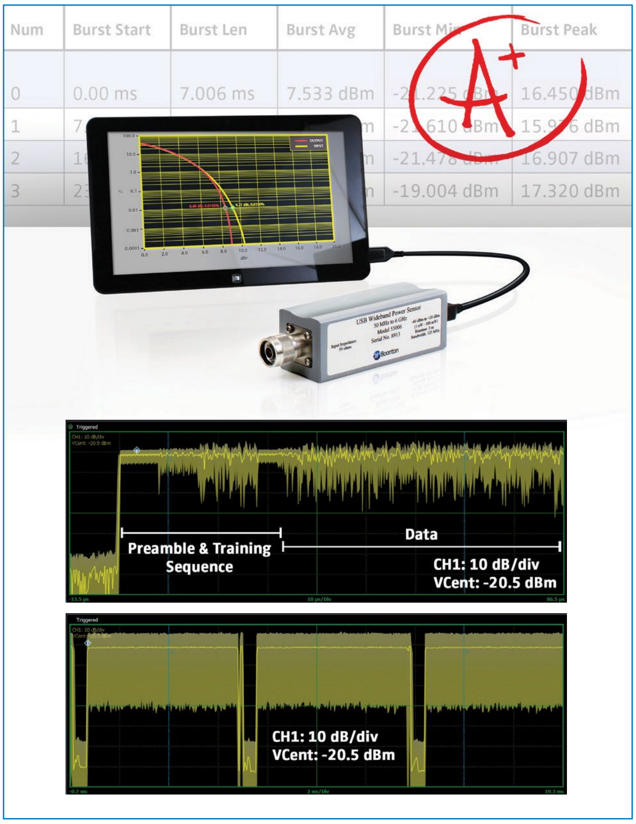

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Wi-Fi a key enabler for carriers to fill in the holes

Wi-Fi in the form of Carrier Grade is gaining traction rapidly as an inexpensive way for carriers to unify their hotspots and provide coverage in areas where cellular radio is weak. Further, Wi-Fi is providing a way to cover rural areas cost effectively, which has been a bone of contention for carriers since the beginning of the mobile revolution.

Recently the Wireless Broadband Alliance (WBA) published its annual report on the state of the Wi-Fi ecosystem, compiled by global research company Maravedis-Rethink, which reveals that 57% of operators have firm timelines in place for the deployment of Carrier-Grade network architecture. The report also contends that as confidence grows in Carrier-Grade Wi-Fi, the shift away from Best Effort networks will continue to gather speed.

"Increased Operator confidence in Carrier grade Wi-Fi technology has led to a surge in the growth of deployments over the past 12 months and set a trend that will to continue. Within 5 years there will be as much as a 70% rise in the number of Carrier-grade public Wi-Fi hotspots deployed, vastly outnumbering current best effort," said Shrikant Shenwai, CEO of the WBA.

On October 12th the UK House of Commons debated network coverage 'notspots', which highlights the challenges faced by mobile network operators in delivering ubiquitous service. But their problems are not restricted to remote and rural areas as there are numerous total or partial notspots in urban environments as well, thanks to densely packed buildings that obstruct the cellular signal.

Dave Fraser, CEO, Devicescape says "In the UK, free amenity Wi-Fi of the kind offered by numerous consumer facing businesses and premises owners has become a significant connectivity resource, delivering essential backup when the cellular network struggles to deliver optimum performance indoors. The businesses that make it available to their customers have, as a result, become important connectivity providers in their own right.

"This amenity Wi-Fi exists on a scale that is simply too expensive and impractical to replicate with traditional infrastructure deployment but it can be integrated into a wider connectivity service. Only by blending all forms of available connectivity can operators deliver the consistency today's consumer requires. Because even if they reach 100% geographic coverage, cellular service will still cease at the thresholds of numerous buildings, both public and domestic."

However, carriers and cable companies own a significant number of hotspots. A recent Bloomberg report claims that Comcast aims to combine their millions of Wi-Fi hotspots with cellular to challenge the incumbent big four wireless carriers in the USA. This hybrid Wi-Fi/Cellular network will ironically enable Comcast to enter the cellular market in the USA in spite of the high barriers of entry and to do it cost-effectively. Comcast can do this as they struck a deal with Verizon in 2011 giving them the right to resell Verizon's cellular service.

This shows that carriers need to leverage their Wi-Fi to drive down costs and fill in the 'notspots' that they have been promising to do for years. Wi-Fi has the potential to cover most indoor and pavement use cases in urban areas, but it also can offer a lifeline to rural areas.

To illustrate the potential here, EUSANET, a leading German provider of satellite-based broadband access and Eutelsat Broadband have joined forces to deliver a groundbreaking broadband for rural German communities by combining satellite-based Internet services with Wi-Fi networks.

The system has the capability to deliver download speeds of up to 100 Mbps to individuals in communities of several hundred homes – outstripping the capabilities of mobile LTE technology. Further, these broadband services can be delivered quickly and without large-scale construction work in regions un- and underserved with ADSL infrastructures.

The Black Forest community of Oberried / St. Wilhelm is the first to benefit. The network went live at the end of September and combines service from the Eutelsat KA-SAT satellite with a high-speed wireless network based on the latest Wi-Fi technology. This combined system currently delivers download speeds of up to 30 Mpbs and uplink speeds of up to 5 Mbps per household but could be upgraded further in the future. The Internet access service is complemented by Voice-over-IP telephony services. The first tests to supply households with TV over the same system are also under way. This additional innovation would allow communities in some mountainous areas to receive terrestrial television for the first time.

To conclude, Wi-Fi is evolving rapidly and a quick adoption of Carrier Grade Wi-Fi could revolutionize the way carriers run their networks. In an era where costs are ever more important Wi-Fi offers the most cost effective and easiest way for carriers to cover 'notspots' and rural areas. Other systems can be deployed, such as small cells, but they are generally more expensive and Wi-Fi is ubiquitous as it is available on nearly every end user device.

By Jean-Pierre Joosting
Editor MWEE

Dialog snaps up Atmel

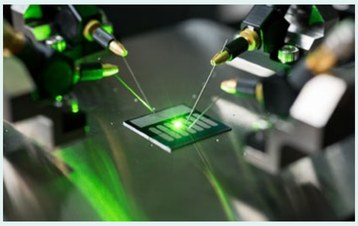
Dialog has agreed to acquire Atmel in a cash and stock transaction for total consideration of approximately $4.6 billion. The combined company is expected to address an attractive, fast growing market opportunity of approximately $20 billion by 2019, including mobile power, IoT and automotive. The transaction will enable Dialog to complement its leadership position in power management ICs with a leading portfolio of proprietary and ARM based microcontrollers in addition to high performance ICs for connectivity, touch and security. Dialog will also leverage Atmel's sales channels to significantly diversify its customer base. Combined synergies realised through the acquisition are expected to deliver an improved operating model and new revenue growth.

We firmly believe that by combining power management, microcontrollers, connectivity and security technologies, we will create a strong platform for innovation and growth in the large and attractive market segments we serve, said Jalal Bagherli, Dialog Chief Executive Officer.

www.diasemi.com

First optical rectenna converts light to DC current

Researchers have demonstrated the first optical rectenna using nanoscale components, a device that combines the functions of an antenna and a rectifier diode to convert light directly into DC current.



Based on multiwall carbon nanotubes and tiny rectifiers fabricated onto them, the optical rectennas could provide a new technology for photodetectors that would operate without the need for cooling, energy harvesters that would convert waste heat to electricity - and ultimately for a new way to efficiently capture solar energy.

In the new devices, developed by engineers at the Georgia Institute of Technology, the carbon nanotubes act as antennas to capture light from the sun or other sources. As the waves of light hit the nanotube antennas, they create an oscillating charge that moves through rectifier devices attached to them. The rectifiers switch on and off at record high petahertz speeds, creating a small direct current.

Billions of rectennas in an array can produce significant current, though the efficiency of the devices demonstrated so far remains below one percent. The researchers hope to boost that output through optimization techniques, and believe that a rectenna with commercial potential may be available within a year.

"We could ultimately make solar cells that are twice as efficient at a cost that is ten times lower, and that is to me an opportunity to change the world in a very big way" said Baratunde Cola, an associate professor in the George W. Woodruff School of Mechanical Engineering at Georgia Tech.

www.gatech.edu

University hits Apple for $234 million for patent infringement

The University of Wisconsin has been awarded $234 million in damages after a jury decided that Apple's A7, A8 and A8X application processors had infringed its patent. The patent – U.S. Patent No. 5,781,752 – relates to improving the speed and efficiency of computer operation by predicting data dependences between instructions and re-ordering instruction execution order so as to minimize such data dependences.

The University of Wisconsin is represented though its patent licensing arm, the Wisconsin Alumni Research Foundation (WARF). WARF filed the patent infringement suit against Apple Inc. in 2014 in federal court in the Western District of Wisconsin. The U.S. Patent and Trademark Office issued the patent to WARF in 1998 on behalf of UW–Madison Computer Science Professor Gurindar Sohi and three graduate students - Andreas Moshovos, Scott Breach, Terani Vijaykumar.

www.warf.org

Satellite and Wi-Fi deliver rural broadband up to 100 Mbps

EUSANET, a leading German provider of satellite-based broadband access and Eutelsat Broadband have joined forces to deliver a groundbreaking broadband for rural German communities by combining satellite-based Internet services with Wi-Fi networks.

The system sets new benchmarks for rural connectivity with the capability to deliver download speeds of up to 100 Mbps to individuals in communities of several hundred homes – outstripping the capabilities of mobile LTE technology. Further, these broadband services can be delivered quickly and without large-scale construction work in regions un- and underserved with ADSL infrastructures.

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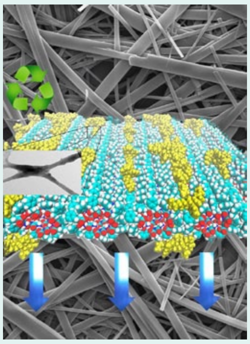
To receive the service, customers need just a 12cm external antenna to access EUSANET broadband. At the heart of the community system are satellite dishes with reception and transmitting units connected to the Internet via the high throughput satellite KA-SAT. Based in the community are a server, router, satellite modems and the latest wireless units. Three radio cells, with a reach of several kilometers, supply the households using free and public frequencies. Additional radio cells outside the community of St. Wilhelm are also under construction to extend the service.

www.eusanet.de

Biodegradable displays could reduce waste in mobile electonics

University of Missouri researchers are on the path to creating biodegradable electronics by using organic components in screen displays. The researchers' advancements could one day help reduce electronic waste in the world's landfills. The seriousness of the problem is highlighted by the fact that Americans, on average, replace their mobile phones every 22 months, junking more than 150 million phones a year in the process.



"Current mobile phones and electronics are not biodegradable and create significant waste when they're disposed," said Suchismita Guha, professor in the Department of Physics and Astronomy at the MU College of Arts and Science. "This discovery creates the first biodegradable active layer in organic electronics, meaning, in principle, we can eventually achieve full biodegradability."

Guha, along with graduate student Soma Khanra, collaborated with a team from the Federal University of ABC (UFABC) in Brazil to develop organic structures that could be used to light handheld device screens. Using peptides, or proteins, researchers were able to demonstrate that these tiny structures, when combined with a blue light-emitting polymer, could successfully be used in displays.

"These peptides can self-assemble into beautiful nanostructures or nanotubes, and, for us, the main goal has been to use these nanotubes as templates for other materials," Guha said. "By combining organic semiconductors with nanomaterials, we were able to create the blue light needed for a display. However, in order to make a workable screen for your mobile phone or other displays, we'll need to show similar success with red and green light-emitting polymers."

www.missouri.edu

Navigation service for older people

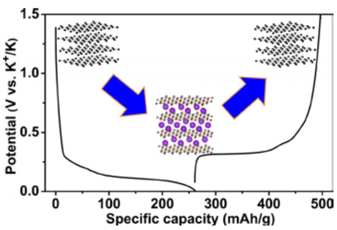
In a further example of the mobile revolution facilitating modern life, VTT Technical Research Centre of Finland has developed a mobile phone-based navigation service which guides older users to the right address, even when lost in a strange town. The result of a European project, the service helps older people to use public transport, assisting them along the entire route.

This intuitive navigation service differs from standard public transport applications by offering continuous guidance during the journey, walking directions to stops and destinations, and timetable and realtime information. It helps senior travellers to find the right mode of transport, change routes, get off at the right stop and walk to the destination from the last stop. Developed through the European ASSISTANT (Aiding SuStainable Independent Senior TrAvellers to Navigate in Towns) project, the application can be used on computers as well as mobile phones.

www.vtt.fi

Potassium-ion a possible cheaper alternative to lithium-ion batteries

Researchers at Oregon State University have overturned a scientific dogma that stood for decades, by showing that potassium can work with graphite in a potassium-ion battery - a discovery that could pose a challenge and sustainable alternative to the widely-used lithium-ion battery. This type of battery based on materials that are far more abundant and less costly.



A potassium-ion battery has been shown to be possible. And the last time this possibility was explored was when Herbert Hoover was president and the Great Depression was in full swing - 1932.

"For decades, people have assumed that potassium couldn't work with graphite or other bulk carbon anodes in a battery," said Xiulei (David) Ji, the lead author of the study and an assistant professor of chemistry in the College of Science at Oregon State University.

"That assumption is incorrect," Ji said. "It's really shocking that no one ever reported on this issue for 83 years."

The Journal of the American Chemical Society published the findings from this discovery, which was supported by the U.S. Department of Energy and done in collaboration with OSU researchers Zelang Jian and Wei Luo. A patent is also pending on the new technology.

The findings are of considerable importance, researchers say, because they open some new alternatives to batteries that can work with well-established and inexpensive graphite as the anode, or high-energy reservoir of electrons. Lithium can do that, as the charge carrier whose ions migrate into the graphite and create an electrical current.

www.orst.edu

Mobile operators must have Wi-Fi Calling

With at least ten wireless operators already offering native Wi-Fi Calling, the market is set to grow rapidly in Q4 2015, according to a Strategy Analytics report.

Unlike earlier versions of calling on Wi-Fi, native Wi-Fi Calling lets users make and receive calls and texts on their smartphones just as if they were on the cellular network, using the phone's dialer and contact lists. Calls can handover between Wi-Fi and Voice over LTE (VoLTE) during the call for a seamless experience.

Apple's support for Wi-Fi Calling in last year's iPhone 6 encouraged more operators to add the service capabilities to their networks and offer software upgrades for capable phones — certain models from Apple, Samsung, Microsoft and others. With 13 million new Wi-Fi Calling capable iPhones 6s and 6s+ just sold in the first weekend they were on sale, the number of wireless customers that can take advantage of Wi-Fi Calling is expanding rapidly.

www.StrategyAnalytics.com

The Rise of Wideband Wireless

By Oliver Kanzler (Director RF & Wireless, EBV Elektronik)

Keith Benson (Product Line Director, Amplifier Products; Analog Devices, Inc.)

Radio system design is becoming ever more complex with increasing demands on performance, cost and power consumption. With many different frequency bands in use around the world, and commercial systems now extending up into the millimetre wave frequencies above 50GHz, today's RF system designer is facing significant challenges.

Wideband amplifiers are addressing this challenge of multiple bands and complex radio front ends. Instead of a separate chain of components for each band, the new generation of wideband amplifiers provide a single front end that can handle a wide range of frequencies with high performance across the whole band. This can significantly reduce the complexity of an RF design.

Analog Devices Inc (ADI) and EBV Elektronik work closely together to support design engineers by providing the latest information at their desk for these designs. ADI is using the latest design techniques and process technologies for high performance wideband amplifiers, while the technical specialists at EBV assist developers with the selection of suitable components for their design and provide design in support during the development phase.

Oliver Kanzler

There are several areas where wideband designs are shaking up the market, from cellular infrastructure and point-to-point links to test and measurement. Equipment manufacturers are increasingly looking at a platform approach where a single board or system can be used for customers in different regions around the world. Ideally, this same platform can also be used for different applications with minimal configuration, opening up more opportunities for cost savings from economies of scale.

In the cellular infrastructure market, wideband amplifiers are able to provide the RF front end for existing 2G, 3G, 4G and 5G base stations with a single device instead of dozens or even hundreds of components. These wideband devices span frequencies from 800MHz to 3.5GHz and deliver a number of advantages for both the designer and the operator of the networks. Traditional RF front end designs require separate amplifiers and support components for each band, so a single wideband device can replace many other components in the front end RF board. This reduces the cost and complexity of the board and increases the reliability by having less components. This design approach also reduces the complexity of parts management and the operating expenses for the operator as a single board can be used for networks around the world rather than requiring an operator to manage multiple versions.

EBV's specialist engineers are also seeing the use of wideband amplifiers increasing in small cells. As the name suggests, these are smaller cells supporting ten or twenty users and are smaller, cheaper and lower power than large base stations. This allows operators to cost effectively expand network coverage and so is increasingly popular.

For small cells the wideband amplifiers have current consumption as low as possible, allowing for a smaller design compared to using a separate front end signal chain for each frequency band that the phone network needs to support. EBV's field applications engineers (FAE) are increasingly showing customers the range of devices available that can help the developers balance the number of users supported by the small cell with the power consumption and bill of materials (BoM) cost.

EBV's FAEs can also provide support for modelling the amplifier performance and simulating its use in a design and guide developers through the different trade offs. For example, while the wideband amplifier may have a higher noise figure than dedicated narrowband amplifier, there is no need for an additional RF switch to change frequency bands. As a result, the overall noise of the signal chain is reduced. This can then be used to reduce the cost of other components in the signal chain to achieve the desired performance, or provide longer range. EBV can also supply evaluation boards so that developers can test out the wideband amplifier along with the whole signal chain to demonstrate the lower overall noise figure.

This single amplifier approach also allows the designer to focus on the challenging issues of antenna design and the power efficiency of the whole link. The ADI wideband amplifiers operate up to 80 GHz to enable this flexible design, reducing the complexity of product management and through the higher reliability helping to reduce the operating costs.

Wideband amplifiers are also increasingly popular in test and measurement systems. The same challenges of addressing many different RF bands in cellular infrastructure equipment are multiplied for the instrumentation developer. The latest instruments have to handle wider bandwidths than ever before, from the low end up to 80GHz and 90GHz. Whether testing the latest point-to-point communication link design or a high performance phased array radar platform, the instrument designer has to be able to provide gain for a signal with the best possible linearity across the widest possible band. While cost is perhaps less of a factor, the performance is vital, as the instrument – whether a signal generator or spectrum analyser – has to provide the highest possible signal quality.

All this means there are several different ranges for the wideband amplifiers, and EBV's FAEs can help the designer determine the right parts for the RF range of the application. Cellular base station and small cell designs typically use frequencies from 100MHz to 6GHz or 8GHz with modulation around the carrier frequencies of 2G, 3G, 4G and 5G. The 100MHz to 20GHz band covers most of the military communications systems, where a wideband amplifier can support 'cognitive' software defined radios that analyse all the available bands and identify a particular network to connect to. The protocols for that network are then downloaded to a controller chip, allowing one handset to be used with many different radio systems. This band also coves the military radar applications.

Instrumentation designs will be generally looking to use a wideband amplifier above 20GHz, rising to 40 or 50GHz for mainstream designs and reaching 80GHz and 90GHz for testing very high performance applications. The point-to-point links will be operating at 60GHz in the unlicensed band and up to 86GHz in the most challenging designs and need test and measurement systems that can extend reliably up into this frequency range.

ADI has patents covering techniques that allow the wideband operation across the higher range of frequencies with noise figure and power consumption that is appropriate for the different applications. A key role for EBV's engineers is helping developers with the range of devices for those applications.

The process technology used to implement the amplifier is an essential part of the performance of the device. There is always a compromise in providing the highest performance at the best possible price, which is why the target bands are important. Sometimes a lower cost technology such as 0.25µm Gallium Arsenide (GaAs) pHEMT (pseudomorphic high electron mobility transistor) can be used to deliver sufficient performance in the RF bands from 2GHz to 20GHz with good linearity and gain, making use of decades of experience at ADI in the development of new architectures. Other applications, especially at 50GHz and above, require a shorter gate length of 0.1 – 0.15µm in the pHEMT GaAs devices. These GaAs-based wideband pHEMT amplifiers provide the best linearity and lowest noise for ADI's designers to provide the wideband performance at the higher frequencies. This expertise delivers the noise and current performance that allows the wideband amplifiers to be used across the range of frequencies and applications.

CONCLUSION

A large number of applications are opening up for wideband amplifiers. As the demands of cellular infrastructure equipment increases, designers can make use of wideband amplifiers to reduce the complexity and power consumption of designs, hence reducing cost both in the installation and maintenance of systems around the world. The same technology can be used to reduce the cost and enhance the reliability of high performance point-to-point links to bring broadband connectivity to wider areas and new customers. The technology also provides the performance necessary for leading edge instrumentation, delivering the test and measurement capabilities that help develop these sophisticated RF systems.

Keith Benson

BOX OUT

There are a number of key parameters for designers using wideband amplifiers. Alongside the frequency, gain and 1dB power point, the IP3 the third order intercept point value is also used to indicate the maximum signal the amplifier can handle before intermodulation distortion occurs.

For low noise amplifiers such as the HMC1049 and HMC753, the noise figure (NF) is key, and the P1dB output power enables the amplifier to function as a local oscillator driver.

	HMC1126	HMC1127	HMC1049LP5E	HMC753LP4E
Frequency	2 - 50 GHz	2 - 50 GHz	0.3 - 20 GHz	1-11 GHz
Gain	11 dB	14.5 dB	15 dB	17 dB
NF	-	-	1.8 dB	1.5 dB
Output Power @ 1db	17.5 dBm	12.5 dBm	29 dBm	30 dBm
Output IP3	28 dBm	23 dBm	15 dBm	18 dBm

Links to products and applications:

http://www.analog.com/en/products/amplifiers/rf-amplifiers/wideband-distributed-amplifiers.html
http://www.analog.com/en/products/rf-microwave/rf-amplifiers/power-amplifiers.html
http://www.analog.com/en/products/rf-microwave/rf-amplifiers/low-noise-amplifiers.html

How to implement point-to-point measurement of high-power amplifier pulses with a VNA: a new technique enabled by the Anritsu VectorStar

By Jean-Pierre Guillemet, Field Applications Engineer, Anritsu (France)

Gallium nitride (GaN) technology promises many valuable benefits when used in the fabrication of high-power amplifiers: offering a power output of several hundred Watts, GaN amplifiers are small, robust and operate over a wide frequency range of tens of GHz. Radar and transmitter applications in telecoms, aerospace and defence equipment have much to gain from the use of GaN technology. To successfully lead a GaN development project from research through to commercialisation, however, calls for intensive experimentation and testing before a device with the desired specifications may be produced.

In radar equipment, the pulsed nature of the transmissions imposes a particular constraint on the measurement of an amplifier's output. Very small variances in amplitude and phase must be detected, and conventional testing methods make it difficult for the engineer to distinguish the signal to be measured from noise. This article describes a new technique which makes it far easier to see variances in the pulsed output from a GaN power amplifier.

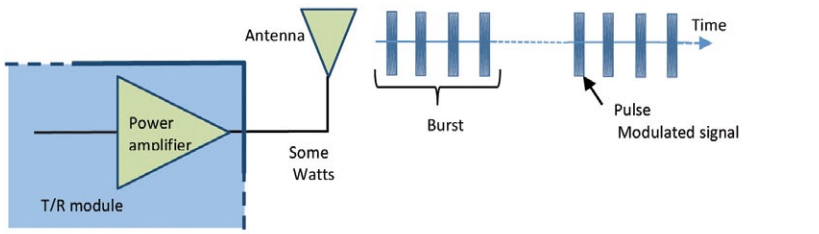


Figure 1: block diagram of a radar T/R module.

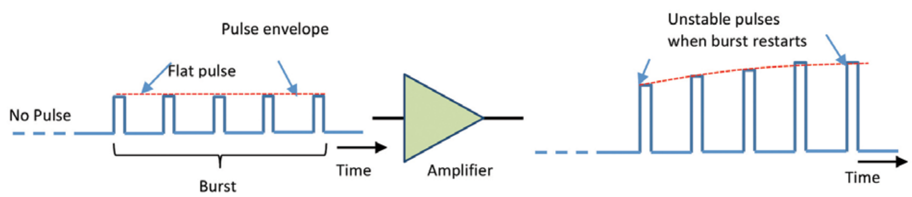


Figure 2: a GaN amplifier can introduce instability into a flat pulse.

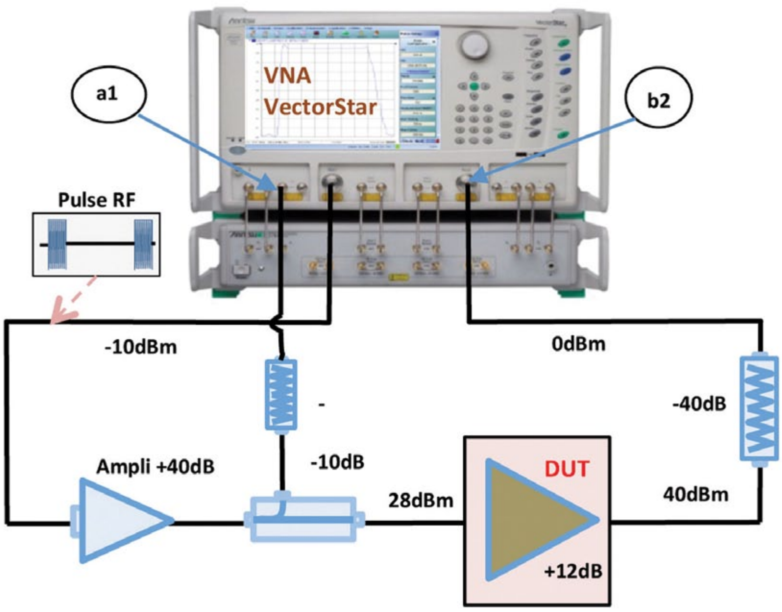


Figure 3: a typical test set-up for characterising a high-power GaN amplifier.

FUNCTION OF GAN AMPLIFIER IN RADAR T/R MODULE

In radar equipment, a GaN power amplifier's high power and wide frequency range are very useful in the T/R (Transmit/Receive) module (see Figure 1). A radar operates by transmitting modulated signals in pulsed bursts of high energy. The characteristics of the received signal, such as its amplitude and phase, can be processed to reveal information about the relative location, distance and speed of movement of an object from which the signal has been reflected.

If the radar's interpretation of the reflected signal is to be accurate, it is crucial that the characteristics of that signal when originally transmitted should be known and controlled to a very high level of accuracy and precision.

To produce known and consistent transmissions, radar equipment manufacturers therefore have to use power amplifiers with known and consistent characteristics: gain, amplitude and phase stability, frequency response and compression point are important parameters. Measurements of each one may be made when transmitting in both pulsed and continuous mode. Now, as a new generation of GaN amplifiers goes into development, methods for testing these characteristics are once again coming under the spotlight.

A particularly important test for GaN amplifiers is the measurement of stability in amplitude and phase from pulse to pulse. Because of electron trapping effects in the GaN material, these amplifiers can tend to suffer from undesirably high levels of instability (see Figure 2). In radar equipment, the acceptable limit for this instability is no more than a few hundredths of a dB (for the amplitude), and a tenth of a degree (phase).

A Vector Network Analyser (VNA) is particularly well suited to the measurement of very small drifts in phase and amplitude, and so is in theory an appropriate instrument for this application. Conventional VNA test methods, however, produce results that are hard to interpret and use when measuring variations in characteristics from pulse to pulse.

MEASURING PULSE INSTABILITIES WITH A VNA

A conventional VNA, which is commonly used to measure S-parameters, performs well with low-power, continuous signals. To measure radar signals – which are high-power bursts – the instrument configuration must be adapted.

Such a configuration may also be used for testing a radar's GaN power amplifier (see Figure 3): the VNA must generate simulated radar pulses, and then measure with the VNA the amplitude and phase stability characteristics of the pulses after amplification.

A high-quality VNA will have an internal signal generator to create pulses. The timing of the pulses may be set in a pulse configuration window displayed in the VNA. These pulses are then used to drive an external modulator to produce the desired radar signals.

When exiting the VNA, these pulses will be at a low power level. In order to raise the power to a level sufficient for a GaN RF amplifier to handle, the signal must also pass through an amplifier, which typically increases the power output by tens of dBm.

The VNA compares the input and output signals of the device under test (DUT). To do this, a coupler routes the input signal back to the VNA's receiver port (a1) via an attenuator, and the output from the GaN amplifer to port 2 (b2) of the VNA, again via an attenuator. Normalisation before the tests begin will allow the tester to cancel out the distorting effects of the test set-up's components, such as the coupler, attenuators and cabling.

MEASUREMENT IN A VNA'S PROFILE MODE

By calculating the ratio of the signals b2/a1, the VNA can measure any drift in

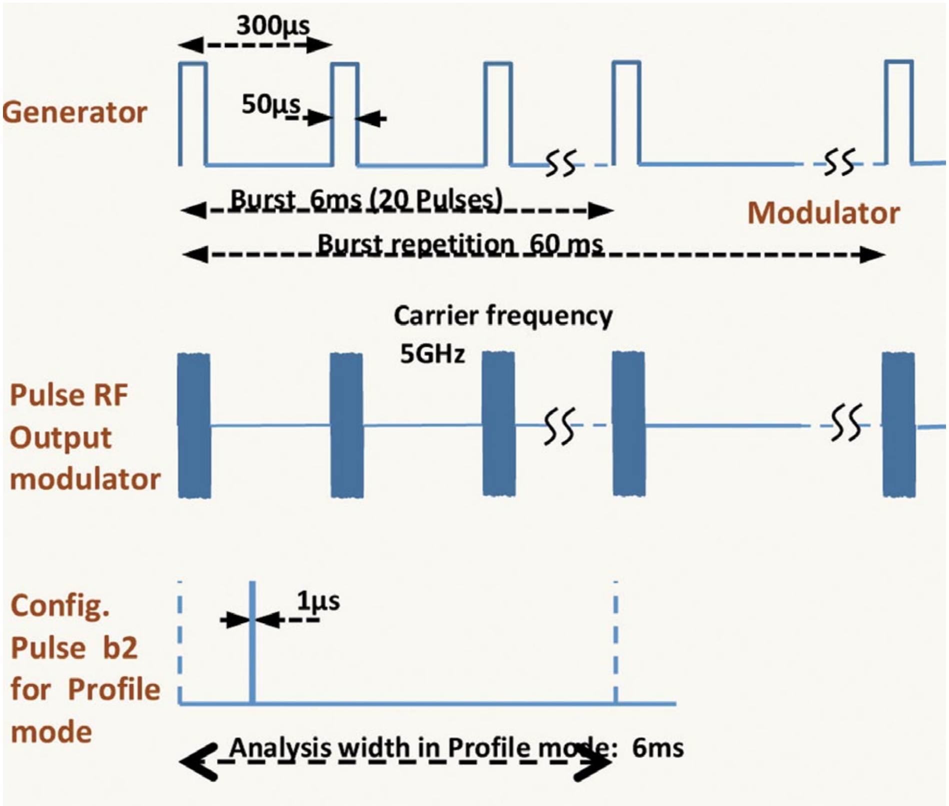
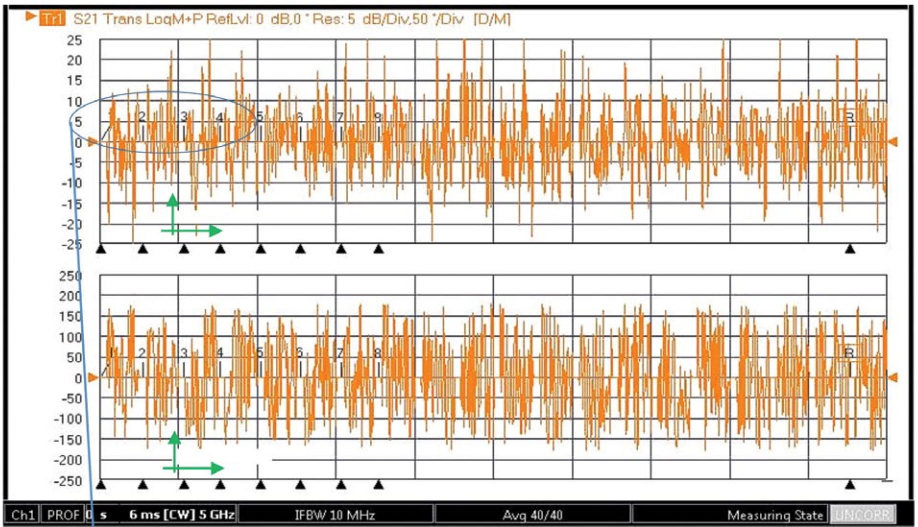
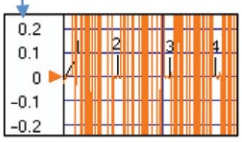


Figure 4: the timing of pulse data capture in a VNA's Profile mode.





Ch1	Tr1	S21	M1 -R :	-5.7057 ms	0.0075	dB,0.03 °
Ch1	Tr1	S21	M2 -R :	-5.3874 ms	0.0012	dB,-0.02 °
Ch1	Tr1	S21	M3 -R :	-5.0691 ms	0.0009	dB,0.02 °
Ch1	Tr1	S21	M4 -R :	-4.7928 ms	0.0006	dB,0.04 °
Ch1	Tr1	S21	M5 -R :	-4.4865 ms	0.0044	dB,0.05 °
Ch1	Tr1	S21	M6 -R :	-4.1862 ms	-0.0009	dB,0.06 °
Ch1	Tr1	S21	M7 -R :	-3.8739 ms	-0.0038	dB,-0.01 °
Ch1	Tr1	S21	M8 -R :	-3.5916 ms	-0.0008	dB,0.01 °

Figure 5: displayed results of Profile Mode test.
Figure 6: magnified section of Figure 5.
Figure 7: marker table result.

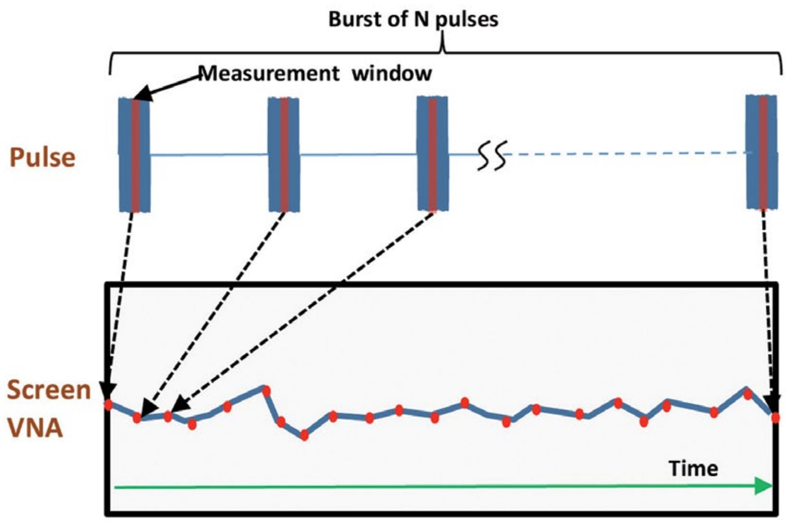


Figure 8: schematic of a VectorStar VNA display when measuring in P2P mode. Note that only results captured in the measurement windows are displayed, which makes it easy for the user to read the curve.

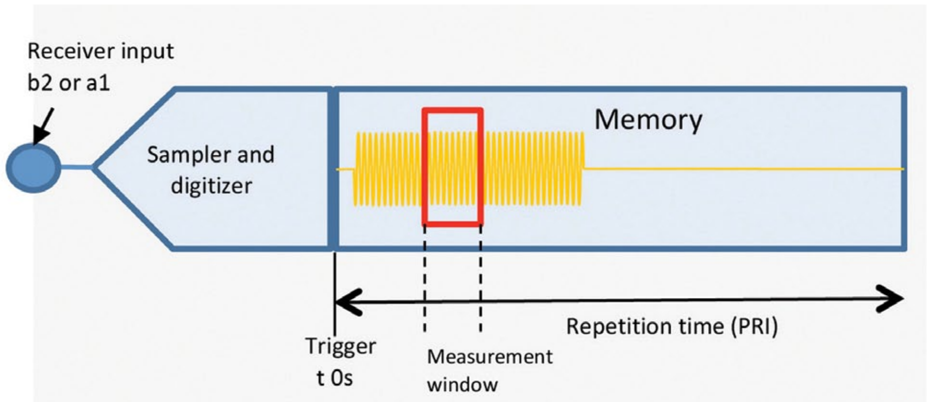


Figure 9: P2P mode calls for a VNA with fast measurement speed and ample memory.

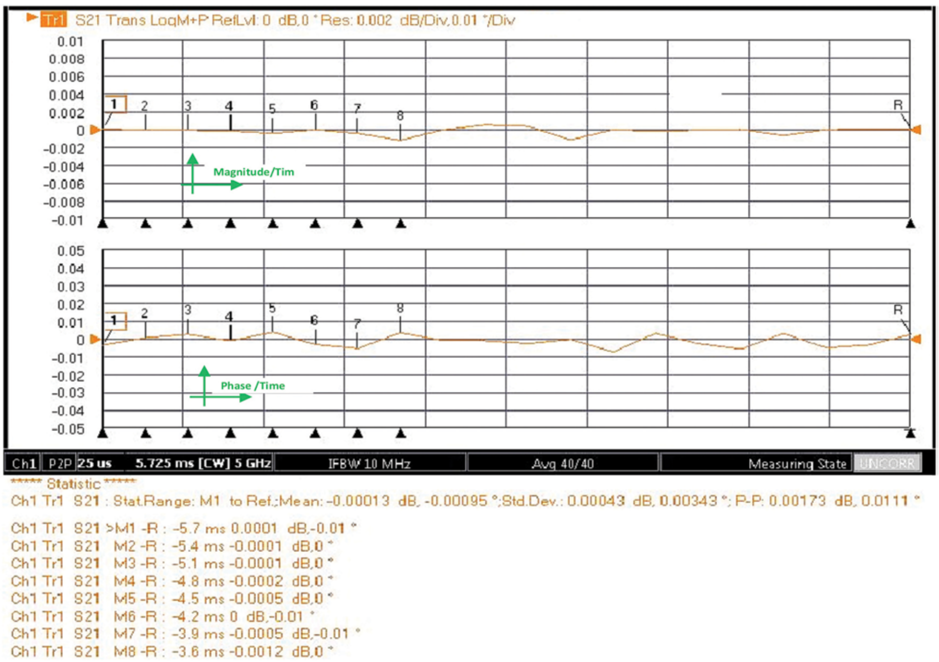


Figure 10: curves and measurement results in P2P mode.

the amplitude and phase of the pulses attributable to the GaN amplifier. Traditionally, most VNAs use an operating technique called the Profile mode for these measurements: this mode allows the user to view signals in the amplitude and phase (time) domain.

Unfortunately, the timing of the measurement windows in Profile mode is not well adapted to the measurement of successive pulses. As Figure 4 shows, the analysis is performed on an entire burst. A typical 6ms burst might contain 20 pulses, each of 50μs' duration. A measurement window of 1μs is used to display the shape of the pulses. This means that, if the user wishes to adequately characterise the entire signal, the measurement will require many points – typically 1,000 or more.

In addition, to allow for the elimination of noise, the displayed measurement will be an average of 40 or more sweeps. This large number of sweeps extends the measurement time: it can easily be several seconds, although the measurement time depends on the number of points, the number of sweeps and the width of the analysis window.

In Profile mode, then, the test engineer is presented with the entire burst: the displayed measurements show the RF energy detected both during pulses and during the intervals between pulses. In practice, this means that the picture is drowned in noise, and it is extremely difficult to distinguish small changes in signal amplitude and phase (see Figures 5, 6). In order to extract any useful information, the user is forced to place markers on each pulse, and then read the data for each in a marker table (see Figure 7).

The marker results allow the user to distinguish changes as small as 0.0075dB and 0.06°. But the reading and placement of markers is a delicate task. It is also difficult to see the trend in the instability of the burst directly on the curve, especially as the values of the changes are very small. It is possible to zoom in on the curve (see Figure 6), but then the curve is distorted by the noise around the pulses. To output the measurements to a PC, the marker table is required. This is laborious, because the user must place the same number of markers as the number of values to be measured.

MEASUREMENT IN P2P MODE

A new measurement technique available in the VectorStar VNA from Anritsu

makes it far easier and quicker to measure instability between one pulse and the next. This technique is called Pulse-to-Pulse (P2P) mode. As well as ease and speed of implementation, the P2P mode's advantages are improved measurement accuracy, faster sweeping speed and the ability to output results to PC software.

The principle of P2P mode is to take measurements on only a selected portion of the pulses, and then to display only the information of interest to the engineer. The user configures the timings, selecting a window in which the VNA will measure the pulse (see Figure 8). On screen, the resulting measurement is clear, free of interference from other signals; a smooth curve of either amplitude or phase is displayed. The operation of the VNA when in P2P mode is shown in Figure 9.

The timing of the VNA's data acquisition operations is controlled by an external trigger signal which is synchronised with the signal generator. The timing of the window – its offset and width – is adjustable in the VNA's menu. A measurement window is represented by one point on the screen, as shown in Figure 8. The same portion of each pulse is measured in each time window. The user chooses in the VNA menu the number of points to be displayed, and the number of pulses per burst. By joining the points, the VNA creates a curve.

Since the number of points displayed on the screen is the same as the number of pulses to be measured, a curve can be generated with, for example, just 20 points per burst, instead of the 1,000 points required in Profile mode, which significantly increases sweep speed.

In addition, in Profile mode the size of the measurement window is a function of the instrument's operation – it cannot easily be configured by the user. Since it must be small enough to enable the signal to be shown and to keep the sweep speed as high as possible, in practice a width of around 1µs is normally the maximum that can be allowed. In P2P mode, the width of the measuring window can be set wider, enabling more points to be calculated and thus to improve the quality of the measurement.

As in the Profile mode described above, sweep averaging may be performed to reduce the effect of noise on the displayed results. Various parameters may be displayed: amplitude, phase, linear, log and impedance.

The results of real measurements in P2P mode are shown in Figure 10. These measurements were performed on a Through rather than a GaN amplifier, which explains the very low instability. Nevertheless, these results show how precisely the VNA is able to measure pulse-to-pulse instability – down to variations of mdB scale for amplitude, and 0.01° scale for phase.

Compared to the Profile mode measurement shown in Figure 5, the P2P mode curve is much easier to read. The placement of markers is similarly easy. A high sweep rate allows the VNA to track rapid variations in component characteristics over time.

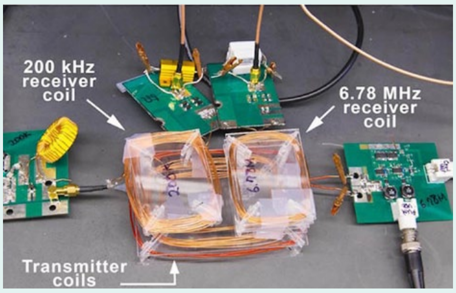
For developers of a new generation of GaN amplifiers for use in radar equipment, this vastly improved measurement technique enables the more precise characterisation of the component, in a shorter period of time, to enable them to get to market faster with a higher-performing product.

Reserchers develop wireless charger that supports different wireless standards

Electrical engineers at the University of California, San Diego, have developed a dual frequency wireless charging platform that could be used to charge multiple devices, such as smartphones, smartwatches, laptops and tablets, at the same time – regardless of which wireless standard, or frequency, each device supports.

"To our knowledge, this is the only multi-standard wireless power transmitter that's been shown to operate simultaneously at two different frequencies with high efficiency," said Patrick Mercier, a professor in the Department of Electrical and Computer Engineering at UC San Diego who led the study published in the IEEE Transactions on Power Electronics.

The latest proof of concept study not only presents a "universal wireless charger" that can deliver power to multiple devices concurrently, it addresses an issue that afflicts existing wireless technology: incompatibility between the three competing wireless standards in today's market (known as Qi, Powermat and Rezence). These three standards operate under different frequencies: Qi and Powermat operate at around 200 kHz while Rezence operates at 6.78 MHz. So herein lies the challenge. In order for a single charging device to support multiple standards, it needs to operate across these very different frequencies. Existing wireless chargers are typically built with a transmitter coil that's optimized to work at one frequency. But as a consequence, the chargers are extremely inefficient at other frequencies.



The prototype of the dual frequency charger is a thin, rectangular box (12.5-cm × 8.9-cm) that contains two transmitter coils: an inner coil optimized to operate at a frequency of 200 kHz (orange), and an outer coil optimized to operate at 6.78 MHz (red). Image courtesy of UC San Diego Jacobs School of Engineering.

To address this problem, Mercier and his team built a charging platform capable of simultaneously operating across the frequencies supported by all three wireless power standards. The prototype that they built is a thin, rectangular box (12.5 centimeters × 8.9 centimeters) that contains two transmitter coils: an inner coil optimized to operate at a frequency of 200 kHz, and an outer coil optimized to operate at 6.78 MHz. One of the features of this design is that the coils lie in the same plane, allowing for a compact size. The platform is just big enough to fit two smartphones side by side. Another important feature of the prototype is a filtering circuit that the researchers designed to prevent the coils from interacting with each other and causing efficiency losses.

The researchers then tested the charging platform using two receiver coils (one optimized for 200 kHz operation and the other for 6.78 MHz), which served as models for two different smartphones. Engineers demonstrated that the charging platform was able to deliver power to both receiver coils at the same time at efficiencies ranging from 70 to 80 percent. The receiver coils were also able to receive power regardless of where they were placed on the charging platform.

Realtime radar target generation

By Dr. Steffen Heuel, Darren McCarthy, Rohde & Schwarz

INTRODUCTION

Radar systems are used across many industries and in a variety of applications, including commercial, industrial and defense. The use of radar technologies ranges from automotive collision avoidance radar, weather radar, air traffic control (ATC) radar and defense applications such as early warning radar and missile tracking. The end use application of a radar dictates its physical size, operating frequency, waveform, transmit power, antenna aperture and many other unique parameters. Every parameter and component is to be tested to ensure proper functionality.

Radar system operators are interested in functionality testing, namely target detection and tracking. For functional tests, targets have to be generated over the entire unambiguous range, unambiguous radial velocity interval and azimuth/elevation coverage with different radar cross sections (RCS) to ensure an acceptable accuracy and resolution, detection and false alarm rate of the radar system. Field testing can be extremely time-consuming, complex and expensive, and can involve repeatable conditions that are difficult to configure. For example, an airborne radar on a fighter jet might be tested at a test range under controlled conditions, where artificial targets are deployed, detected and tracked by the radar. The global positioning system (GPS) coordinates of a target are then compared with the collected radar data to check the radar performance.

As the cost of field testing can be somewhat prohibitive if done on a regular basis and while a radar system is under development, an alternative is to set up real-life radar test simulations that include many different types of targets and scenarios. The generation of radar targets makes it possible to test the overall functionality of the radar including RF without the expense of field testing. Radar target generators introduce targets with a time delay, Doppler frequency shift and attenuation. Several technical implementations of target generators exist, such as coaxial delay lines (CDL), fiber optical delay lines (FODL) or digital radio frequency memory (DRFM). Today commercial off-the-shelf (COTS) measuring equipment can also be used.

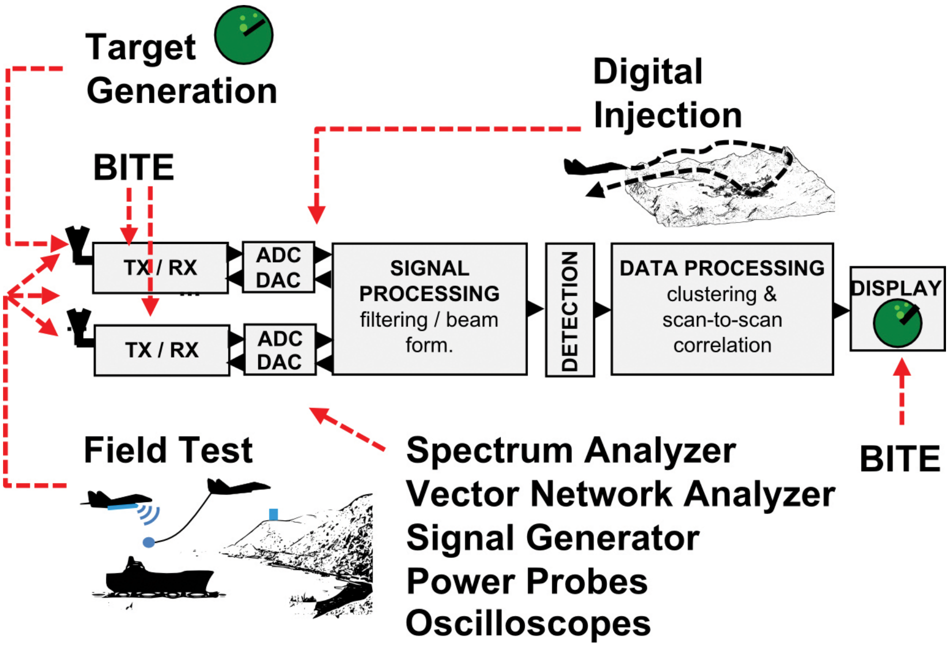


Figure 1: Radar tests performed on a multipurpose radar system.

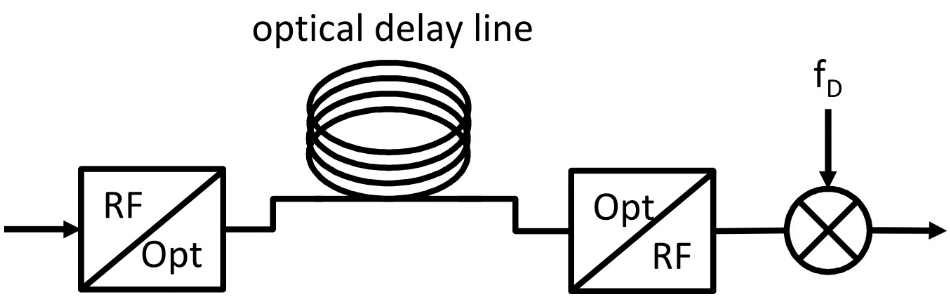


Figure 2: Simplified block diagram of a fiber optical delay line (FODL).

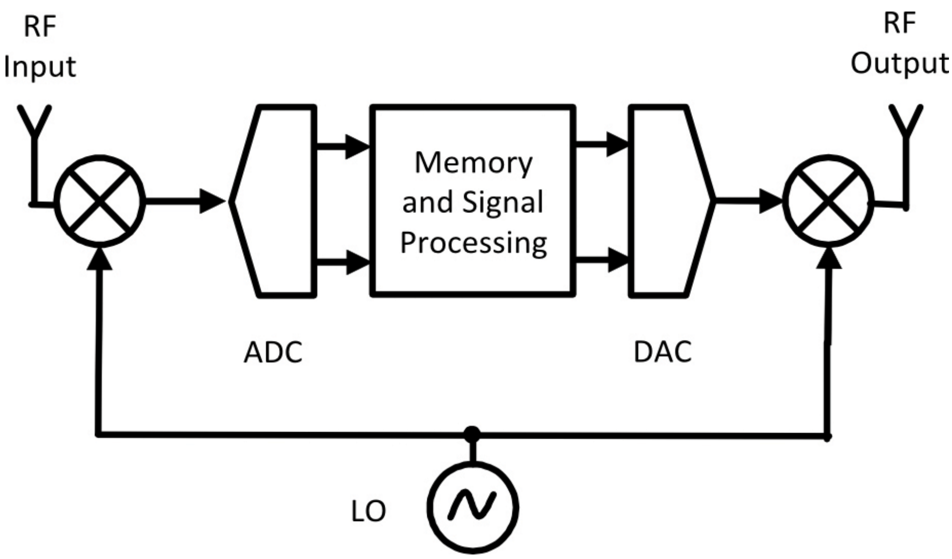


Figure 3: Simplified block diagram of a DRFM system.

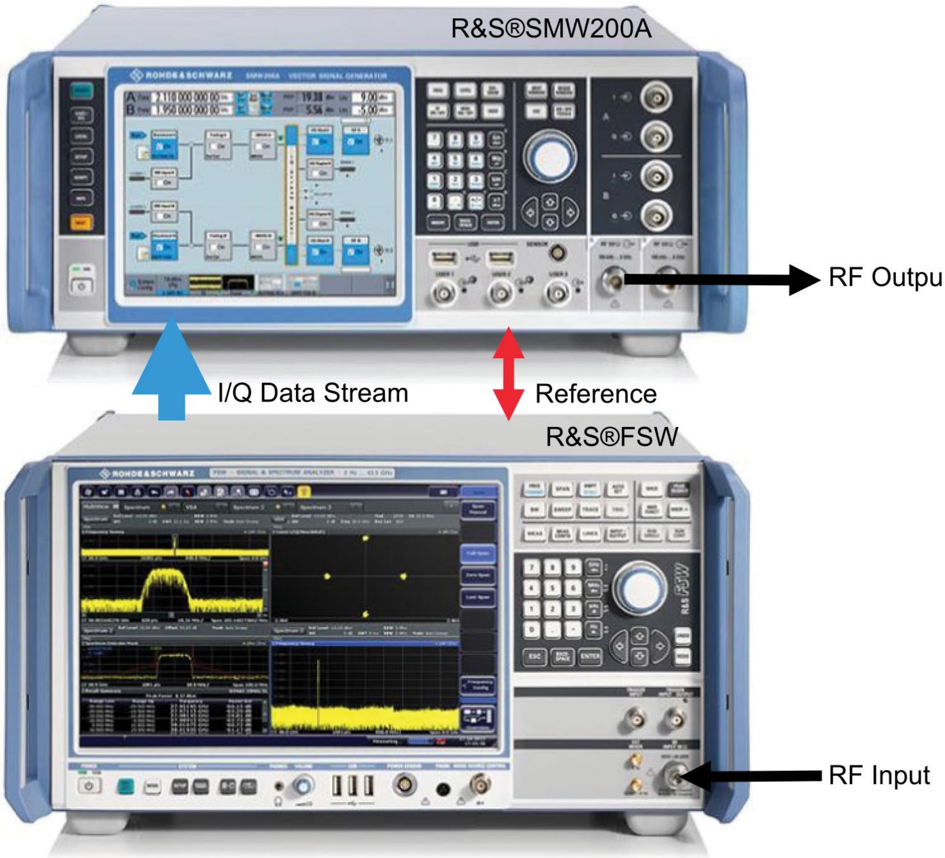


Figure 4: Representation of a COTS realtime radar target generator (R&S®SMW200A vector signal generator and R&S®FSW signal and spectrum analyzer).

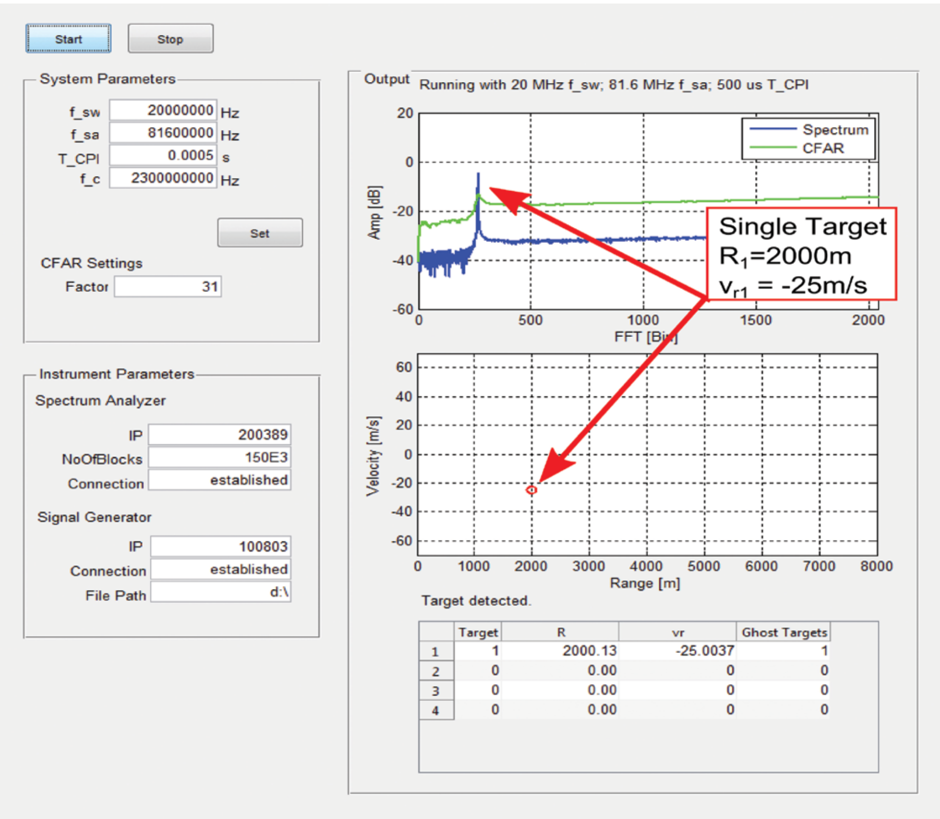


Figure 5: Single target generated by the COTS radar target generator.

The performance and capability of radar target generators and their usability to test a radar system is the key point and depends on several technical parameters. This article explains different radar target generator architectures, clarifies performance needs and design criteria that make a target generator reasonable for radar tests, and shows examples of measurement results.

RADAR TESTS

There are several different measurement tasks that must be performed before a radar system is put into service and handed over to an operator. During research and development, mainly hardware component tests and measurements are performed. Most of these tests focus on the transmitter, receiver and only partially on the signal processing or system functionality.

The T&M industry offers various kinds of radar test equipment. This equipment focuses on the parametric performance of the radar and can measure spectral purity, transmit power or sensitivity during development and production. As a result, the radar is partially tested and important functionality, such as signal detection, is never completely tested in closed-loop operation.

To test the complete radar system (baseband and RF) and to ensure that all elements function in line with specifications and meet customer requirements, many more tests are performed, as indicated in Fig. 1.

Parametric measurements must be supplemented by further test and monitoring functionality. Built-in test equipment (BITE), for example, monitors some hardware components and functionalities. While BITE is able to provide a pass or fail assessment of a radar, it is not necessarily designed to give information on the radar performance. If a radar does not detect a target, how does an operator know if the radar is functioning properly?

Therefore, field tests with towed spheres might be performed to baseline the radar capabilities and test the entire radar processing chain, but not the processing capabilities. Some radars have digital injection capability, where scenarios can be injected into the radar processor. While a field test gives comprehensive results about the radar performance and functioning in line with specifications, digital injection tests the radar processor capabilities. As mentioned previously, field tests are expensive, barely reproducible and limited in

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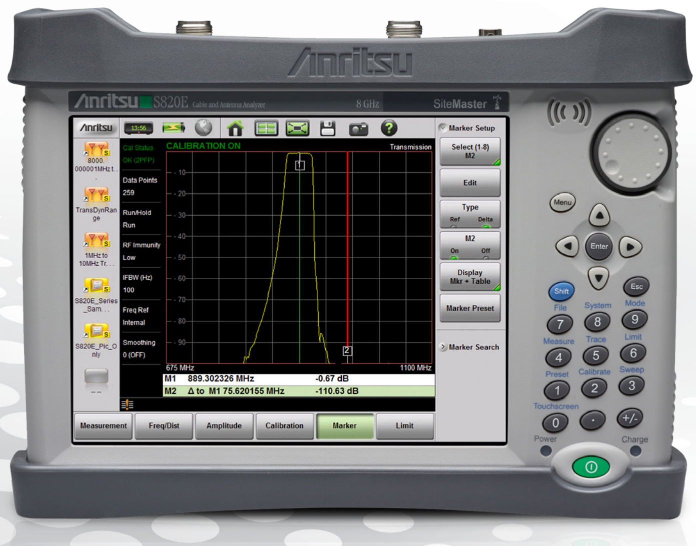

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availability of certain targets. For these reasons, radar target generators are used to replace some field tests and make testing reproducible; they save time and costs, and can test the entire processing chain by injecting radar targets.

The technical demands placed on radar target generators by such requirements represent a challenge to the fundamental architecture of the target generation system. While there are economic advantages that tend to favor a laboratory test system instead of field testing, the functional performance of the radar system must be verified through a balance of laboratory and field test environments. Furthermore, as radar systems add electronic protection (EP) functionality to their designs, these new system requirements may require new test methods.

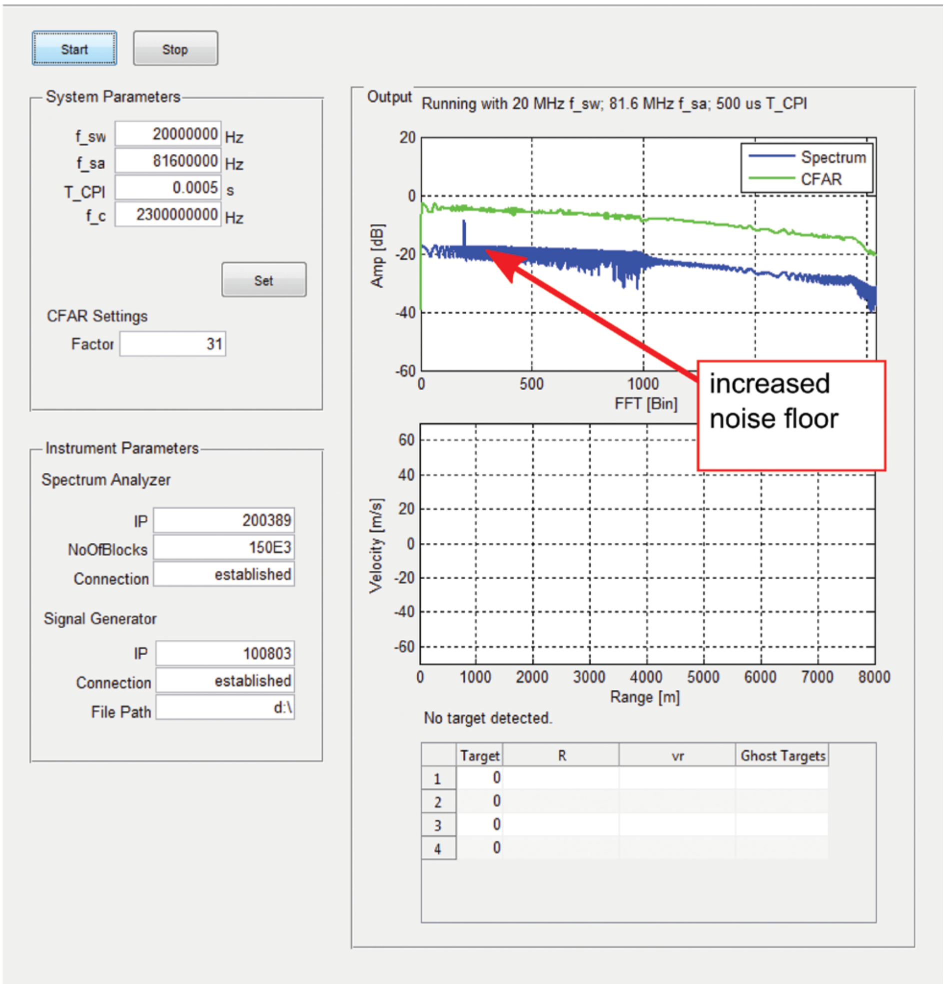

Figure 6. SDR operating in co-existence with another service.

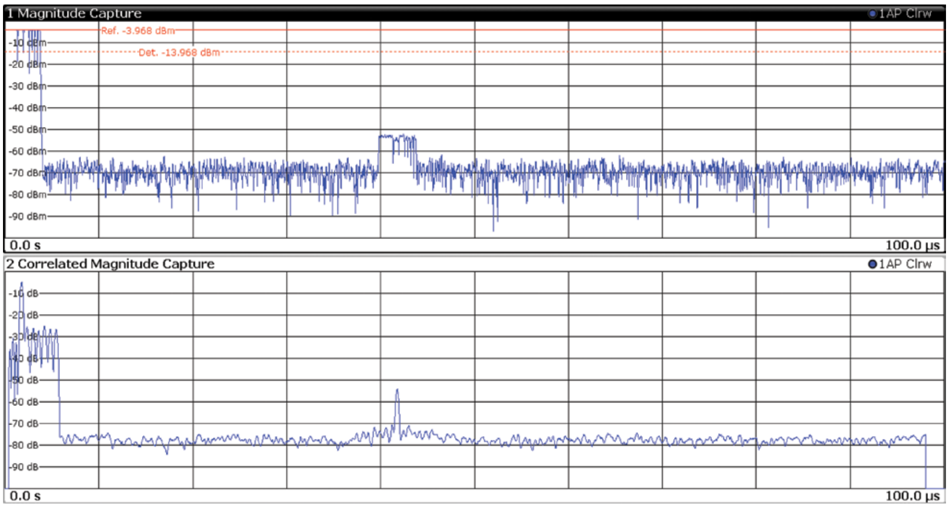

Figure 7. Barker code (beginning), correlated magnitude and the corresponding echo signal (40 µs later).

RADAR TARGET GENERATORS

Radar target generators apply time delay (range), Doppler frequency shift (radial velocity) and attenuation to a radar signal. The actual radar signal is received, manipulated and retransmitted. Other systems have the radar waveform stored, and waveform replay is triggered. The various kinds of radar target generators have very different performances and test different levels of functionality; some are able to generate a single target for very specific radar systems in a dedicated frequency band only, while others cover a wide frequency spectrum and offer complex target scenario simulation. There are also specific radar target generators for dedicated frequency bands, for example to be used in testing automotive radar sensors [8].

The performance and capability of radar target generators and the ability to test a radar system depend on several economic and technical parameters. Aside from efficiency and cost, the following technical parameters are considered:

- System architecture;
- Frequency coverage and bandwidth;
- Phase noise performance, signal distortion, spurious emissions and overall echo signal quality;
- Digitization performance, sampling frequency and number of effective quantization bits;
- Maximum Doppler frequency shift, Doppler steps;
- Maximum range, minimum range, range steps;
- Trigger and/or continuous operation;
- Flexibility to reproduce authentic environmental scenarios and possible tests of interest.

Operating frequencies of radar systems vary over a very wide range of frequency bands. From long range surveillance radars that operate in HF or L-band, ATC radars in S-band, naval surveillance radars in X-Band up to automotive radar sensors in K-/W-band. Therefore, the radar target generator should cover a broad range of spectrum.

Bandwidth determines range resolution in radar or allows operation of frequency agile radars. Not only greater bandwidth offers higher range resolution; frequency agile radar systems also need high bandwidth. Therefore, the bandwidth of the target generator has to cover at least the bandwidth to faithfully reproduce the waveform.

Phase noise performance and signal fidelity are of great importance, as poor performance or signal fidelity causes distortion or additional phase noise of the retransmitted signal. For example, the radar can only detect slow moving targets if there is good phase performance. If the target generator has high additive phase noise, the radar target generator may limit the ability to test the true performance of the radar.

To simulate delay and Doppler, digitization is necessary in most modern radar target generators. The radar signal is captured, digitized, manipulated, converted to analog and retransmitted with attenuation. The effective number of bits (ENOB) and spurious-free dynamic range (SFDR) are a way of quantifying the quality of an ADC, which is important for representing the incoming radar signal and reproducing the radar echo signal.

The other technical parameters, such as the minimum/maximum range or Doppler, the number of targets or test scenarios, depend mainly on the signal processing performance, architecture, and baseband processing capabilities of the radar target generator.
Today radar engineers make use of different kinds of radar target generators.

1. FIBER OPTICAL DELAY LINES (FDOL)

FODLs have been used for several decades in the test and measurement of radar systems – for example, to measure phase noise of radar systems and to simulate reproducible signals for outdoor range testing of radio and radar systems. These relatively flexible, phase coherent and small systems convert the RF signal of the radar to optical and delay it by means of a fiber optical line of a certain length before the signal is reconverted to RF and retransmitted to the radar. Some systems are able to introduce Doppler frequency shift, as indicated in Fig. 2.

The phase velocity of an optical signal in fiber is approximately 5 µs/km, while the loss is of the order of 0.5 dB/km. Hence, a very fine range spacing in the domain of ps can be reached. The bandwidth of a fiber optical delay line is very high. It is mainly limited by the modal dispersion for multimode fibers and is in the range of GHz/km. In single-mode fibers the modulation bandwidth is limited by material dispersion and can become 100 GHz/km for a wavelength with very low dispersion [1]. The dynamic range is limited by quantum noise at low RF and by nonlinear processes at high RF [3], and decreases linearly with increasing signal bandwidth [1]. As soon as Doppler frequency is added, the spurious-free dynamic range depends on additional parameters and is often reduced by dozens of dB. Although Doppler frequency shift can be modulated to the RF signal, the length of the fiber delay (range) is constant and a moving target cannot be generated realistically.

There are several advantages of FODLs. FODLs have constant delay versus frequency, are immune to vibration, are largely resistant to electromagnetic interference, and fiber delays do not radiate energy. Also the repeatability of simulation, low system cost and time-savings are key advantages. Tests where excellent close-in carrier phase noise performance is necessary, such as the fixed target suppression (FTS) test, can be performed very well. However, FODLs cannot generate time-variant range-Doppler targets, nor do they offer continuous range settings or arbitrary signal attenuation and gain.

2. DIGITAL RADIO FREQUENCY MEMORY (DRFM)

DRFMs can be used for radar target simulation in test and measurement. These kinds of systems manipulate the radar signal digitally. A DRFM downconverts, filters and digitizes the received RF signal. The signal is then stored and/or modified. It is reconverted to analog, and mixed to RF frequency using the same local oscillator (LO) as for the downconversion. A final amplification and retransmission finalizes the processing chain. This method is shown in Fig. 3.

One of the first DRFMs designed was the ALQ-165 airborne self-protection jammer (ASPJ), which contributed to Joint Vision 2010. Its development began in 1979; however, the program was suspended in 1992 [6]. The ASPJ was able to cover the frequency band from 0.7 GHz to 18 GHz and later from 1 GHz to 35 GHz. The average cost of a unit was USD 1.27 million [4].

The commercial and public information about DRFMs that is currently

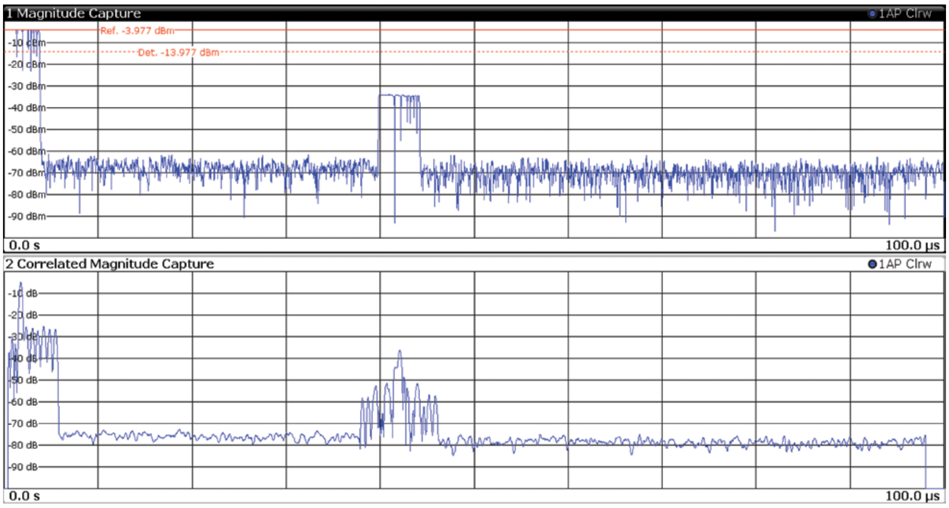

Figure 8. "DRFM representation" of the same echo signal with different signal fidelity.

available shows that these systems can cover frequencies up to 40 GHz, offer up to 12-bit digitization with up to 1.4 GHz of instantaneous bandwidth, up to –65 dBc spurious-free dynamic range with a minimum delay of 90 ns. However, due to technical restrictions these technical figures cannot be combined into a single DRFM. For example, most of the wideband DRFMs have extremely reduced signal fidelity, use much less than 12 bits or were built for research purposes only.

The minimum delay that is introduced is mainly limited by the ADC and DAC, which take some cycles to convert the analog data to digital and vice versa, and also depends on the bandwidth and number of bits. In addition, signal processing adds a number of processing cycles to the radar echo signal. Typical minimum range delays nowadays range from below 100 ns to below 1 µs.

In DRFMs it is important to know how the analog RF signal is represented in the digital domain (amplitude, phase, I/Q) and the number of bits, because this is what mainly determines the signal fidelity. Another key point of DRFMs is spurious-free dynamic range (SFDR) (characterized by the ADC), because the radar may try to discriminate between targets and electronic countermeasure (ECM) signals. Depending on the effective number of bits (ENOB), nonlinearity of components and noise, the SFDR is limited.

While high signal fidelity DRFMs with coherent target echo returns might be suitable for radar tests, the use of a DRFM with a user interface to test a broad variety of signal conditions and scene effects may be limited. This very dedicated equipment comes at a certain price and perhaps with limited flexibility to thoroughly test the functional parameters of the radar. Technical performance specifications and the exact costs of a DRFM are rarely commercially available. According to the US Department of Defense (DoD), the cost of a single DRFM module ranges from USD 150,000 to USD 700,000, depending on its capabilities [5].

3. COMMERCIAL OFF-THE-SHELF (COTS) TEST AND MEASUREMENT EQUIPMENT

COTS test and measurement equipment nowadays is also able to generate radar targets, basically in a similar fashion as DRFMs do, by RF downconversion, digital manipulation in baseband and RF upconversion.

The radar target generator consists of a receiver (RF signal analyzer) and a transmitter (RF signal generator) using COTS test and measurement equipment, which is normally used as standalone equipment for analyzing or generating RF signals. When used in conjunction, these two instruments can operate as a radar target generator.

The COTS system operates from 100 kHz to 40 GHz and receives any kind of RF radar signal in the specified frequency band with up to 160 MHz bandwidth and converts the signal to in-phase and quadrature-phase data (I/Q data). The I/Q data is transferred to the baseband input of the signal generator, where time delay, Doppler frequency shift and attenuation are applied to the specified user values. The radar echo signal is then retransmitted to the radar by the signal generator. See Fig. 4.

One advantage of this measuring equipment is its exceptional RF performance, which is suitable for additional parametric radar tests during research and development or production. The flexible and modular approach allows the vector signal generator or the signal and spectrum analyzer to be used in other setups as well or in their dedicated field installation.

MEASUREMENTS

To demonstrate this radar target generator, a software defined radar (SDR) and MATLAB® signal processing is used. In the demo system, a waveform with multitarget resolution capabilities is utilized and the SDR's performance is analyzed using the COTS radar target generator.

A single target is generated by the radar target generator and observed in the SDR (which acts as a radar under test). Fig. 5 depicts the MATLAB® graphical user interface (GUI) of the radar under test including the spectrum, range-Doppler map and target list. A single local maxima is observed, whose power is higher than the constant false alarm rate (CFAR) threshold. By measuring the beat frequency, the range and radial velocity are determined. In the radar target generator, a range R1 = 2000 m and Doppler frequency shift of vr1 = –25 m/s are generated. This is measured by the radar very accurately. See Fig. 5.

The COTS radar target generator is able to generate up to 20 targets in different range-Doppler cells. The signal generator also has multiple RF sources, making it possible to test radar against interference, as for example co-existence with Long Term Evolution (LTE) or other services [2].

Fig 6 shows the same radar target, but in addition a second frequency-modulated continuous-wave signal is transmitted. The noise floor is increased heavily. The radar echo signal can still be observed visually, but the CFAR threshold is too high for an automatic detection.

In addition to testing the functional performance of the radar, the COTS target generator can help assess modern electronic protection measures in the radar. This might be necessary, as for example in Europe when several planes vanished from the air traffic control radar screen in mid-2014 [7]. One example might be to detect the presence of a DRFM being used as an electronic countermeasure.

In the following scenario, a phase-modulated radar waveform, such as a Barker code, can be used to test the performance of the radar signal processing. The Barker code is transmitted and delayed in the radar target simulator. The radar waveform has a very specific baseband waveform, and the radar receiver can detect the fidelity of the echo and whether or not the echo return was virtual or real using correlation filters. An uncorrelated signal might result from an ECM system due to resampling at a different rate, a small number of effective bits in the analog to digital conversion, phase noise or amplifier distortions in the target simulator. Depending on the DRFM, the generated echo signal fidelity will likely be different than one from a real target. The radar processes focused on electronic protection can detect the differences from the returned echo with different fidelity. This measurement can also be assessed by the presented radar target generator.

Fig. 7 shows a Barker-coded radar signal at the beginning of the measurement and the corresponding radar echo signal attenuated about 50 dB as magnitude and correlated magnitude capture. The time-side lobe measurement shows the expected coherent echo return delayed by 40 µs. Fig. 8 shows the echo signal return and correlated magnitude capture when using a different sampling rate (e.g. when using a DRFM), which in turn represents different signal fidelity. The correlation of the echo signal dramatically changes.

SUMMARY

The reliability expected of radar systems is extremely high, which is why test and measurement of these is of major importance. There are several different approaches to using a radar target generator to test the entire radar system, from the antenna, transmitter and receiver all the way down to the signal processing. This article presented these approaches and explained their key economic and technical performance indicators.

The target generator's RF performance must be better than the radar under test and offer a variety of test scenario configurations. A perfect performance balance brings many field tests into the lab and reduces the cost of software and hardware testing. Fiber optical delay lines are still used today in radar tests, but lack flexibility in test and measurement, for example in order to generate range-Doppler-dependent targets. A DRFM handles this drawback and offers additional solutions when it comes to generating radar echo signals. However, the DRFM is a very dedicated solution, can be very costly and is not necessarily designed to be used as test equipment with a flexible interface. In comparison, COTS test and measurement equipment offers a wide range of test solutions, from signal and component test or analysis to radar target generation. The multipurpose benefits of measuring equipment and the flexible and modular approach (which can also be used as a radar target generator) increase the flexibility and effectiveness of this equipment for use in a test laboratory.

The different radar target generator approaches each have their own specific advantages, but all of them bring parts of the field test into the laboratory, make testing less complex and reduce costs by providing high repeatability and improved automated test capabilities.

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RF switches

boast constant impedance technology

Integrated Device Technology has expanded its RF product portfolio with two switches that offer low loss and high isolation, with a new-to-the-industry constant impedance technology, called Kz™.

The F2914 and F2915 are 50-ohm SP4T and SP5T RF switches that exhibit insertion loss of only 1.1 dB with corresponding IIP2 of 124 dBm and IIP3 of 61 dBm at 4 GHz.

The products utilize IDT's new Kz innovative design technology to maintain a near-constant impedance when switching between RF ports, improving hot switching reliability and system response time while protecting downstream components from transients. The latest switches are ideal for base stations (2G, 3G and 4G), repeaters, test and ATE equipment, digital pre-distortion, and point-to-point, public safety and cable infrastructures.

The switches are packaged in an industry-standard NBG24 4-mm x 4-mm 24 pin QFN package, allowing customers to take advantage of the new switches on existing as well as new designs. Samples are available now.

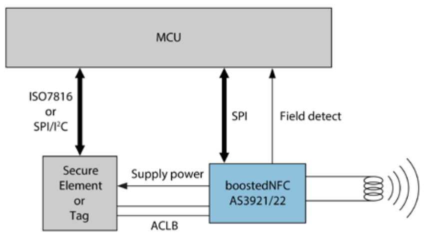
www.IDT.com

NFC analog front end

targets smartwatches and wearable devices

The company, ams AG has announced an NFC (Near Field Communications) analog front end (AFE) for manufacturers of smart watches, wristbands and other space-constrained devices, enabling them to reliably support contactless payments and ticketing.

The AS3921 NFC analog front end features boostedNFC technology from ams, which increases the useable operating volume of an NFC reader by up to 900% when compared to conventional NFC implementations. This greatly improves the reliability and perceived speed of NFC transactions, particularly in devices such as smart watches and wristbands that only have room for an extremely small antenna. It also ensures reliable NFC transmission in other device types which have a smaller antenna than that of a contactless card, or which present difficult operating conditions for NFC transmissions.



Optimised for space-constrained assemblies, the AS3921 enables OEMs to implement a simpler design than the conventional NFC controller-based architecture allows, resulting in a simpler and cheaper system, occupying a board footprint around one third smaller, using fewer components and consuming less power.

Drawing just 12 µA in normal operation, and providing a power-saving Secure Element wake-up function, the AS3921 drains far less power from the battery than NFC controller circuits, which typically draw 60 µA or more. Packaged in an ultra-compact wafer-level chip-scale package (WL-CSP) measuring just 2.115-mm x 1.735-mm, and connecting directly to the Secure Element with few external components required, the AS3921 with boostedNFC technology implements active load modulation: it generates an RFID card response which is synchronous to the reader's field. This allows for card-to-reader communication at coupling factors as much as one order of magnitude lower than is possible with the passive load modulation (PLM) used by contactless cards.

A device which uses the AS3921 and which has an antenna of just 100mm2 can achieve the same or a bigger operating volume as a contactless card with a conventional PLM circuit, transmitting via an antenna typically at least 2,150mm2 in area. In some cases, the device might need no dedicated NFC antenna at all, provided its metal casing can be used in place of a normal antenna.

www.ams.com

Qualcomm introduces first Wave 2 802.11ac Wi-Fi System-on-Chip

Qualcomm Atheros has introduced the first fully integrated, smart gateway system-on-chip (SoC) incorporating its next generation Qualcomm® Internet Processor (IPQ), Qualcomm® VIVE™ with Qualcomm® MU | EFX MU-MIMO technology, built-in Gigabit Ethernet, and Qualcomm® StreamBoost™, with support for dual band simultaneous (DBS) transmission and LTE backhaul.

The IPQ40x8/x9 SoC will be the basis for a wide variety of applications and services, including home routers, enterprise access points, hotspots, carrier LTE gateways and range extenders. This fully integrated solution will provide for cost-effective development while ensuring top-of-the-line network performance and efficiency.

The IPQ40x8/x9 integrates two 2x2 radios capable of up to 1.73 Gbps maximum PHY rate, a quad-core ARM CPU and a Gigabit Ethernet switch onto the same silicon chip. As the industry's first fully integrated Wave 2 MU-MIMO Wi-Fi® SoC, the IPQ40x8/x9 is a cost, size and power-effective SoC that enables original equipment manufacturers (OEMs) to bring 11ac benefits to mainstream segments. Additionally, IPQ40x8/x9 has the flexibility to configure its radios for traditional 2.4 GHz and 5 GHz dual band simultaneous operation, or both configured to 5 GHz band for single-band simultaneous or range extender operation.

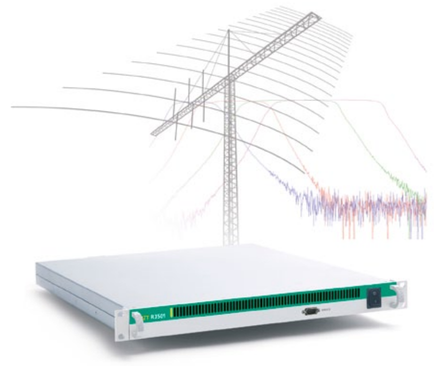
Platforms based on the IPQ40x8/x9 are highly configurable with USB3.0, PCIe, SD/eMMC, Ethernet and LTE interfaces, making them suitable for a large number of use cases, including smart home gateways and Internet-of-Everything hubs, to residential consumer premises equipment (CPE), to Wi-Fi backhaul equipment, to LTE gateways.

www.qualcomm.com

RF receiver with adaptive preselector

suits signal search, spectrum monitoring

IZT GmbH has introduced the IZT R3500, an RF receiver that delivers high performance for the interception of RF signals. Instead of standard systems with fixed filters, the R3500 offers a highly linear, flexible preselector with electronically configurable start- and stop frequencies.



The preselector implemented in the IZT R3500, allows the user to arbitrarily select a combination of one high-pass and one low-pass filter. These filters are then cascaded in the signal path electronically, but completely passively with no amplifiers in between. Within the input frequency range of 9 kHz to 40 MHz, a pool of high-pass filters with corner frequencies spaced in a ratio of approximately 1:1.26 can be selected. This limits the amount of incoming signal energy and provides highly effective protection against unwanted IP2 products. The user can freely cascade one out of 12 high-pass filters with one out of 13 low-pass filters. In a very large signal situation, they can be combined to resemble a highly selective sub-octave filter bank. For broadband, automatic signal search algorithms, a bandwidth of several megahertz may be best suited. In a low power RF environment, the filters can be switched off completely.

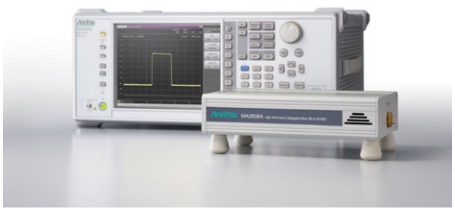
Like all receivers of the IZT R3000 series, the IZT R3500 supports up to four subchannels as IQ, complex FFT or PSD data over Ethernet. The sub-channels can be placed anywhere within 9 kHz and 40 MHz. Signal processing, data format and control interface of the IZT R3500 are fully compatible with the IZT R3000 series, giving current users of the IZT R3000 receivers an easy migration path.

www.izt-labs.de

Fundamental mode waveguide mixer

suits radar and backhaul test

Anritsu Corporation has released the MA2808A high performance fundamental mode waveguide mixer, a millimeter-wave measurement option for the MS2830A spectrum-analyzer/signal-analyzer.



The 60 to 90 GHz MA2808A combines ultimate sensitivity performance with a wide measurement span in an easy-to-use configuration, to enable millimeter-wave measurements that traditional harmonic-mixer and down-converter methods have been unable to achieve.

Millimeter-wave technology is currently used in a number of wideband wireless applications but this latest release will be welcomed by automobile radar and wireless backhaul providers in particular. High resolution automobile collision avoidance radars are using 77/79 GHz to be able to detect objects such as pedestrians, making millimeter-wave measurement capability vital. Previous measurement methods have suffered with large conversion losses as well as the appearance of non-existent ghost signals (image responses), problems now addressed by the MA2808A.

In order to meet the need for faster, higher capacity communications, wireless backhaul providers are looking at connecting increasing numbers of small cell base stations with core networks, using E-band signals of 60 to 90 GHZ. The tight specifications on spectrum emissions in these bands require very high performance measurement equipment with high bandwidth and the best possible sensitivity.

www.anritsu.com

Single wireless MCU runs Thread and Bluetooth Smart

Freescale Semiconductor has introduced the Kinetis KW41Z – claiming to be the industry's first multi-mode radio MCU to support concurrent operation of IEEE® 802.15.4 Thread and Bluetooth Smart/BLE connectivity while hosting associated applications. An expansion of Freescale's Kinetis KW40Z family of wireless MCUs, the latest KW41Z MCU features extended memory – up to 512K Flash and 128K RAM – allowing multiple networking stacks to run on a single device and enabling true multiprotocol designs. The device also supports the latest Bluetooth specification v4.2, and offers exceptional RF performance with an on-chip balun facilitating wider coverage, better interference immunity, lower power and complexity, and fewer RF front-end components for a robust design.

The Kinetis KW41Z MCU helps transform a wide range of popular home devices such as thermostats, home security systems and door locks into advanced IoT systems by addressing multiple use cases in a single device. The KW41Z MCU can run applications, add Thread connectivity, provide control of these systems with a smart phone or tablet via BLE, and use BLE to securely join devices to the network (sideband commissioning).

Early access program sampling for the Kinetis KW41Z is planned for Q2 2016, with general availability expected in Q3 2016.

www.freescale.com

VoIP technology adds VoLTE capability

Mushroom Networks have announced that VoIP Armor — a technology that significantly enhances the voice quality and reliability of calls made using Voice over Internet Protocol (VoIP) — now supports Voice over LTE (VoLTE). The addition of VoLTE strengthens reliability and failover mechanisms for VoIP-based phone systems. VoLTE is a standard, data-only technology that carries voice calls over the new LTE data network. Operators are in the early stages of deploying the technology, but adoption is gaining ground.

VoIP Armor directly addresses and solves the problems of inconsistent voice quality and reliability of VoIP calls by creating an adaptive self-healing IP tunnel that adds reliability and protects against any negative network conditions such as starvation, loss, latency and jitter. It is available as a standalone appliance as well as built into the patented, flagship Truffle Broadband Bonding systems from Mushroom Networks, which aggregate and intelligently orchestrate multiple Internet access lines. The technology leverages two or more Broadband Bonded Internet links to protect the VoIP packets against loss, delay and jitter as well as against starvation from other cross traffic. The end result is that VoIP calls are highly reliable and consistently achieve high call quality.

VoIP Armor also boosts simultaneous call capacity because of the increased WAN bandwidth of the bonded Internet lines. By adding VoLTE support, enterprises now have unmatched reliability for their VoIP-based systems and they no longer have to rely only on wired transport technologies such as DSL, cable, fiber, MPLS and others.

www.mushroomnetworks.com

High power amplifier

covers 1 to 2.5 GHz and delivers 2 kW CW

Empower RF is shipping another industry leading RF amplifier system that complements the frequency coverage and power level "footprint" of their next generation, high power PA product family.

The latest Model 2180 covers 1 to 2.5 GHz and delivers an unprecedented 2 kW CW of broadband output power in a 8U, air cooled chassis. Offering unrivaled size, weight, and power advantages and building on a design architecture that has been a catalyst for technology upgrades from customers with diverse requirements from multiple markets, Model 2180 provides high performance for end applications that include, but are not limited to, test and measurement, electronic warfare, and communications.

Customer specific product variations which can be leveraged from this baseline, 1 to 2.5 GHz platform, include high power pulse applications for S-Band radar and multi-kW "scaled up" power combinations for L and S-Band applications.

The amplifier offers user selectable configuration and operation in three different modes - AGC (Automatic Gain Control), ALC (Automatic Level Control) and MGC (Manual Gain Control). Optional filter/switches for improved harmonic rejection can be specified. Fast electronic VSWR protection provides safe and reliable operation during adverse load conditions.

User interface capabilities of this amplifier that are standard with Empower next generation designs allow the user to initiate remote management and diagnostics via an embedded web server, enabling network managed site status and control simply by connecting the unit's Ethernet port to a LAN. Using a web browser and the unit's IP address (IPV4) allows ease of access with the benefit of multilevel security. The control system core runs an embedded OS (Linux).

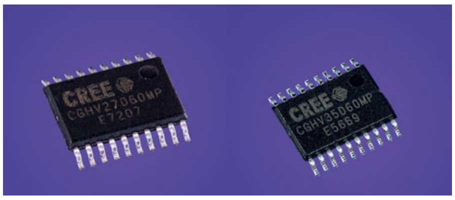
www.EmpowerRF.com

50-V plastic GaN HEMTs

for LTE and radar applications

Wolfspeed, a Cree company, has introduced two plastic-packaged 50-V/60-W GaN HEMT devices that provide the intrinsic GaN value of power and bandwidth in a low cost package platform.

Supplied in miniature (4.5-mm x 6.5-mm), economical, plastic SMT packages, these devices are ideal for LTE, small cell base transceiver station (BTS), radar, public safety radio, and other communications applications.



The CGHV27060MP is a 50-V/60-W broadband GaN HEMT with both linear and pulsed applications circuits and no internal input or output match, which allows it to support a wide range of frequencies spanning UHF through 2.7 GHz. Tested at 2.5 GHz, the GaN HEMT is well suited for LTE micro base station amplifiers with 10- to 15-W average power and high efficiency topologies, such as Doherty or Class A, B, and F amplifiers. Utilizing an S-Band radar circuit, the 50-V device provides 16.5 dB gain, 70% drain efficiency, and 80 W output power at pulsed PSAT with a 100 µs pulse width and 10% duty cycle. At 14-W PAVE, the device delivers 18.5 dB gain, 35% efficiency. This miniature plastic-packaged transistor is also capable of 65 W of continuous wave (CW) output power when used in high efficiency amplifier designs.

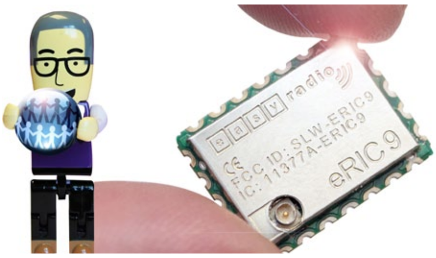
Internally pre-matched on input, and unmatched on output, the CGHV35060MP is a 50-V/60-W broadband GaN HEMT designed for operation from 2.7 GHz to 3.5 GHz. Tested at 3.3 GHz, the miniature device exhibits 14.5 dB gain with 67% drain efficiency, and is optimized for S-Band applications, including: weather, air traffic control, marine, port surveillance, and search and rescue radar applications.

Additionally, both of the new 50-V GaN HEMTs are compatible with industry standard digital pre-distortion (DPD) correction methods to increase amplifier efficiency.

www.wolfspeed.com

LPRS to unveil FCC and IC approved easyRadio wireless controller

LPRS (Low Power Radio Solutions) will be presenting for the first time their FCC and



IC approved platinum eRIC (easyRadio Integrated Controller) modules at the latest Motiv8 Technical Forums. Also on display will be the very robust range of Circuit Design ISM modules and the updated range of IQRF Wireless Mesh Network modules, both available from LPRS.

The approved eRIC9-FCC wireless transceiver module has FCC certification for use in the USA and IC approval for use in Canada as well as all of the European approvals, therefore reducing the complexities OEM's can face when submitting their own products for certification. The modules are available with selectable operating frequencies for world markets in the ISM bands of 868-MHz for the UK and Europe, and 915-MHz for the USA and Canada.

www.motiv8forums.com

65 GHz 1.85-mm attenuators

handle 1-W power

P1dB has announced availability of 1.85-mm, 65 GHz attenuators, designed to handle 1-W of continuous RF power.

The 1.85-mm attenuators are available in 3 dB, 6 dB, 10 dB, 20 dB and 30 dB attenuation values. All attenuator values can be found in the attenuator category page on the P1dB website.

The following 1.85-mm 65 GHz attenuators are available: P1AT-18MF-65G1W-3

(3-dB); P1AT-18MF-65G1W-6 (6-dB); P1AT-18MF-65G1W-10 (10-dB); P1AT-18MF-65G1W-20 (20-dB); P1AT-18MF-65G1W-30 (30-dB).

www.p1db.com

SP7T and SP8T switches

with N connectors operate to 6 GHz

RLC Electronics has introduced the SP7T and SP8T switches with N connectors. These switches operate up to 6 GHz, and are designed for both low power and high power applications (500-W CW at 6 GHz, 2000-W CW at <500 MHz).

In addition to long life, the switches also feature extremely low insertion loss

(0.1 dB to 4 GHz and 0.3 dB to 6 GHz, typically) and VSWR over the entire frequency range, while maintaining high isolation (>80 dB). The switches can be provided in latching or failsafe modes, which is standard on all RLC switches.

The switches are also available with other RF connectors, including SC, HN, TNC and BNC. Control connector options include solder terminals, in addition to special power connectors such as MS and sub-D. Manually controlled versions can be provided if desired.

www.rlcelectronics.com

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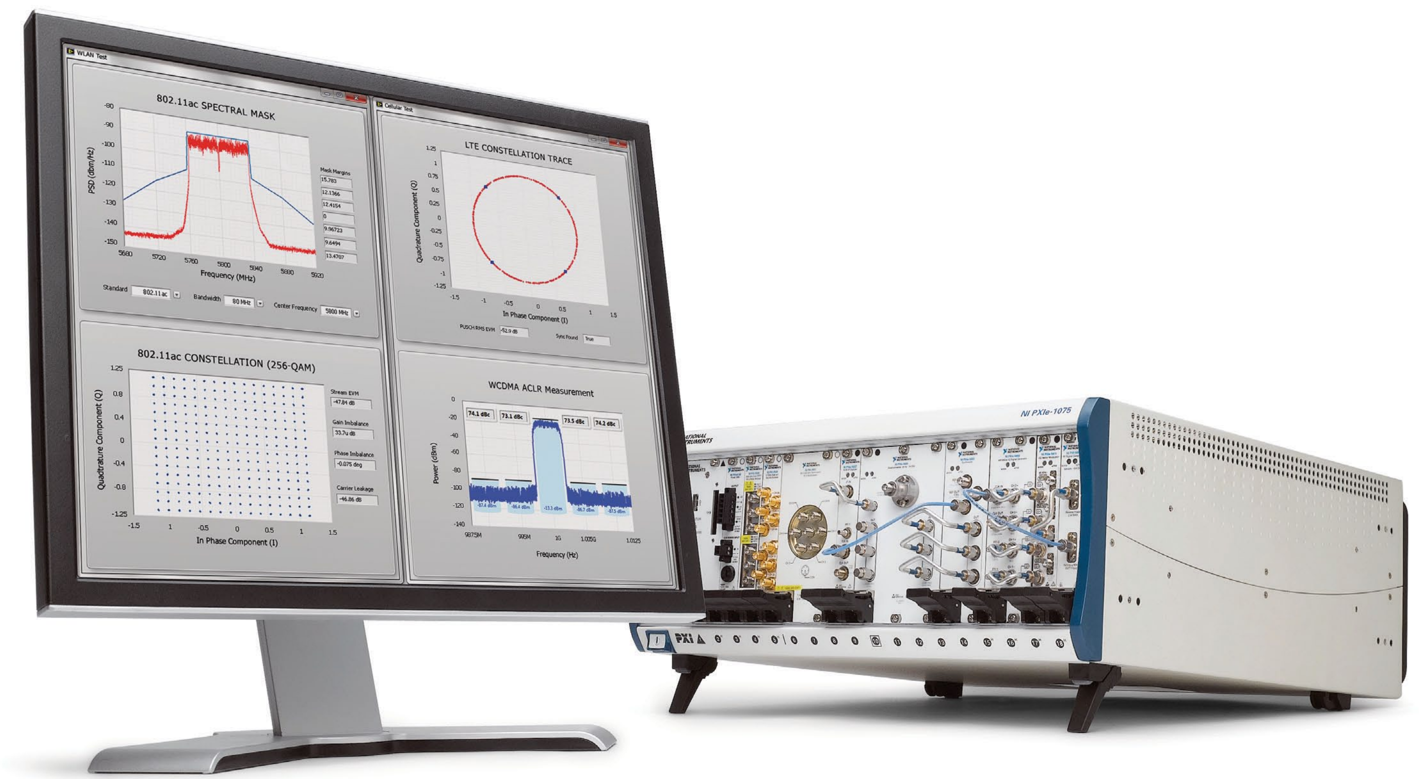

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