

# New-Tech

Magazine

Europe

July  
2016

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**Avoid the pitfalls of obsolescence**

## CREATIVE INNOVATION TECHNOLOGY



PLANNING



PROCESS



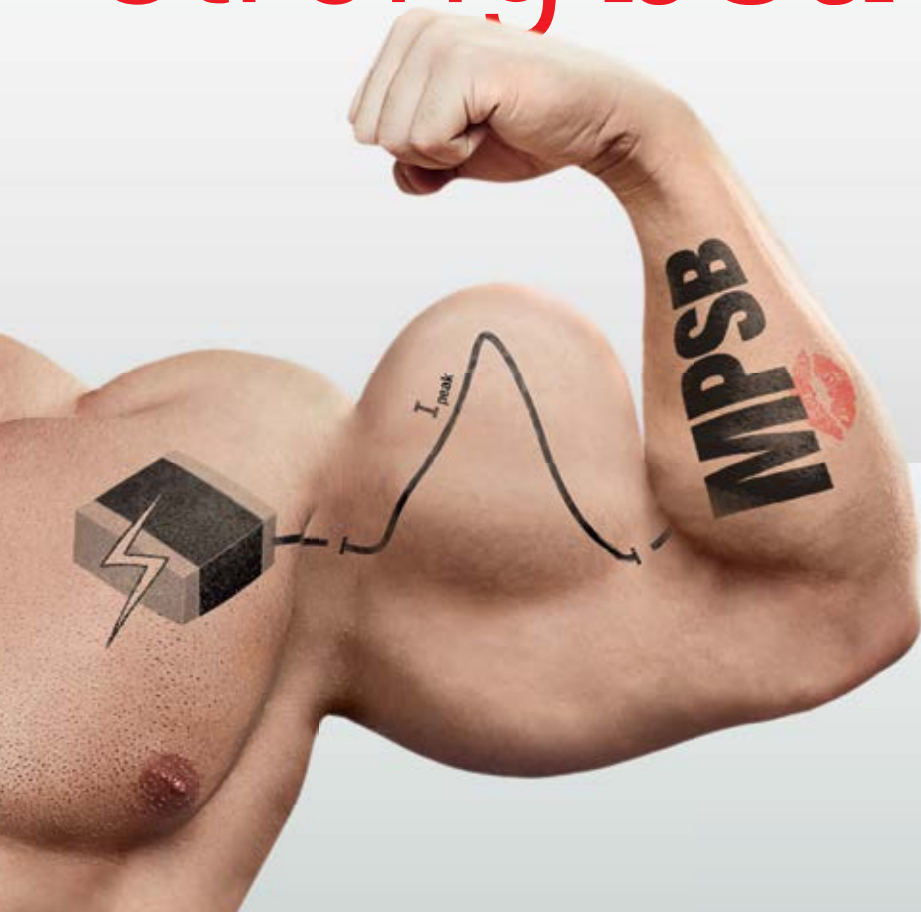
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1812

2220

3312

# ARIS Internet-of-Things Board



**Analog Devices ADXL362**

Ultralow power 3-axis MEMS accelerometer



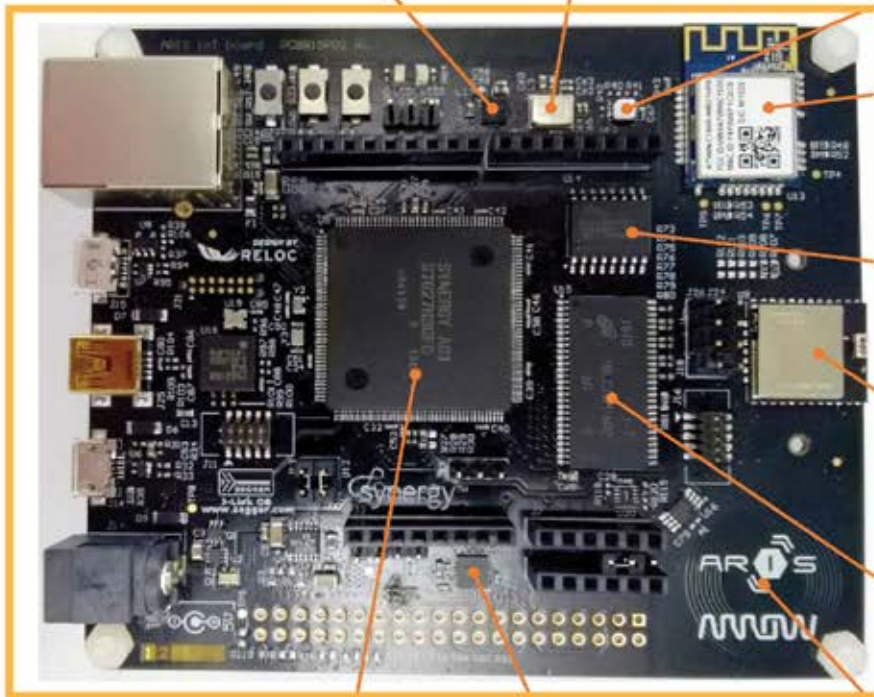
**Analog Devices ADXR290**

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**Micron MT48LC16M16A2**

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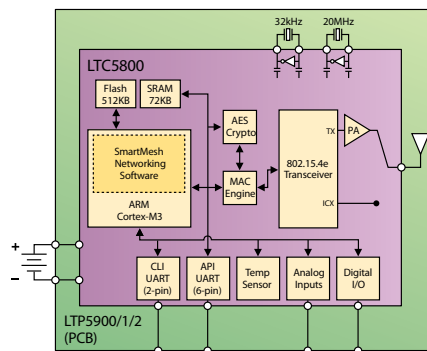
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# New-Tech Europe

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July 2016

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Our specialized target audiences prefer **New-Tech Europe** because they know that our publications are a reliable source of the latest information in their respective fields. Our multidimensional editorials, news items, interviews and feature articles provide them with a full, well-rounded picture of the markets in which they operate - an essential asset for every technological leader striving to stay ahead, make the right decisions, and generate the next global innovation.

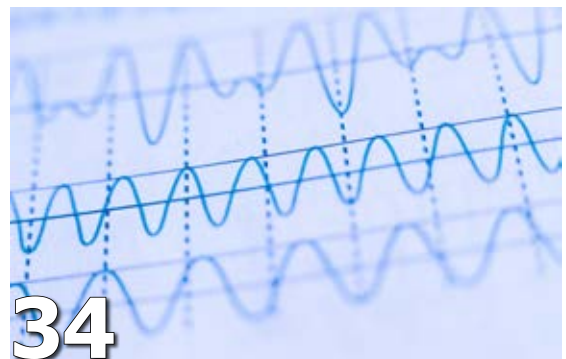
Moreover, as an attractive platform for advertisers from around the world, **New-Tech Europe** has become a hub for bustling international commercial activity. Here, through ads and other promotional materials, Israeli readers obtain crucial information about developers and manufacturers worldwide, finding the tools, instruments, systems and components they need to facilitate their innovative endeavors.

Targeting the needs of both the global and european industries and global advertisers, **New-Tech Magazines Group** constantly expands and upgrades its services. Over the years, the company has been able to formulate a remarkably effective, multi-medium mix of offerings, combining magazine publications with useful online activities, newsletters and special events and exhibitions.



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## APIX now de-facto Automotive SerDes standard with 50 million units shipped

### APIX adoption rapidly accelerating for in-car transmission technology

Inova Semiconductors announces that 50 million devices based on its APIX technology have now been deployed. APIX is used by ten of the leading automotive manufacturers and more than 30 OEMs and tier 1 suppliers, and features in 34 different car models.

Due to the increasing numbers of displays and cameras in today's connected vehicles, the adoption of APIX devices is rapidly accelerating. Originally launched in 2008, the APIX platform had shipped 30 million devices by August 2015; and has now added a further 20 million units, to reach this coveted 50 million milestone in less than one year later.

APIX (Automotive Pixel Link) is a multi-channel SerDes



(serialiser/deserialiser) Technology which was designed by Inova for high-resolution in-car video applications such as infotainment and safety. The latest generation, the APIX3, can establish multiple display links with a bandwidth of up to 12Gbps and supports HD and Ultra HD displays.

The 50 million figure represents the combined sales of this "de-facto industry standard" device by all of Inova's licensed partners, including Toshiba, Socionext, Analog Devices and Cypress Semiconductor.

"APIX's tremendous success has been built upon a number of factors, both technological and commercial," said Thomas Rothhaupt, Director Sales & Marketing at Inova Semiconductors.

## LG Innotek Unveils Flexible Textile Pressure Sensors

LG Innotek announced a development of new concept textile flexible pressure sensors. This sensor senses pressure from the entire surface of the sensor and it is even bendable.

Pressure sensors can measure the level of the external force. Being installed in medical appliances and automobiles to gauge and analyze the pressure, it is used for individual customized service.

Former commercialized sensors are coin shape and made of PCB substrates or PET films, making them difficult to bend or deform. And it was difficult to measure the pressure uniformly from the large area because of its point sensing way. Even it gives feeling of irritation when the sensor touches your body.

LG Innotek's sensors have highly elastic polyurethane material to fit your body comfortably. And its measurement



of face pressure distribution by sensing capacitance change caused by pressure. The company has filed thirteen patents regarding the related technologies in South Korea and secured the product quality for mass production in this year.

The company's development of the textile flexible pressure sensors are flexible, making them suitable for products such as gloves and chairs that come in direct contact with the human body.

This new pressure sensor makes it possible to implement new features by utilizing the pressure information in various areas such as health care and automotive.

In Health-care areas, the sensor helps to improve accuracy of Telemedicine. When the patients wear the device or walk on the carpet, the sensor can detect body balance and acting patterns. The information from the device will [→](#)

# INTEGRATING DESIGN WITH FLEXIBILITY

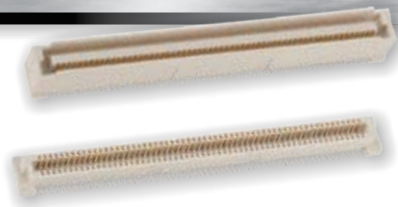
Minitek® Pwr 3.0/4.2mm  
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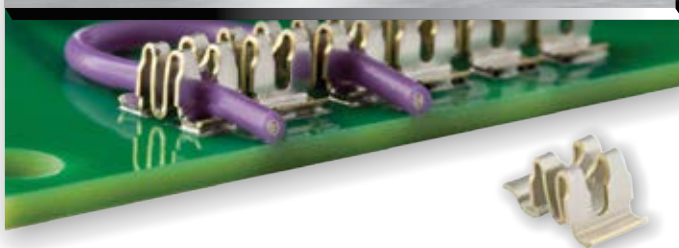
BergStak® 0.80mm - PCIe  
Gen 4 Mezzanine Connector



USB 3.1 Type C Gen 2 Connector



Griplet® Miniature IDC Connector



Industrial Mini I/O





➔ automatically be sent to the medical centre. If you apply this sensor to your sports gear, you can be served more detailed and improved training service for yourself. For example, the sensor detects the pressure of your hands on the golf club as well as the position of your hands. Then, it sends the information to your smartphone to help you find the perfect grip.

You can attach these sensors to automotive for safety and convenience. The sensor understands your posture, body type and weight to automatically correct height of car-seat or pressure of airbag.

If you apply the sensor to a chair, it measures the pressure on the seat and sends the data to you. You can use this information to correct your posture or analyze your study patterns.

The company developed special polyurethane material that is sensitive to the pressure and has great elasticity, and inserted the material between the electronic fibers. When

an external force is applied to the sensor, electric poles inside the fiber detect the deformation to determine the pressure.

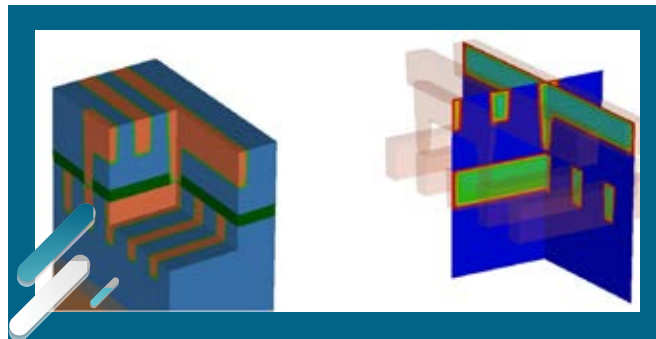
This product is very durable in various environments. It works normally over 240 hours from 40 degrees below zero to 80 above zero. A sensor remains functional even after the average 70-kg man sits on the sensor 100,000 times.

Changhwan Kim, Head of the LG Innotek's R&D Center said, "We tried to break away from the previous method and attempt new methods to develop innovative products." He also said, "We will continue to develop materials and components in various fields to provide new experiences to our customers."

According to BBC Research & Consulting, a global market research institute, the global pressure sensor market is expected to grow from USD 11.5 billion in 2014 to USD 16.3 billion in 2019. The annual average growth rate is expected to be 7.2% between 2014 and 2019.

## Imec and Synopsys Collaborate on Interconnect Resistivity Model to Enable Early Screening of Interconnect Technology Options at Advanced Nodes

World-leading nano-electronics research center imec and Synopsys, Inc. (NASDAQ: SNPS) announced an interconnect resistivity model to support the screening and selection of alternative interconnect metals and liner-barrier materials at the 7nm node and beyond. With the continued scaling of advanced process nodes, the impact of parasitic interconnect resistance on the switching delay of standard cells rises considerably. The new model developed through this collaboration enables the evaluation of interconnect material and process options through simulations in the early stages of technology development, when wafer data is not available, and in the process optimization and integration stages of technology development, where it reduces expensive and time-consuming wafer-based iterations.



"We have already released to our partners a number of sets of model parameters related to various liner/barrier systems for Cu metallization or to alternative metals, such as Ru and Co, which they will use to screen metallization options for next-generation interconnect technologies," stated Dan Mocuta,

director, Logic Device and Integration at imec.

To use the new resistivity model, customers simulate the fabrication of the interconnect structure in 3D using the Synopsys process emulation tool Process Explorer, and then simulate the wire and via resistance in Raphael, the Synopsys gold standard interconnect field solver. This simulation flow accounts for the impact of layout rules, multi-patterning flows, and process-induced 3D features on the resistance of any conductive net in a multilayer interconnect stack, thereby predicting the ➔



➔ influence of material, process and patterning choices on the interconnect resistance at scaled dimensions.

Imec has calibrated the resistivity model to wafer data for Cu, W, Ru and Co interconnects.

"The new resistivity model developed through this collaboration with imec is an important component of our pre-wafer simulation solution to enable our mutual customers to perform

early screening of interconnect technology options at advanced nodes," said Dr. Howard Ko, senior vice president and general manager of the Silicon Engineering Group at Synopsys.

Imec's research into advanced logic scaling is performed in cooperation with imec's key partners in its core CMOS programs including GlobalFoundries, Intel, Micron, SK Hynix, Samsung, TSMC, Huawei, Qualcomm and Sony.

## First Flight Test for Upgraded C-130 Transport Aircraft Successfully Completed

A successful first flight test was recently completed for the C-130H (Hercules) transport aircraft upgraded by Elbit Systems for the Israeli Air Force (IAF), under an agreement signed with the Israeli Ministry of Defense. This initial flight test was the first in a series of flight tests, and future flight tests were agreed upon and will be performed in the coming months.

During the flight tests, the aircraft's systems performance was tested in various modes of operation and in a variety of flight altitudes and conditions, in both day and night. The test demonstrated "out of the window" flight, in which live video was displayed on the head-up display (HUD), presenting flight and navigation data overlaying the real world by using two and three dimensional symbols, enhanced degraded visual landing applications and head tracking capabilities. Airborne refueling was also demonstrated as part of the flight tests.

The IAF pilots were impressed with the new capabilities, and the feedback was positive. They emphasized the contribution to flight safety of the new configuration and the enhanced situational awareness gained in different phases of the flight. They also noted the reduced workload and the improved cockpit communication due to flight in "head out" orientation. The modernization project, which began in 2012, extends the operational life of the aircraft and significantly improves its operational capability, particularly in precision flying, low-level night flight and operations in adverse weather. The modernization not only contributes to improved flight safety but also reduces operating costs by introducing cutting-edge digital systems to replace obsolete analog systems that have



become unreliable and costly to maintain after four decades of intensive service.

Elbit Systems' airborne platform upgrade programs utilize systems, subsystems and applications being deployed on the most advanced platforms, both military and commercial, in order to meet current operational needs and

enable integration of future operational and technology capabilities.

Background Information - Elbit Systems Military Transport Aircraft Upgrades:

IAF C-130:

The first sorties of the upgraded C-130 were reported in October 2015 by the official IAF magazine. During those flights, Colonel Ariel Manor, the Head of the Aircraft Engineering Department, said: "The IAF is basically receiving a new aircraft". The improved planes will possess significantly upgraded operational capabilities, especially in the field of low altitude flight and flying in dark nights.

In January 2014, Elbit Systems announced that it was awarded a follow-on contract to supply the IAF with additional C-130H capabilities which will allow the aircraft to meet the stringent international CNS/ATM (Communications Navigation and Surveillance/Air Traffic Management) standard and operate in commercial airspace.

In December 2012, Elbit Systems announced that it was awarded a contract by the Israel Ministry of Defense to upgrade the IAF's C-130H (Hercules) transport aircraft.

In recent years, Elbit Systems has performed several ➔



→ upgrade projects for military transport aircraft, among them:

Upgrade of the Korean Air Forces' C-130, in which the Company installed various types of advanced electronic systems and also converted the existing analog cockpit into a "Glass-Cockpit" using Elbit Systems' cutting-edge digital flight displays.

Upgrade of the Romanian Air Forces' C-130 transport aircraft, in which the Company installed various types of advanced electronic systems, including those produced by Elbit Systems EW and SIGINT – Elisra. The project was executed in cooperation with local companies in Romania, led by the

Romanian aeronautical industry.

The Brazilian Air Forces' C-95 freighter-wayfarer aircraft has also been upgraded by Elbit Systems' Brazilian subsidiary AEL Sistemas S.A.. The program includes integration of advanced avionics such as digital maps, displays, advanced communication and navigation systems and additional advanced systems, aimed at improving the aircraft's performance and the pilot's survivability. These new, cutting edge avionics systems meet the high standards of newly manufactured aircraft, specifically in flight safety and mission performance in harsh weather conditions.

## Peruvian regulatory authority awards contract to Rohde & Schwarz

In line with its procurement guidelines, the Peruvian Ministry of Transportation and Communications (Ministerio des Transportes y Comunicaciones – MTC) commissioned Rohde & Schwarz to deliver and install a country-wide system for monitoring the frequency spectrum. A total of 30 stationary and mobile units are interconnected and used for frequency management throughout Peru.

In 2015 and 2016, Rohde & Schwarz put one stationary and one mobile measurement and direction finding system into operation at each of 15 different cities throughout Peru. The MTC uses Rohde & Schwarz equipment to regulate and monitor the frequency spectrum, specifically to ensure interference-free reception of radiocommunications services. The system is suitable for use in Peru's different climate zones. It is used in areas ranging from the desert regions on the Pacific to the Andean highlands.

The core of the new system is the compact R&S UMS300 monitoring and radiolocation system from the R&S UMS family of universal monitoring systems. The system features rugged housing for outdoor installation on the antenna mast,



greatly increasing the sensitivity of the system. Installation on masts or roofs also reduces infrastructure requirements. The stations are controlled using the R&S ARGUS spectrum monitoring software, which supports various operating modes. The system offers interactive operation or fully automatic test sequences and can be run in local mode or via remote control.

Effective frequency management prevents or helps identify and eliminate interference in radiocommunications. This is achieved by monitoring the

electromagnetic spectrum and locating the position of suspect signals. Rohde & Schwarz has been globally successful in the field of spectrum monitoring for decades. The company's stationary and mobile system solutions enable regulatory authorities worldwide to perform their jobs. Rohde & Schwarz system solutions fulfill all of the relevant requirements and recommendations of the International Telecommunication Union (ITU) – the United Nations (UN) agency responsible for regulating the use of the frequency spectrum.



## Nanotech "Tattoo" Can Map Emotions and Monitor Muscle Activity

Novel skin electrode is comfortable and has endless commercial and medical applications, says TAU researcher

A new temporary "electronic tattoo" developed by Tel Aviv University that can measure the activity of muscle and nerve cells researchers is poised to revolutionize medicine, rehabilitation, and even business and marketing research.

The tattoo consists of a carbon electrode, an adhesive surface that attaches to the skin, and a nanotechnology-based conductive polymer coating that enhances the electrode's performance.

It records a strong, steady signal for hours on end without irritating the skin.

The electrode, developed by Prof. Yael Hanein, head of TAU's Center for Nanoscience and Nanotechnology, may improve the therapeutic restoration of damaged nerves and tissue — and may even lead to new insights into our emotional life.

Prof. Hanein's research was published last month in Scientific Reports and presented at an international nanomedicine program held at TAU.

One major application of the new electrode is the mapping of emotion by monitoring facial expressions through electric signals received from facial muscles. "The ability to identify and map people's emotions has many potential uses," said



Prof. Hanein. "Advertisers, pollsters, media professionals, and others — all want to test people's reactions to various products and situations. Today, with no accurate scientific tools available, they rely mostly on inevitably subjective questionnaires.

"Researchers worldwide are trying to develop methods for mapping emotions by analyzing facial expressions, mostly via photos and smart software," Prof. Hanein continued. "But our skin electrode provides a more direct and convenient solution."

The device was first developed as an alternative to electromyography, a test that assesses the health of muscles and nerve cells. It's an uncomfortable and unpleasant medical procedure that requires patients to lie sedentary in the lab for hours on end. Often a needle is stuck into muscle tissue to record its electrical activity, or patients are swabbed with a cold, sticky gel and attached to unwieldy surface electrodes.

According to Prof. Hanein, the new skin electrode has other important therapeutic applications. The tattoo will be used to monitor the muscle activity of patients with neurodegenerative diseases in a study at Tel Aviv Medical Center.

The electrode is the product of a European Research Council (ERC) project and received support from the BSMT Consortium of Israel's Ministry of Economy.

## Thales Alenia Space Signs Contract with Orbital ATK to Produce Additional Key Hardware for Upcoming Cargo Resupply Missions to International Space Station

Ficosa, top-tier global provider devoted to the research, development, manufacturing and marketing of high-technology vision, safety, connectivity and efficiency systems for the automotive and mobility sectors, has been awarded four contracts from two American OEMs to produce 8,900,000 units of rear-view mirrors over a period of five years in North America. The total amount of these orders is 510 million dollars (approximately 449 million euros) and means a record number of contracts closed with OEMs in a single year in the North American region.

In the words of Joan Cañellas, Ficosa North America CEO: "These

new projects for rear-view mirrors ensure high production volume and consolidate our business with strategic customers in the North America region, reaffirming our commitment and steady growth in this area".

The new facility in Cookeville wins three of the four contracts. Three orders will be produced in the new facility in Cookeville (Tennessee), which will be the group's most advanced worldwide. These will be the first new projects to go to the new factory, which will kick off its activity in October 2016.

In total, these new contracts will account for 1,700,000 rear-view mirrors annually for a period of five years. The value [➔](#)



→ of this Cookeville production will represent an economic value of 460 million dollars (405 million euros), and will begin in the first quarter of 2018. The Cookeville plant, which is expected to be fully operational later this year, will be a leader in painting and injection processes thanks to the latest technology production equipment. Furthermore, Ficosa North America is currently recruiting 240 new workers for positions including project managers, technicians, engineers, operators and human resources specialists. For its part, the Mexican facility of Salinas Victoria (Nuevo León) will produce a fourth order consisting of 80,000 rear-view mirrors per year for a period of 5 years. This contract comes from an American OEM in the premium segment and is valued at a total of 50 million dollars (43.9 million euros). Production



will start in the last quarter of 2018. Consolidating its presence in North America North America has become, after Europe, the most important market for this multinational corporation, which began operations in this region in 1994 and where it produces mirrors, gearboxes and brake systems. In the United States, Ficosa currently has a commercial office and development center, which employs 35 engineers, in Detroit (Michigan); a production centre in Shelbyville (Kentucky) and a new plant in Cookeville (Tennessee), which when at full capacity will replace the Crossville factory (Tennessee). The two Ficosa plants in Mexico, located in Salinas Victoria (Nuevo León) and Escobedo (Nuevo León), where the company also has an R&D plant, reinforce Ficosa's activity in the North American region.

## ESA commits to next stage of UK revolutionary rocket engine

The UK's Farnborough airshow saw ESA's commitment to the next step in developing a revolutionary air-breathing rocket engine that could begin test firings in about four years. The Synergistic Air-Breathing Rocket Engine, SABRE, is a unique engine designed to use atmospheric air in the early part of its flight to orbit before switching to rocket mode for its final ascent to space.



The UK's Reaction Engines Ltd has been working on SABRE for many years. Success could lead to single-stage-to-orbit spaceplanes. ESA is investing €10 million in SABRE, joining £50 million from the UK Space Agency. Since 2008, ESA has played an important technical management role. In 2010, ESA independently reviewed SABRE's viability, opening the way to UK government investment. Back in 2012, ESA oversaw the testing of a key element - the precooler that chills the hot airstream entering the engine at hypersonic speed. To render the air usable by the engine as oxidiser it needs to be cooled from 1000°C to -150°C in just a hundredth of a second - at the same time as avoiding the formation of potentially dangerous ice. A number of research and development projects followed

through ESA, helping to demonstrate the feasibility of other elements, such as the novel rocket nozzles, air intake design and thrust chamber cooling. ESA also helped to refine the overall SABRE design, looking at how it could be manufactured.

Today saw the contract signing by Franco Ongaro, ESA's Director of Technical and Quality Management, and Mark Thomas, Chief Executive Officer of Reaction Engines Ltd, to commit the next stage of ESA funding towards SABRE.

In about two years, this latest phase should define the configuration of the engine as well as allow the detailed design of the prototype demonstrator engine to begin.

Once the feasibility of the technology was demonstrated via individual elements in 2012, the next step is to build a ground demonstrator engine in 2020, which will bring all these elements together to verify the performance of the complete engine cycle.

The end result of this made-in-Europe technology would be low-cost, reliable and reusable engines, potentially enabling future vehicles that could perform the equivalent job of today's rockets while operating like an aircraft - revolutionising access to space.





## ARCHOS enhances its IoT activities and joins the LoRa™ Alliance

ARCHOS announces it joins the LoRa™ Alliance, the leading technology alliance for the Internet of Things (IoT) and low-power wide area networks (LPWAN). Among the other members of the Alliance, together with its partners, the French consumer electronics manufacturer, intends to deliver additional solutions compatible to the LoRaWAN™ protocol, for a wider ecosystem, in line with organizations' technological demand as well as budget constraint. Headquartered in Paris, ARCHOS is a pan-European technology company that designs, develops and manufactures high-end consumer electronics: tablets and smartphones, connected objects, IoT network.

Unveiled late 2015, its subsidiary PicoWAN provides businesses with a turnkey end to end solution allowing them to focus on their core activities, while achieving significant RoI through their own private and secure network.

PicoWAN is a Low-Power Wide-Area Network (LPWAN), with bidirectional communication capabilities, offering a proprietary MAC (wireless network protocol) optimized for Pico-Gateways, with high connection capacity, sensors including a development



kit, a cloud platform, data analytics services, as well as a customer application. This deep indoor network can be densified at will and is customizable to meet different security layers. By joining the LoRa Alliance™, ARCHOS aims to provide organizations with best of breed technologies compatible to both PicoWAN and LoRaWAN™ protocols, for well-balanced solutions at effective cost.

Benefiting from a long-track expertise in communication protocols and software development, which drove to the introduction of several world premieres in the Google environment, ARCHOS will unveil by the end of the year a complete line of base stations and sensors compatible to the LoRaWAN™ protocol, to service any business looking for a smarter organization, from cities to vertical markets. ARCHOS is currently building a network of affiliated partners and certifying their LoRaWAN™-compatible end devices and sensors. Domains of applications will consist in smart metering, consumption management, processes and costs optimization, in cities and vertical markets.

## Mouser Now Stocking the Hexiwear Open Source IoT Platform from MikroElektronika and NXP

Mouser Electronics, Inc. is now stocking Hexiwear wearable platform products from MikroElektronika. Completely open source and developed in partnership with NXP, the Hexiwear device incorporates a low-power NXP Kinetis K64 microcontroller, Bluetooth® low energy (BLE) and wireless connectivity, and six onboard sensors into a compact wearable form factor for developers who need a complete Internet of Things (IoT) toolkit. With Hexiwear's low-power yet versatile hardware, compatible smartphone and iOS apps, and cloud connectivity, developers can prototype and build devices such as cloud-connected edge nodes, wearable devices, or complex controllers for industrial IoT

applications.

MikroElektronika's Hexiwear, available from Mouser Electronics, is a small and sleek, low-power wearable development kit packed with sensors to help wearers quantify themselves and their environment. The Hexiwear hardware includes a low-power, high-performance Kinetis K64 microcontroller based on an ARM® Cortex®-M4 core, and a Kinetis KW40Z multimode radio system-on-chip (SoC). The expandable board features a 3D accelerometer and magnetometer, 3-axis digital gyroscope, pressure sensor and 600mA battery charger as well as a capacitive touch interface 1.1-inch, full-color OLED display. [→](#)



# Latest News

→ The Hexiwear platform uses FreeRTOS, the Kinetis software development kit (SDK), as well as the Kinetis Design Studio integrated development environment (IDE). In addition, Hexiwear developers can access Kinetis Design Studio source files and complete hardware and software schematics, making the Hexiwear platform truly open source. The platform is designed for expansion with easy access to SPI, I2C, and other serial interfaces for customization. Developers can plug the Hexiwear device into its docking station and add from nearly 200 sensors through MikroElektronika click boards™. Further expanding the functionality of the Hexiwear device, the Hexiwear smartphone app for Android and iOS allows developers to remotely access the readings from all of Hexiwear's sensors, and log the data into a cloud. Hexiwear is available from Mouser Electronics as a single unit or as part of the Power User Pack, which includes the docking station. Also available are Hexiwear color packs — featuring a wristband, soft cover, and front mask — and a standalone docking station with onboard programmer



and support for up to three click boards. With the Hexiwear platform, developers can combine the style and usability of high-end consumer devices with the functionality and expandability of sophisticated development platforms, making Hexiwear the ideal form factor for IoT edge node and wearable markets. With its broad product line and unsurpassed customer service,

Mouser caters to design engineers and buyers by delivering What's Next in advanced technologies. Mouser offers customers 22 global support locations and stocks the world's widest selection of the latest semiconductors and electronic components for the newest design projects. Mouser Electronics' website is updated daily and searches more than 10 million products to locate over 4 million orderable part numbers available for easy online purchase. Mouser.com also houses an industry-first interactive catalog, data sheets, supplier-specific reference designs, application notes, technical design information, and engineering tools.

## ZF Invests Further in Radar Facility in Brest, France

Peter Austen, Global Portfolio Director, Driver Assist Systems at ZF TRW said: "Radar is a fundamental part of the automated driving equation. When combined with camera, intelligent control units and actuators, it can help to enable partially automated driving functions such as Highway Driving Assist with automated lane change. Together with our advanced camera systems, our AC1000 family is an ideal solution to meet Euro NCAP requirements up to 2020."

ZF's radar systems are designed, assembled and tested at Brest which currently occupies approximately 2200 square meters. The facility produces around 300,000 units per year, and the company anticipates that this figure will exceed one million by 2020.

Mickael Leon, plant manager at Brest, added: "Brest has been



our global centre of excellence for radar systems since the turn of the century. Our ongoing investment in the plant shows our commitment to the technology – one where we anticipate significant volume increases as the market adoption of active safety and automated driving systems continues to accelerate. Furthermore, we have an exceptionally skilled workforce in Brest which has increased by nearly 30 percent over the last 18 months. We

are investing further in our engineering resources as this area of the business continues to expand."

ZF TRW has designed and developed radar in Brest since 1999 and started production with its first generation system in 2002. Since then, the company has launched radar on multiple global passenger car and truck platforms, and with the AC1000 family it is entering its fifth generation.

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# Electromagnetic compatibility: The major considerations when working with switching power supplies

> Don Li, CUI Inc

In this article we examine the rules and regulations governing control of EMI and the types of noise generated by switching power supplies to provide basic guidance for EMI mitigation, whether installed in other equipment as part of a larger system or in stand-alone applications.

## Switching Power Supplies and EMC Standards

“Switching power supply” is a generic term that describes a power source with a circuit to convert dc to ac voltages that can be further processed into another dc voltage. Switching power supplies can be categorized as ac-dc power supplies (ac input) or dc-dc converters (dc input) since both incorporate dc to ac conversion for voltage change. By virtue of

their inherent design characteristics, switching power supplies generate electromagnetic interference composed of signals of multiple frequencies. The dc-dc converter converts the input dc voltage to an ac voltage that can be stepped up or down via a transformer. Ac-dc power supplies also utilize high frequency circuits for voltage conversion. However, the internal ac voltage in either case is not a pure sine wave but frequently a square wave that can be represented by a Fourier series that consists of the algebraic sum of many sine waves with harmonically related frequencies.

These multiple-frequency signals are the source of conducted and radiated emissions which can cause interference to both the equipment in which the power supply is installed

and to nearby equipment which may be susceptible to these frequencies.

## Laws, Regulation, and International Cooperation -

The electro-magnetic spectrum has been widely used for broadcasting, telecom and data communications through intentional emissions of electro-magnetic fields. In order to protect the electromagnetic spectrum and ensure compatibility of collocated electrical and electronic systems, regulatory bodies have established standards to control conducted and radiated EMI in electronic equipment. In Europe, one of the main standards is CISPR 22, adopted by the majority of the European Community, while in the US the FCC is the regulatory body. The FCC’s Part 15 rules categorize digital

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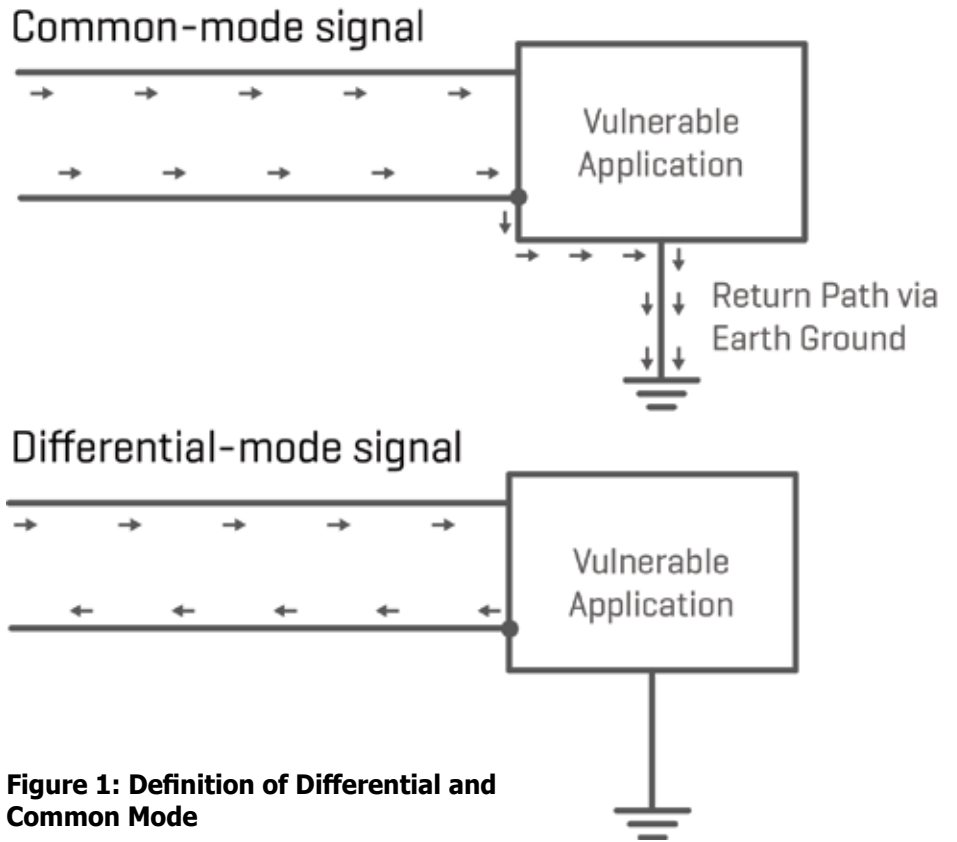


electronic equipment into Class A (designated for commercial, industrial, or business environments) and Class B (designated for use in a residential environment). Emission standards are more restrictive for Class B devices since they are more likely to be located close to other electronic devices used in the home.

CISPR 22 regulations have been harmonized with the FCC standards, and, with minor exceptions, can be used to certify digital electronic equipment. Harmonization requires that the same standard be used for both conducted and radiated emissions. Measurements made above 1 GHz must be made in accordance with FCC rules and limits as CISPR 22 has no specified limits for frequencies above 1 GHz and conducted / radiated emission limits specified in FCC Part 15 and CISPR 22 are within a few dB of each other over the prescribed frequencies.

### EMC Testing and Compliance

EMC testing and compliance is

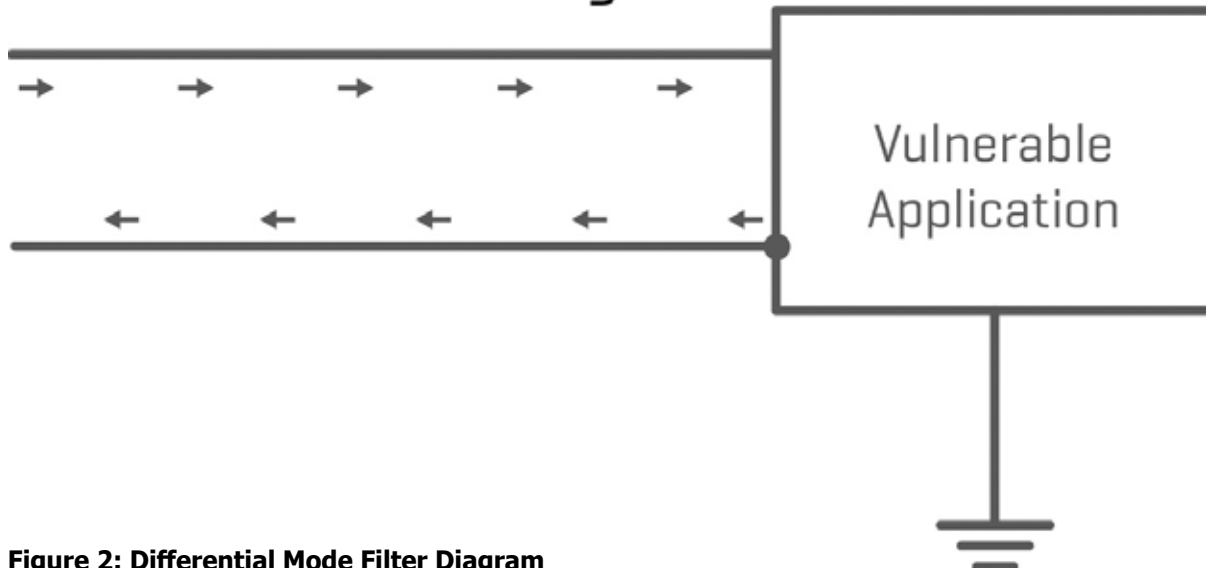


**Figure 1: Definition of Differential and Common Mode**

performed according to the test procedure defined by the ANSI standard , which does not include either generic or specify product

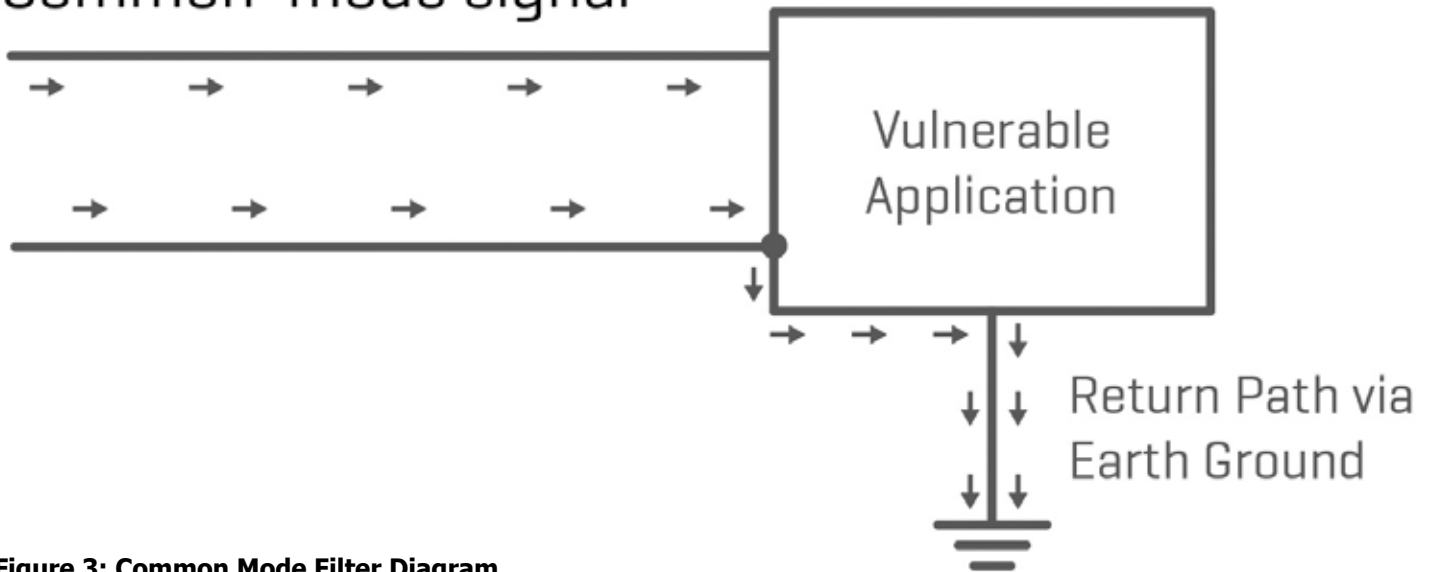
related limits on conducted and radiated emissions. It is worth noting that testing is done with the entire system, not just the power module.

### Differential-mode signal



**Figure 2: Differential Mode Filter Diagram**

# Common-mode signal



**Figure 3: Common Mode Filter Diagram**

Even external power supplies that are in compliance with the regulations as a standalone product need to be tested with the end-system.

## EMI/EMC Fundamentals Sources and Associated Frequencies

EMI can first be categorized as transient or continuous interference. Transient EMI arises when the source emits a short duration pulse of energy rather than a continuous signal. Sources can include switching electrical circuitry, as well as electrostatic discharge (ESD), lightning, and power line surges. Repetitive transient EMI can be caused by electric motors, gasoline engine ignition systems and continuous digital circuit switching.

Continuous interference can be further subdivided by frequency band. Frequencies from a few tens of Hz up to 20 kHz are classified as audio, whereas radio frequency interference (RFI) occurs in a frequency band from 20 kHz and above (the level is increasing as new technologies

emerge).

### EMI Coupling

Coupling occurs either via conduction, radiation or induction. Conducted EMI emissions are measured up to 30 MHz. Currents at frequencies below 5 MHz are mostly differential mode, while those above 5 MHz are usually common mode.

The differential mode current is the expected current on a two wire pair, i.e., current leaves at the source end of the line and comes back on the return side of the line. The noise is measured on each line with respect to a designated reference point. Differential mode currents flow between the switching supply and its source or load via the power leads and these currents are independent of ground.

Common mode currents flow in the same direction in or out of the switching supply via the power leads and return to their source through ground. In many cases, common mode noise is conducted through parasitic capacitance in the circuit but

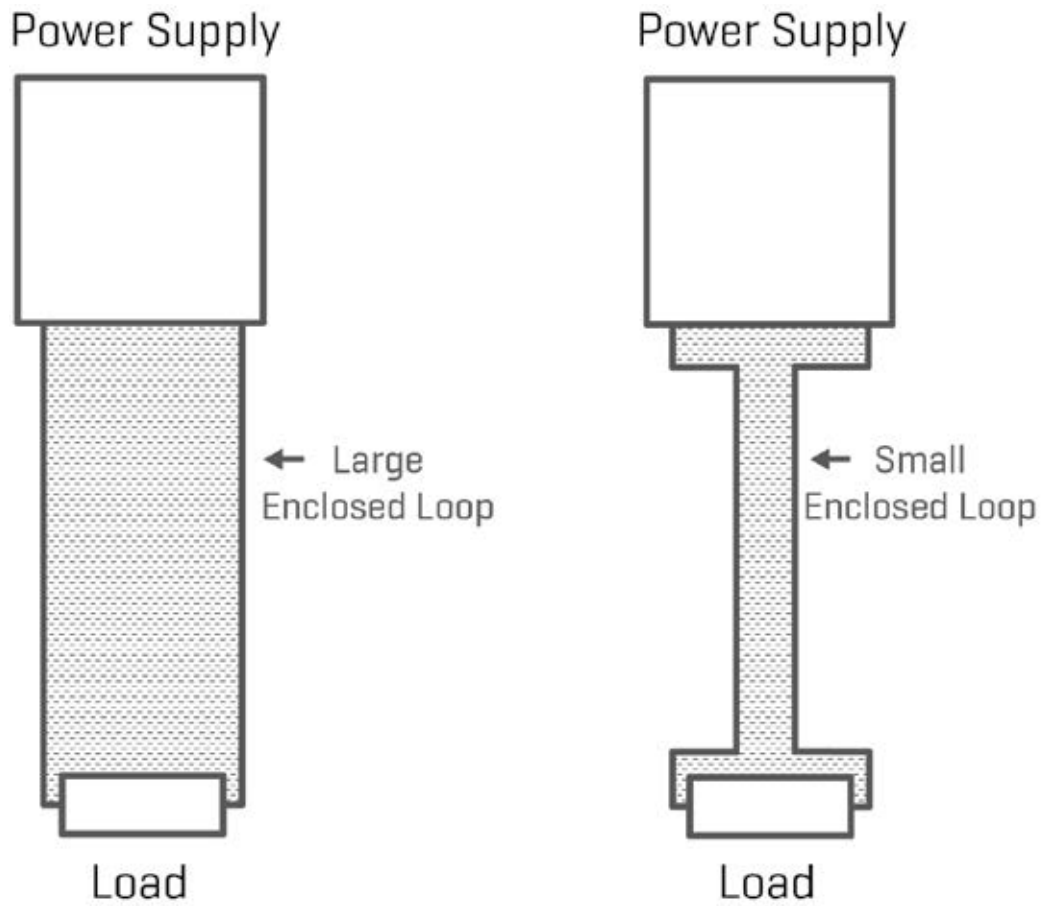
can also flow through the capacitance between the case and ground.

Radiated coupling occurs when source and receptor (victim) act as radio antennas. The source radiates an electromagnetic wave that propagates across the open space between the source and the victim and is received by the victim.

Inductive coupling (either electrical or magnetic) is rare relative to conductive or radiated coupling and occurs where a short distance separates source and receptor.

Electrical induction occurs when a varying electric field exists between two adjacent conductors and causes a change in voltage across the gap. Whereas magnetic induction occurs when a varying magnetic field exists between two parallel conductors, inducing a change in voltage along the receiving conductor.

Characterization of the EMI problem requires understanding of the interference source and signal, the coupling path to the victim and the nature of the victim, both electrically



**Figure 4: Reduced Antenna Loop Area to Reduce Radiated Emissions**

and in terms of the significance of the malfunction. The risk posed by the threat is usually statistical in nature; so much of the work in threat characterization and standards setting is based on reducing the probability of disruptive EMI to an acceptable level rather than its assured elimination.

### Conducted EMI

To effectively mitigate conducted emissions, it is imperative to address the differential mode noise and common mode noise separately.

Differential mode noise can usually be suppressed by connecting bypass capacitors directly between the power and return lines of the switching

power supply. The power lines that require filtering may be those located at the input or the output of the switching power supply and the bypass capacitors on these lines need to be physically located adjacent to the terminals of the noise generating source to be most effective.

Attenuation of differential mode currents at lower frequencies around the fundamental switching frequency of the noise generating source may dictate that a much higher value of bypass capacitance is required, meaning a ceramic style capacitor would not be suitable. Ceramic capacitors up to 22  $\mu\text{F}$  are only suitable filtering across the lower voltage outputs of switching power supplies

but not for those supplies where 100 volt surges can be experienced. Instead, electrolytic capacitors, which have a high capacitance and voltage rating, should be employed.

To suitably attenuate differential mode current both at the lower fundamental switching frequency as well as at the higher harmonic frequencies, differential mode input filters usually consist of a combination of electrolytic and ceramic capacitors.

Further suppression of differential mode currents can be achieved by adding an inductor in series with the main power feed to form a single stage L-C differential mode low pass filter with the bypass capacitor.

Conversely, common mode conducted



currents are effectively suppressed by connecting bypass capacitors between each power line of the switching power supply and ground. These power lines may be at the input and/or output of the switching power supply.

Further suppression of common mode currents can be achieved by adding a pair of coupled choke inductors in series with each main power feed. The high impedance of the coupled choke inductors forces common mode currents through the bypass capacitors.

### Radiated EMI

Radiated EMI can be suppressed by reducing RF impedance and reducing the antenna loop area. This is achieved by minimizing the enclosed loop area formed by the power line and its return path.

The inductance of a printed circuit board track can be minimized by making it as wide as possible and routing it parallel to its return path. Similarly, because the impedance of a wire loop is proportional to its area, reducing the area between the power line and its return path will further reduce its impedance. Within printed circuit boards this area can be best reduced by placing the power line and return path one above the other on adjacent printed circuit board layers. Reducing the loop area between a power line and its return path not only reduces the RF impedance, but it also limits the effectiveness of the antenna because the smaller loop area produces a reduced electromagnetic field.

Furthermore, a ground plane located on the outer surfaces of the printed circuit board significantly suppresses radiated EMI, particularly if located directly below the noise-generating source.

And to further reduce radiated noise, metal shielding can be utilized, placing the noise-generating source within a grounded conductive housing, and interfacing to the clean outside environment is via in-line filters. Common mode bypass capacitors would also need to be returned to ground on the conductive housing.

### System-Level EMI Mitigation Techniques

Although most switching supplies are designed to meet applicable EMI standards as stand-alone modules, the system itself needs to be designed to generate a minimum EMI profile to meet regulatory standards. Specific areas in the system design that are candidates for EMI mitigation practices include the signal lines, printed circuit boards (PCB), and solid state components.

### Summary

Switching power supplies generate EMI because of their inherent design. Domestic and international regulatory bodies regulate these emissions through promulgation of rules and standards such as the FCC Part 15 rules and the CISPR 22 standard.

Power modules are one of many components within a system and EMI requirements, both radiated and conductive, apply to an overall electronic system. Since the EMI requirements apply to the overall system, significant effort must be expended on system design to limit noise.

Further information on EMI mitigation in power modules, including an application note, is available from the ac-dc power supplies and dc-dc converters pages of the CUI website.

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## Chromebook: The vanguard of the new mobile revolution

### > Arm

ARM-Android ecosystem transforming large-screen compute in ways that echo smartphone experience

Think back to 2009, as the Android smart phone era dawned and the mobile computing world was changed forever. Up to that point, the utility of a mobile phone was still voice communications. Data, location and apps-store services were rudimentary, if available at all.

But the introduction of the Android operating system, coupled with the low power-consumption, size and cost benefits of the ARM architecture, began to transform the very definition of mobile phone design and user experience.

This transformation was highlighted by:

- Longevity: Advances in low-power design and battery life put a day's worth of always-on computing in consumers' hands.
- Enhanced utility: The availability of

rich graphics and media content on portable devices helped make feature phones an integral tool in consumers' daily lives.

- Services: The ease of apps development and the introduction of app stores, such as Google Play, brought about a significant increase in number of apps and apps developers. It simplified the consumer experience in many ways, including eliminating the need to install CDs. In the process, such services revolutionized the broader software world.

- Form factor: Thin, light and quiet form factors coupled with good performance, device/data security and highly responsive devices continue to influence systems design.

- Connectivity: Wireless connections (cellular, Bluetooth and WiFi) were integral to the utility of smart phones, connecting users to a vast world of apps and services.

Since 2009, each smart phone generation has delivered improved performance at the same or lower power consumption, more robust user experiences and richer apps. Thanks to relentless ARM ecosystem innovation, each new generation's premium phone migrated over time to different price points, opening new computing experiences to more (and sometimes previously smart phone-less) consumers. The Android-ARM ecosystem has helped proliferate computing throughout the world.

In concert with this hardware revolution, a software ecosystem has created indispensable apps and enabled software developers to reach new levels of creativity. The smart phone has become, for billions of people, an indispensable device in daily life, helping users connect and communicate, learn and share and become more productive and efficient at work and at home.

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Software and hardware entrepreneurs around the world have extended the Android smart phone and apps ecosystem into productive and clever new applications in a variety of industries, from construction to industrial, entertainment, mining and medical, education and the physical sciences. In short, there is arguably not a single industry that hasn't benefitted from this innovation.

Indeed, this ecosystem, coalescing around the Android operating system and the ARM architecture, has created profound change:

- In 2009, 180 million smart phones shipped; today we're shipping 1.5 billion smart phones annually.
- The related silicon revenue is \$26 billion annually.
- On the software side, more than 1.5 million apps have been developed.
- In the first quarter of 2016 alone, consumers downloaded 11 billion items from the Google Play store.

## New era dawns

This mobile ecosystem, echoing 2009, is now fundamentally influencing large-screen compute, including Chromebooks. Soon, users will enjoy Android apps on Chromebook, bringing the mobile experience, the diversity and innovation of the Android ecosystem and ARM technology to large-screen devices.

This is occurring in part because consumers now demand more of their smart phone "mobile" experience on those large-screen devices - experiences including the ones mentioned above (long battery life, rich graphics and media content, widespread apps availability and so forth). The ARM ecosystem will help deliver technology to enable that.

Since their introduction in 2011, Chromebooks have set a foundation of speed, simplicity, security and shareability, and Chrome has established itself as the best operating

system for the web. Android apps build on top of that foundation to provide additional functionality across productivity, entertainment, games, social and messaging. With the addition of Android, Chrome is now on par with other operating systems, erasing the features gap with traditional laptop operating systems. With Google Play, Chromebooks get one of the fastest growing, mobile-first app ecosystems in the world. In short, consumers will soon begin to engage with big-screen devices in ways that echo the satisfying and productive experiences they have enjoyed on their smartphones.

For developers, the availability of Android apps on Chromebooks creates new markets. It will open new vistas for developers to push their apps into the large-screen form factor and to develop new sets of apps and use cases that leverage newer form factors and system performance. The scalability opportunity is clear. Microsoft, for example, is supporting Office productivity suites on Android.

## System design implications

Android apps on Chromebooks will significantly influence form factor design. OEMs, therefore, should consider how:

- Convertible form factors and Android apps deliver a full tablet experience in a clamshell device.
- The convertible form-factor encourages users to hold the device much more than traditional clamshell, which makes the materials much more prominent and important to the experience and to design considerations.
- Weight and thickness determine whether the user is using the device in a tablet mode and therefore getting the full potential of Android.
- Keyboard and mouse input will

influence consumers' use cases.

ARM has worked closely with its partners to deliver compelling designs on Android devices—thin, sleek devices that offer long battery life and compelling performance such as:

- Game console-quality graphics performance on 2.5K and 4K resolution screens.
- Support for 4K video content.
- Support for multiple camera sensors with resolutions and frame rates more typical of a digital SLR.

## Performance gains

What can OEMs expect on the performance front? If the history of mobile innovation is any guide (and it is), they can expect a lot. Stretching back to the dawn of the Android smartphone era in 2009, with the first single-core ARM Cortex-A8-powered device, CPU performance-per core has jumped 15x since then, while multicore performance has soared 49x.

These types of technical benefits have helped the software ecosystem flourish in the past decade, making ARM ubiquitous with Android, to the point where

- 97% of all games are ARM native.
- 40% of top 100 apps games are ARM native only.
- 89% apps & games target the ARM architecture.

This success is tied to Android apps running natively on ARM. As the smart phone industry started to ramp, it was only natural for Android developers to write to the hardware that was powering the smartphone revolution. As the market opportunity exploded, other architecture companies wanted to exploit the market growth.

## Native advantage: ARM

But for other architectures to try to be competitive, they have had to

translate the ARM native code into their own instruction forms within their architectural constraints. This comes at a cost in terms of performance, energy use and user experience. Efficiency, the work done per unit of energy, is heavily impacted where translation between architectures is required.

A third of the top 200 Android apps need their code to be translated at run-time to execute on non-ARM-based devices. This can translate to an unpleasant user experience (as well as cost engineering time and effort). For example, searching for a text string in a PDF document can take four times longer on a non-ARM-based device. These sorts of slowdowns can lead to additional re-engineering time and effort. However, the good news is that nearly 1.6 times the number of native apps runs on ARM-based devices than any other mobile processor.

As Android moves onto Chromebook, this binary translation of non-ARM apps will continue. On ARM-based Chromebook hardware, Android runs on top of the same ARM Linux kernel as Chrome OS and uses Chromes OS to filter user events such as mouse, keyboard and screen updates through to the Android OS. If the underlying hardware is not ARM-based, the version of Android that runs on the Chromebook will still

need to incorporate binary translation technology. The Chromebook will experience the same performance degradation and increased power consumption because of the code translation required.

The advantage of Android apps, most of which run natively on ARM, can be seen in solutions such as Pocket Code and Lightbot. These are very popular apps for educators, who tend to favor Chromebooks, but to date the apps have been available only on Android. With Android app ecosystem being enabled on Chromebook, a new world of solutions opens for users. And since Pocket Code and Lightbot are written natively on ARM, users won't have to worry about performance degradation or increased power consumption by using these apps on ARM.

## Conclusion

The same ARM ecosystem innovation that changed the mobile world in 2009 is at work again, this time in Chromebooks. Android on Chrome eliminates the features gap between clamshells and traditional laptop operating systems and unlocks a vast new potential for designers and apps developers. At the same time, it provides a fresh opportunity for the ARM ecosystem to contribute to and influence the large-screen compute segment, bringing with it expertise

and experience in low-power design and high performance compute and graphics capability.

For consumers, it means those rich mobile applications they've embraced in the smartphone and tablet form factors are moving to large-screen devices, where they will transform the traditional laptop experience.

For OEMs, the benefits of the ARM ecosystem coupled with Android on Chrome mean new and compelling design opportunities to deliver robust experiences in thin, sleek and low-power form factors for new users.

For developers, Android on Chrome unlocks new markets and scalable opportunities for use cases based on the form factor, performance and low-power attributes that the ARM ecosystem is delivering to OEMs.

Large screen mobile devices are expected to grow from 230 million units in 2014 to 330 million units in 2019, according to the research firm IDC. That's a healthy rate that echoes the growth that forecasters anticipated in 2009 when the ARM ecosystem and the Android apps developer community joined forces to change the mobile world. Seven years later, that ARM-Android partnership is transforming the mobile world again.

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## DACD Solution Simplifies Smart LED Lighting Design

› John Wiggernhorn, Fairchild

Smart LED lighting systems in various fields - from home to commercial to public applications - are taking off at great speed. The U.S. market researcher IHS projects over 160 Million smart lighting systems to be sold in commercial applications this year, with a CAGR of over 40 percent through 2018. This is due to their inherent advantages, such as low power consumption, dimmability and choice of color, flexibility in size and easiness of combining to form LED strips. These capabilities are key for creating attractive lighting solutions according to the customers' architectural guidelines and preferences. One frequent problem that industrial lighting designers have when they are developing smart LED solutions is not having the necessary power supply expertise, which was not a key competency before LED

lighting took off.

Another difficulty for inexperienced LED lighting designers arises when systems have to be designed for various wattage levels. The complaint heard most often is that it takes lighting product designers too long to respond to different wattage specifications because each single solution tends to be customized. This implies devising different semiconductor controller circuits, along with different magnetic components. The result is that LED solutions for industrial and commercial lighting systems tend to be expensive. The commonly used driver solution in LED lighting products is based on switched mode power supply (SMPS) technology. Although well proven and reliable, SMPS-based drivers do not offer the advantages of LED lighting engines with newer Direct AC Drive (DACD) technology.

### The Flicker Problem

The DACD advantages, such as lower cost, smaller form factor, much higher performance and a longer system lifetime are compelling. Yet DACD has been slow to take off, particularly in the commercial and industrial market segments. A key reason is the issue of flicker. Flicker occurs when the AC line to supply the LED system goes through the zero crossing points of its sinusoidal trajectory at twice the powerline frequency of 100/120 Hz. This means the supply voltage momentarily drops to zero and the LEDs switch off, which sometimes causes the effect of a perceptible flicker.

Flicker is not always an issue, but it can be problematic for offices, schools, stores and other brightly lit commercial and industrial spaces, as well as for live video recordings and smartphones.

## Flicker Specs and Solutions

The basic solution to the often disturbing flicker effect is to keep LEDs excited during the AC line voltage drops. This seems like an easy enough remedy. But the practical solutions can be problematic. Thus, up to now, DACD suppliers have used traditional approaches of energy storage to keep the LEDs excited. While this basically solves the flicker effect, it also causes distortion to the input line current waveform. This impacts the power factor (PF) and total harmonic distortion (THD) performance of those LED lighting systems.

This is a particular problem in those industrial and commercial lighting products that have to meet the accepted guidelines for PF and THD performance. Typical specifications require a PF of 0.9 or greater. THD

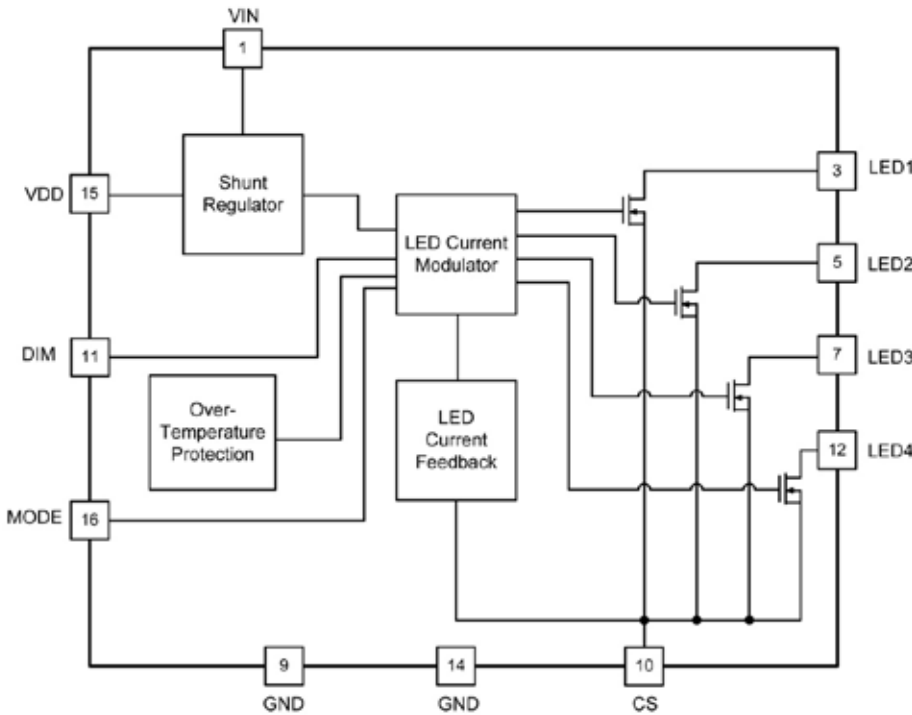
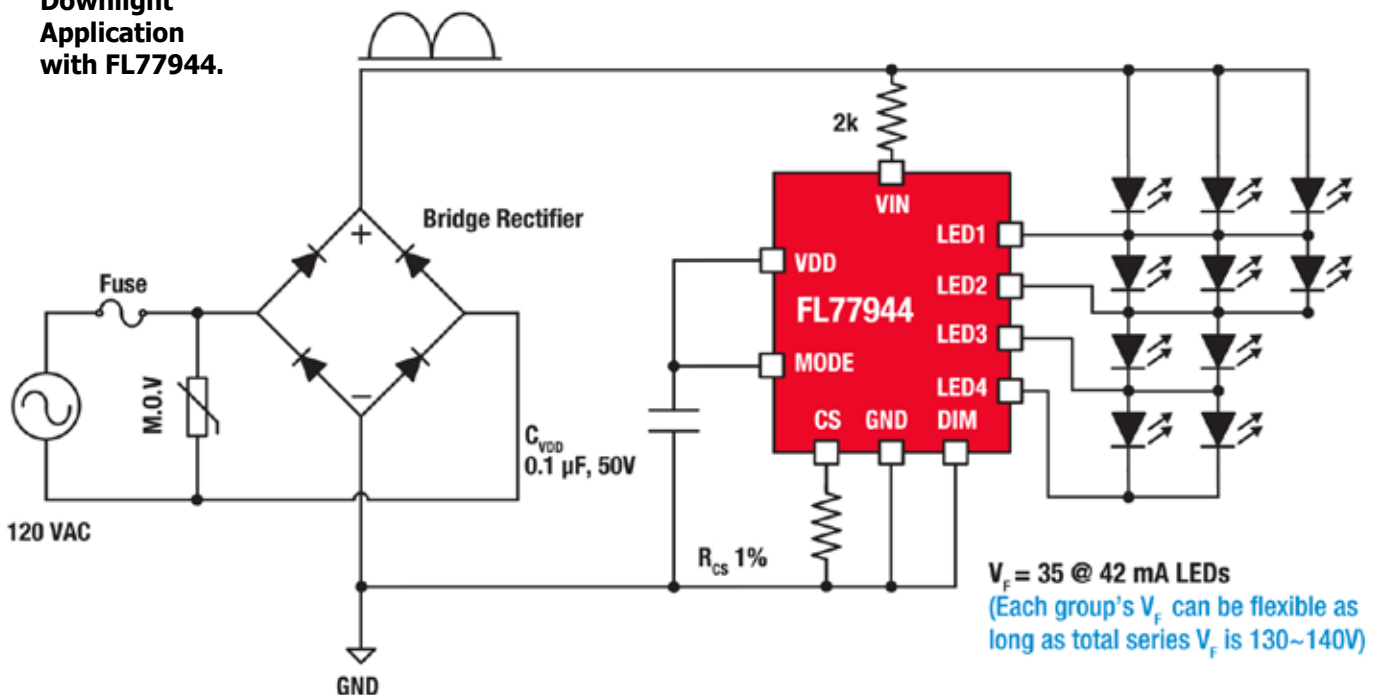


Figure 1. Simplified Block Diagram of the LF77944 LED Driver.

Figure 2. 12-W LED Downlight Application with FL77944.

## Down Light 12W LED Driver Using FL77944



## 22W LED Driver using FL77944

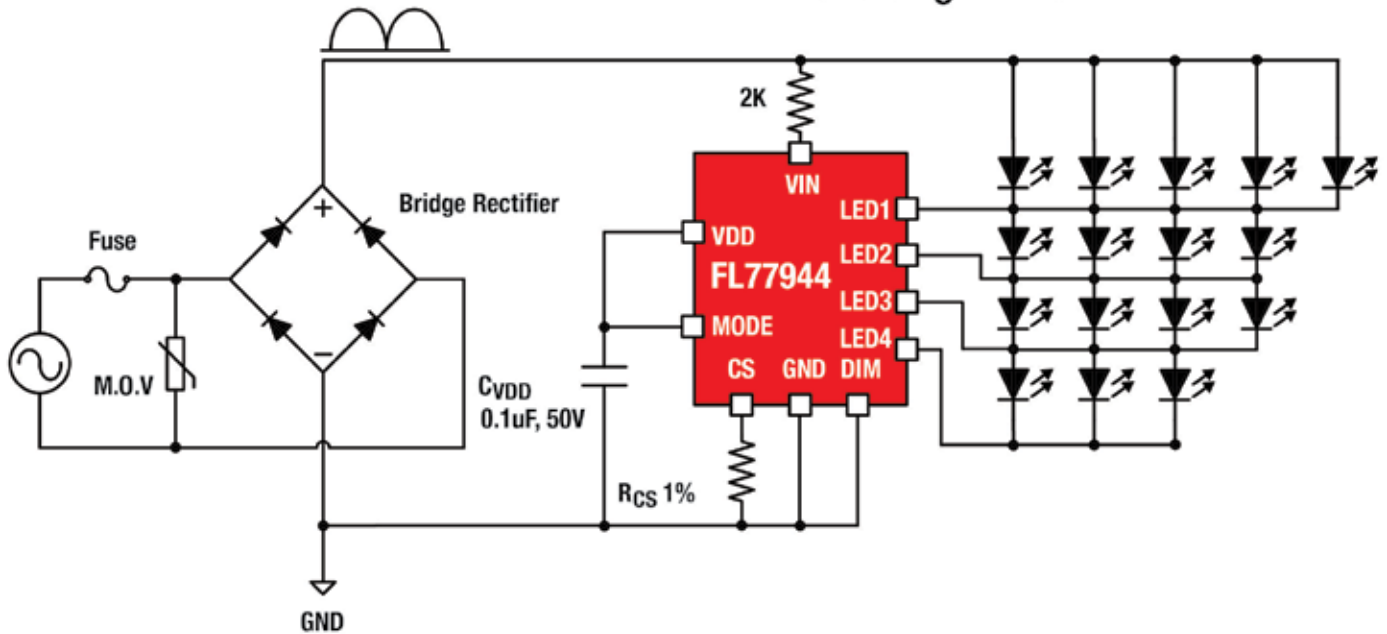


Figure 3. 22W LED Driver Circuit with LF77944.

typically needs to be less than 20 percent. There are currently no standards governing flicker. Most manufacturers and customers accept the US ENERGY STAR recommended spec for calculating the flicker index. It suggests a figure of 0.15 or lower to be optimal since values below 0.15 are considered imperceptible. As a consequence, lighting manufacturers typically aim to achieve or improve on this limit.

### Direct AC Driver for Superior Performance

All these problems are now being addressed, as Fairchild, a leading global supplier of high-performance semiconductor solutions, recently introduced its new FL77944 LED Direct AC Drive family of solid-state LED lighting solutions. The FL77944 and the IP provided by Fairchild enable a tunable flicker index below 0.10 while maintaining PF > 0.9 and THD

< 20%. LED lighting manufacturers can use these integrated driver circuits to easily scale power conditions. This will enable them to create smart and scalable LED systems that are smaller, have higher performance and reliability, offer size advantages and a lower component count as well as longer lifetimes compared to the traditional SMPS approach.

The FL77944 is a cost-effective integrated circuit with everything manufacturers need for smart LED lighting products so they can accelerate time-to-market and focus on differentiating features, rather than spending precious time cobbling together disparate components.

The new Fairchild FL77944 DACD solution offers:

- Comprehensive dimming capabilities. It enables all the dimming capabilities required for smart lighting products, including phase-cut dimming

as well as analog and PWM dimming, which is key for wirelessly connected lighting.

- Scaling for higher power applications. The Fairchild FL77944 can scale upwards to suit higher power applications well above 120W. This is simply done by wiring products in parallel. It also reduces the number of different ICs that lighting manufacturers need to keep in inventory.

- Elimination of electrolytic capacitors. System designs with the FL77944 can eliminate the electrolytic caps, transformers and inductance coils. This reduces both the bill-of-materials (BOM) costs and the overall complexity compared to designs using SMPS.

- Reduced board space. Locating the controller IC on the same PCBs as the LEDs, aided by the absence of electrolytic caps, transformers and inductance coils enables more





**Figure 4. LED Board based on the LF77944.**

compact lighting designs.

- Tunable Flicker reduction. With the addition of external energy storage capacitors, the flicker index can be tuned to application acceptable levels while meeting  $PF > 0.9$  and  $THD < 20\%$ .

- Improved reliability and lifetime. LED products based on the FL77944 should be more reliable and last significantly longer than SMPS-based products as there are fewer points of failure. Eliminating electrolytic capacitors removes the

most common source of failures in SMPS-based products.

To sum up the FL77944 value proposition: It is the simplest, most cost effective lighting solution currently on the market. It provides best-in-class light quality that meets high PF and low THD requirements, along with various dimming principles. It is suited for indoor and outdoor applications, including down light, tube light, high bay, flood light and street light systems.

### Evaluation Board Now Available

At the recent PCIM Europe trade fair (10 - 12 May 2016 in Nuremberg, Germany) Fairchild also demonstrated the FEBFL77944 evaluation board for systems designers. Visit Fairchild's LED Direct AC Drive blog, lighting solutions guide and Direct AC Drive website for detailed product information, datasheets and evaluation boards.

### Author

John Wiggenhorn is General Manager, Offline Power Business Unit, at Fairchild Semiconductor.

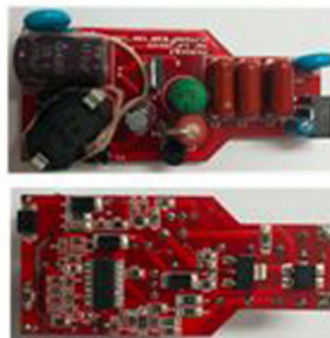
### Direct AC Drive

BOM count excluding LEDs = 23



### SMPS

BOM count excluding LEDs = 62



**Figure 5. Minimum component count (excluding LEDs) 23 vs 62...one board vs two and the SMPS' second board is two-sided board**

# Operation of Microwave Precision Fixed Attenuator Dice up to 40 GHz

> Radha Setty, Mini-Circuits

## Introduction

Mini-Circuits' YAT-D-series MMIC attenuator dice (RoHS compliant) are fixed value, absorptive attenuators fabricated using highly repetitive MMIC processing with thin film resistors on GaAs substrates. They contain through-wafer Cu metallization vias to realize low thermal resistance and very wideband operation. YAT attenuator dice are available from stock with nominal attenuation values of 0 to 10 dB (in 1 dB steps), and 12, 15, 20, and 30 dB. YAT die are specified to operate to 26.5 GHz with excellent attenuation flatness and Return loss.

However, the specified performance is characterized with a continuous ground plane underneath the entire die. A simple modification to the ground plane allows the attenuator

to achieve excellent return loss and attenuation flatness up to 40 GHz. In this article, we explain this method of expanding the usability of YAT-D MMIC attenuator dice for applications up to 40 GHz.

Modification to Expand Performance to 40 GHz:

Figure 1 shows the mechanical dimensions and bonding pad positions of a YAT-D attenuator die. Table 1 summarizes the critical dimensions of the die, and Table 2 shows the Die ID of the entire family of YAT dice.

Critical Dimensions	
Parameter	Values
Die Thickness, $\mu\text{m}$	100
Die Width, $\mu\text{m}$	725
Die Length, $\mu\text{m}$	700
RF IN and RF OUT Bond Pad Size, $\mu\text{m}$	75 x 75
Bond Pad Size, $\mu\text{m}$	110 x 150

**Table 1 Critical Dimensions of the Die**

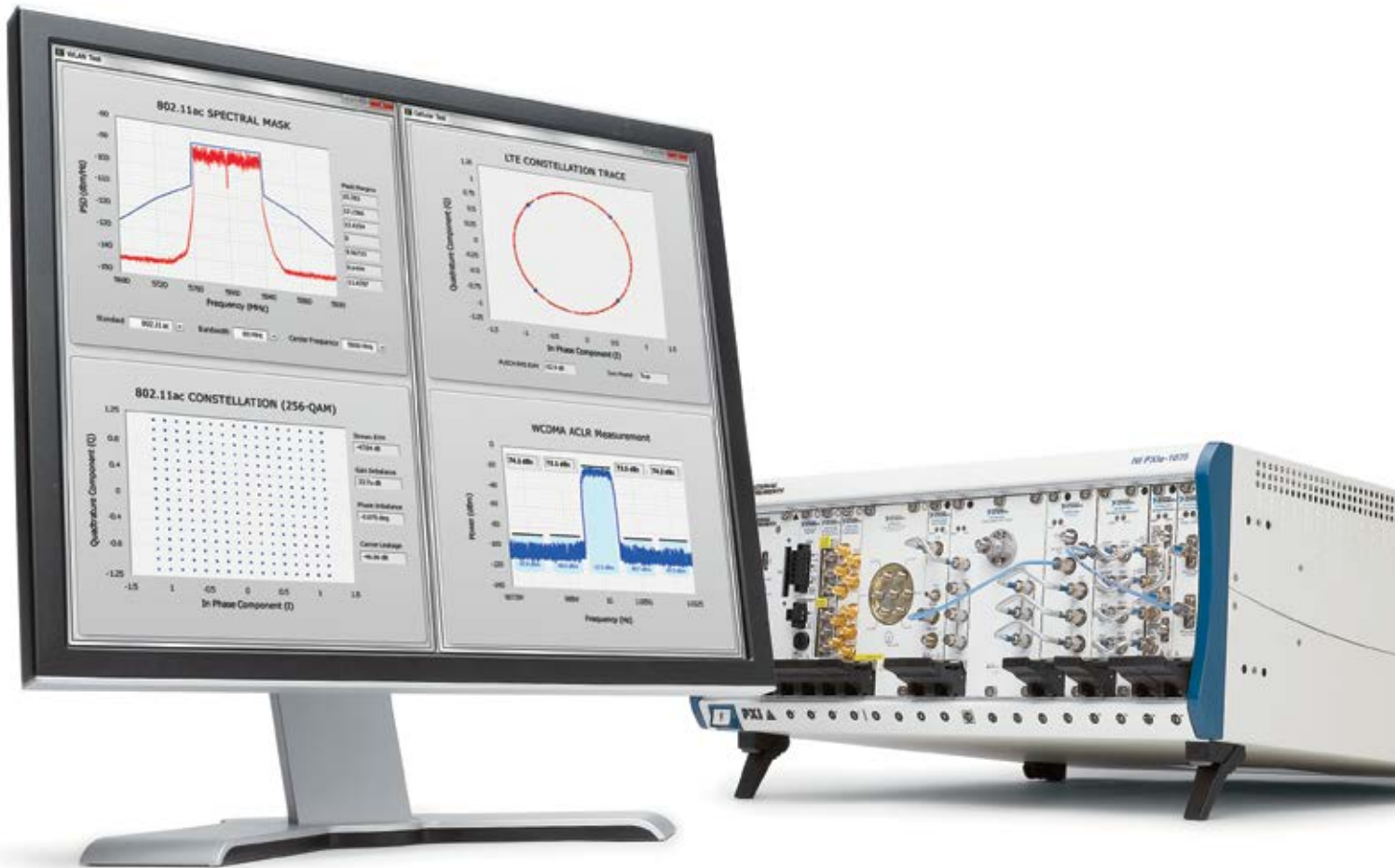
Model	Die ID
YAT-0-DG+	0DB
YAT-1-DG+	1DB
YAT-2-DG+	2DB
YAT-3-DG+	3DB
YAT-4-DG+	4DB
YAT-5-DG+	5DB
YAT-6-DG+	6DB
YAT-7-DG+	07DB
YAT-8-DG+	8DB
YAT-9-DG+	09DB
YAT-10-DG+	10DB
YAT-12-DG+	12DB
YAT-15-DG+	15DB
YAT-20-DG	20DB
YAT-30-DG+	30DB

**Table 2 Die ID**

Figure 2 shows the Assembly Diagram with a solid, continuous

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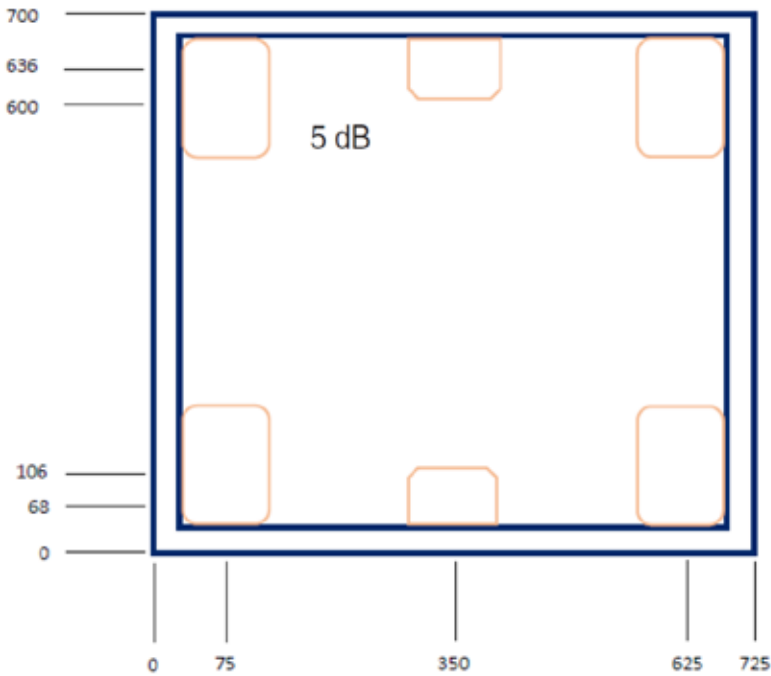
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## Bonding Pad Position (Dimensions in $\mu\text{m}$ , Typical)



**Figure 1: Die Dimensions and Bonding Pad Positions**

ground plane underneath the die. In this arrangement, YAT-D series dice perform superbly to 26.5 GHz. At higher frequencies, however, the attenuator performance degrades due to parasitic effects between the die and the ground plane.

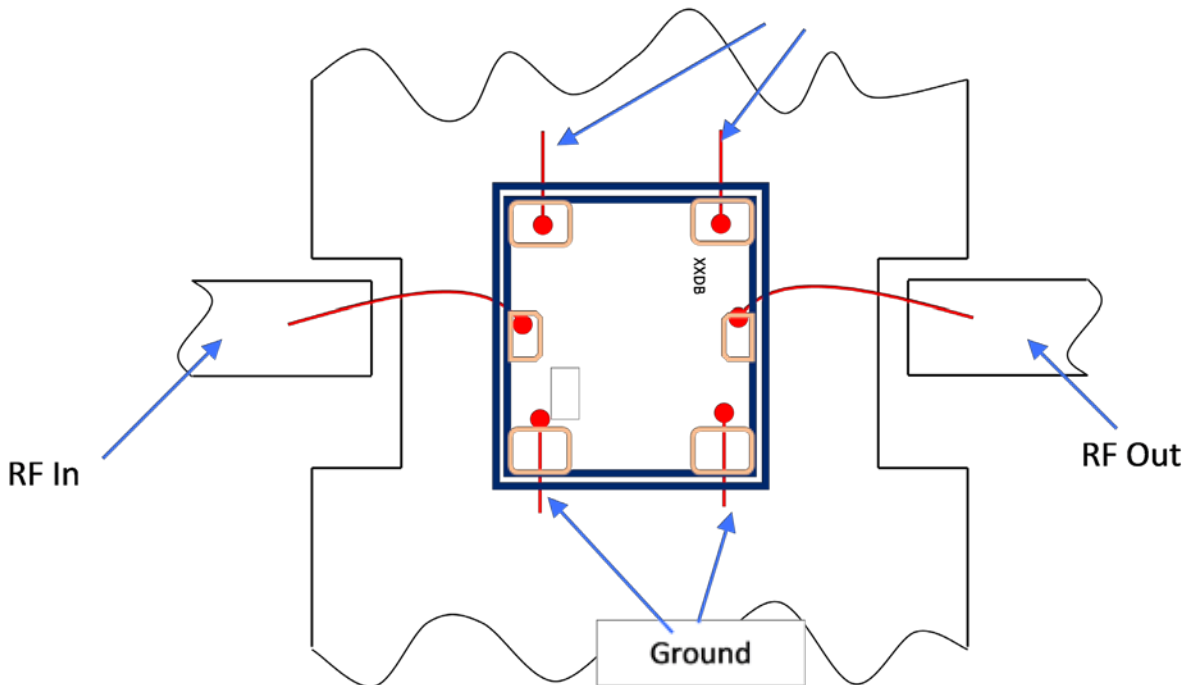
Wire	Wire Length (mm)	Wire Loop Height (mm)
All wires	0.25	0.15

**Table 3 Recommended Wire Lengths**

Table 3 Recommended Wire Lengths  
Wire Wire Length (mm) Wire Loop Height (mm)

All wires 0.25 0.15

The die and the ground plane essentially form parallel conductive plates which create unintended capacitance expressed by the parallel plate capacitance equation (1) below.



**Figure 2: Assembly Diagram**

$$C = (\epsilon_0 A) / d$$

(1)

Where  $\epsilon_0$  = the permeability of the material between the two plates

A = the overlapping surface area of the plates, and

d = the distance between the plates (PCB thickness)

Capacitive reactance becomes smaller

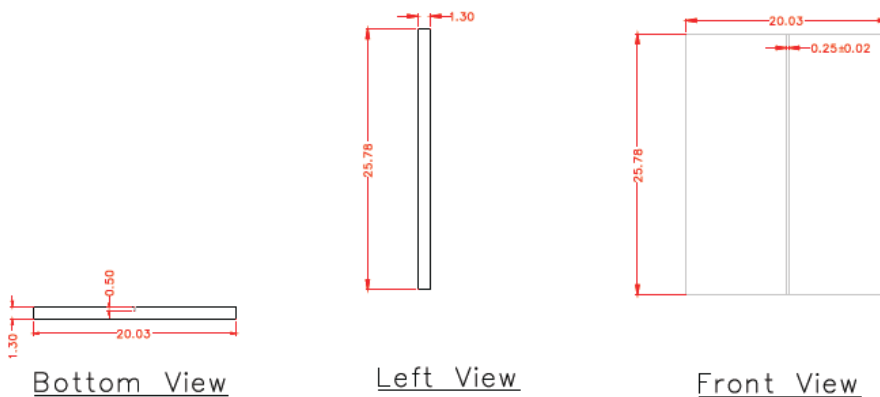
and smaller as frequency increases above 26.5 GHz, and the attenuator becomes increasingly sensitive to the capacitance between the die and ground plane at high frequency. This effect is primarily what limits the frequency range of the attenuator die. Reducing the capacitance between the die and the ground plane, however,

would expand performance to higher frequencies.

It is evident from equation 1 that capacitance is inversely proportional to the gap, d, between the two plates – in this case, the distance between the top of the die and the bottom of the ground plane. Therefore, one way to reduce the capacitance is by widening that gap. This is achieved by creating a small trench in the ground plane 0.5µm deep and 0.25 µm wide, running directly under the series signal path. The modified ground plane is represented in Figure 3, and the layout of the die on both continuous and split ground planes is shown in Figure 4.

Figure 4 Combined and Split Ground under DUT

Note that the width of the gap in the ground plane is very small, and application of conductive epoxy must be such that the integrity of the split is maintained in order to achieve the desired effect.



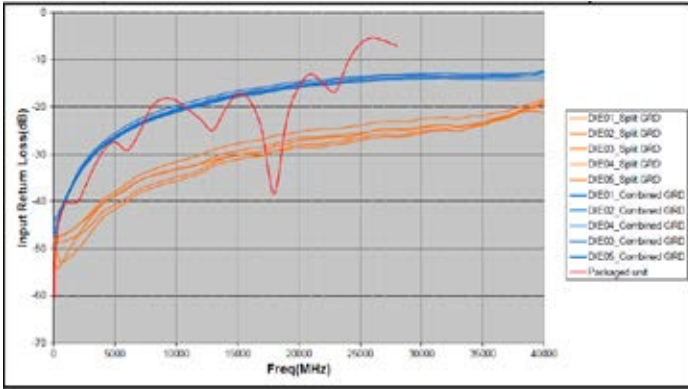
**Figure 3: Modification to ground plane to reduce capacitance.**

	Combined Ground	Split Ground
Ground (Shaded area) Layout		
Description	Standard ground plane directly beneath the entire die	No ground plane directly beneath the series signal path.

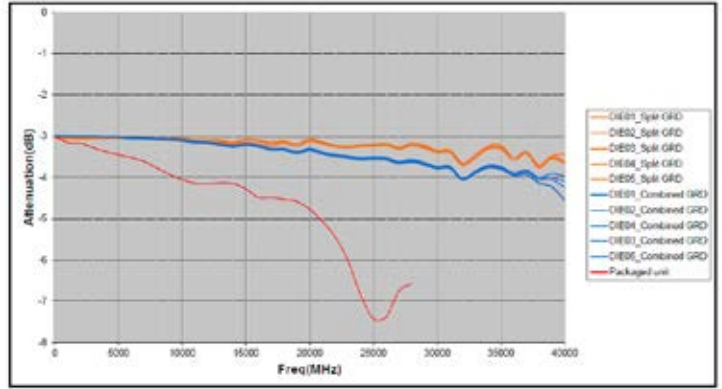
**Figure 4 Combined and Split Ground under DUT**

YAT-3-D+	Freq (MHz)		5 Units of YAT-3-D+ Split Ground			5 Units of YAT-3-D+ Combined Ground		
	From	To	Min.	Avg.	Max.	Min.	Typ.	Max.
Input Return Loss (dB)	10	5000	38.0	48.2	54.4	25.6	41.6	47.7
	5000	15000	27.7	34.0	41.7	16.6	21.0	26.8
	15000	18000	26.1	29.1	31.1	15.4	16.7	17.8
	18000	27000	23.1	26.5	29.4	13.2	14.8	16.6
	40000	40000	18.5	19.4	21.0	12.3	13.0	14.2
Output Return Loss (dB)	10	5000	36.9	51.5	59.9	25.4	39.9	44.8
	5000	15000	27.7	32.8	40.9	16.4	20.8	26.5
	15000	18000	26.4	27.9	30.1	15.3	16.5	17.6
	18000	27000	23.1	25.5	28.6	13.1	14.6	16.4
	40000	40000	18.0	19.2	20.0	12.2	13.2	14.4
RETURN LOSS (Worse of In & Out) (dB)	10	5000	36.9	48.2	54.4	25.4	39.9	44.8
	5000	15000	27.7	32.8	40.9	16.4	20.8	26.5
	15000	18000	26.1	27.9	30.1	15.3	16.5	17.6
	18000	27000	23.1	25.5	28.6	13.1	14.6	16.4
	40000	40000	18.0	19.2	20.0	12.2	13.0	14.2
Insertion Loss In-Out (dB)	10	5000	3.0	3.0	3.1	3.0	3.0	3.0
	5000	15000	3.0	3.1	3.2	3.0	3.1	3.3
	15000	18000	3.1	3.1	3.2	3.2	3.3	3.3
	18000	27000	3.1	3.2	3.3	3.3	3.5	3.7
	40000	40000	3.4	3.6	3.7	4.0	4.3	4.5
Insertion Loss Out-In (dB)	10	5000	3.0	3.0	3.1	3.0	3.0	3.0
	5000	15000	3.0	3.1	3.2	3.0	3.1	3.2
	15000	18000	3.1	3.1	3.2	3.2	3.3	3.4
	18000	27000	3.1	3.2	3.3	3.3	3.5	3.6
	40000	40000	3.8	4.0	4.1	4.1	4.4	4.7
INSERTION LOSS Worse of In-Out/Out-In (dB)	10	5000	3.0	3.0	3.1	3.0	3.0	3.0
	5000	15000	3.0	3.1	3.2	3.0	3.1	3.3
	15000	18000	3.1	3.1	3.2	3.2	3.3	3.4
	18000	27000	3.1	3.2	3.3	3.3	3.5	3.7
	40000	40000	3.8	4.0	4.1	4.1	4.4	4.7
Insertion Loss Flatness (dB)	10-27000	10-27000	0.1	0.1	0.2	0.3	0.3	0.3
	10-40000	10-40000	0.4	0.5	0.5	0.6	0.7	0.9

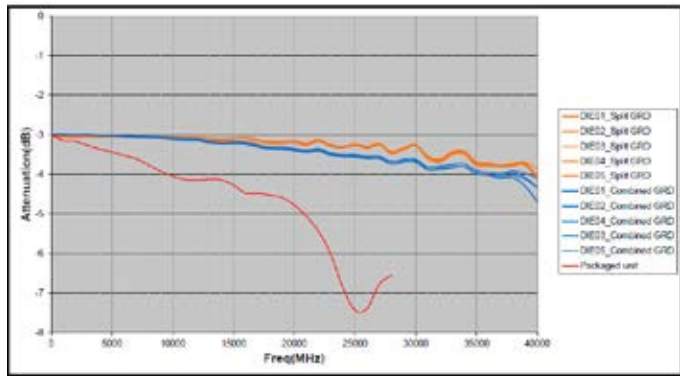
**Table 4 Tabular Summary of Performance: Split vs. Combined Ground**



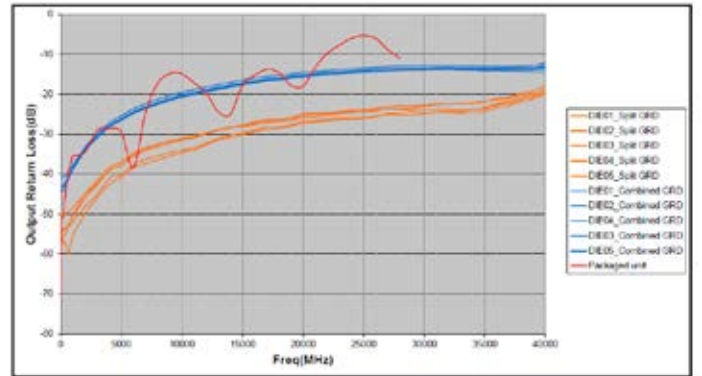
**Figure 8: HMC7891 simulated frequency equalized small signal gain over temperature**



**Figure 10: HMC7891 simulated PSAT vs. frequency over temperature**



**Figure 8: HMC7891 simulated frequency equalized small signal gain over temperature**



**Figure 10: HMC7891 simulated PSAT vs. frequency over temperature**

## Critical Dimensions

Parameter	Values
Die Thickness, $\mu\text{m}$	100
Die Width, $\mu\text{m}$	725
Die Length, $\mu\text{m}$	700
RF IN and RF OUT Bond Pad Size, $\mu\text{m}$	75 x 75
Bond Pad Size, $\mu\text{m}$	110 x 150

**Figure 10: HMC7891 simulated PSAT vs. frequency over temperature**

## Qualifying Performance to 40 GHz

To validate the performance of YAT-D dice with split ground to 40 GHz, a sample of 5 YAT-D dice were tested on

continuous ground plane and another 5 were tested on a split ground plane. Input/output insertion loss, input/output return loss and insertion loss flatness were measured from DC to 40 GHz. The

split ground improved the return loss at 40 GHz from 13 dB to 19 dB typical and insertion loss flatness to from  $\pm 0.7$  dB to  $\pm 0.5$  dB. The test results are presented in Figures 5 – 8 and in Table 4. Figures 4 – 7 include the performance of a packaged YAT attenuator for reference.

## Conclusion

Mini-Circuits' YAT-D series MMIC attenuator dice provide precise fixed value attenuation with excellent flatness from DC to 26.5 GHz. For higher-frequency applications, the simple modification to the ground plane demonstrated here enables superb performance up to 40 GHz, making YAT-D series an extremely versatile building block for a vast range of systems.



## Avoid the pitfalls of obsolescence

### › Dave Doherty, Digi-Key

The market for electronics components has changed radically over the past three decades. The driving force in terms of component volume is now the consumer market and no longer applications such as mainframe computers or military and industrial systems. Almost two-thirds of global sales now are into the PC and mobile-telephony markets, which are heavily consumer driven.

The focus of the consumer markets is to maintain a rapid pace of development in which manufacturers attempt to take full advantage of the advances in process technology that occur typically on a two-year cadence. Components made on what was the most advanced process two or three years ago are quickly rendered obsolete by their replacements. Because most of the products that these devices go into have an even shorter average shelf life, this constant renewal is not a problem. For users in industrial markets, the replacement cycle of many modern

integrated circuits (ICs) has become increasingly problematic. Although dedicated industrial-grade parts, such as those qualified for extended temperature ranges, will generally be supported for more than ten years by IC manufacturers, other systems within the vehicle that do not need the environmental support of industrial market-focused components will often use consumer-grade parts as they offer a high performance-cost ratio or simply are the only components available with the required computational, bandwidth or signal-processing performance.

Manufacturers of medical systems often have to face the problem that, by the time they have succeeded in obtaining regulatory approval for their systems, suppliers will already have classified the parts they depend on as mature.

Memory ICs tend to be highly vulnerable to short-term shifts in supply strategy. Parts designed for memory buses that were state of the art five years ago are

now regarded as legacy designs, with all but specialist manufacturers choosing to focus on more recent bus interfaces such as DDR4 or LPDDR3.

In many cases, manufacturers will announce the end of production with a last-time-buy announcement, which may only arrive six months before manufacturing on that product ceases. The decision that the user needs to take at this point is to work out whether sourcing an alternative is viable and, if not, if there is a requirement to place a last-time buy. The user needs to work out how many they are likely to need to continue to support their products to cover their own lifetime-support commitments. If they wait and miss the deadline, they need to find other ways to source spare parts, which may be through the grey market. Manufacturers will often place device stock they no longer need onto the grey market in order to recoup some of their expenditure. Unfortunately, the



grey market is the way in which many counterfeit products enter the supply chain.

Distributors can help with the situation of monitoring the supply situation and provide advance warning of last-time buys and of the signs that may indicate that a manufacturer will want to suspend production. Digi-Key, for example, sends out obsolescence notifications to customers for parts they have bought previously to ensure they are updated on supply status.

A last-time buy can introduce further issues as some procurement policies are designed to reject products with old date codes. As the target product ages, components bought on a last-time buy will often have date codes that will be too old to fit with this policy.

If a part has gone into its end-of-life phase and the user has missed the last-time-buy deadline, other options may be available. Devices that experience lower sales volume than other parts within a family are more likely to face the end of production more quickly. In many cases it is possible to replace the obsolete part with one that is a near-match, often with minimal redesign. For example, a replacement microcontroller may have more onchip peripherals than the original part but will, when it runs the same software, demonstrate the same behaviour. The technical department within a distributor such as Digi-Key can provide valuable advice on form and fit compatibility for many parts.

The long-term answer to obsolescence issues is to plan for the eventuality and build procurement strategies around components and families that have supply guarantees. To try to provide customers with long lifetime requirements, some semiconductor manufacturers will commit to longer support cycles for a selected group of their parts. For example, Intel sells a range of PC-compatible processors that are standard parts but, so that they can be used in long life-cycle industrial applications, has earmarked

some products as being supported and sold for ten years or more from initial production. This information provides users with high confidence of supply when they design the parts into their systems.

Franchised distributors are vital sources of information in the design phase by indicating to users which parts are supported under long life-cycle plans. Digi-Key, for example, has extensive experience of advising on the medium-to long-term supply scenarios for the components they provide. Customers can provide a bill of materials and experts will check the document for parts that are at risk of going end-of-life.

In some cases, it is impossible to avoid using a part with a high risk of obsolescence because it offers key features not available in competing parts. In those cases, franchised distributors such as Digi-Key can set up contracts in which, in exchange for a commitment on the number of components needed during a product's lifetime, they will arrange that number to be made available and stocked in the warehouse and released for manufacture as needed like any other device.

Changing the product-design strategy to accommodate obsolescence is another approach that users can adopt. This strategy assumes that a number of the parts in the original design are likely to become obsolete during the product's life-cycle. It involves planning component purchases such that they can be replaced more easily by similar parts and accommodate technology insertions that may involve changes in package type and device speed. By designing products such that they can take form and function compatible replacements, it is possible to reduce the risk of being subject to supply problems caused by the obsolescence of a single component.

For example, the use of programmable solutions provides a way to future-proof

key elements of a design. Programmable solutions are often designed in such a way that they can provide a high degree of assurance over form, fit and function for replacement products. Even though the manufacturers may retire older parts in favour of those built on newer processes, the same design will easily move to the replacement parts, which can often be obtained in packages pin-compatible with the originals. The design tools are built in such a way that a design ported to a later, more capable part will in most cases behave as it did in the older product.

Similarly, choosing microprocessors and microcontrollers that use industry-standard architectures available from multiple vendors can provide a greater degree of protection against obsolescence than a product line that may be available from only a single manufacturer. Although finding a direct match for a microcontroller from another supplier's range may not be possible, changes to the design and software may be minimal as such parts often provide similar features and peripherals. The only change may be to device drivers to ensure that the peripherals are mapped to the correct areas of memory for the application. Microcontrollers with on-chip programmable logic and analogue peripherals have proven to be the answer in a number of cases when fixed-function parts have disappeared from the market.

Replacing a dedicated part with the programmable solution involves greater design and integration effort but, in an industry prone to sudden obsolescence, it provides an effective way of managing the problem for key parts of the system. Even with effective design strategies, obsolescence remains an issue that faces many users of electronics components. But with the help of supply-chain partners who can advise on potential alternatives and keep customers informed of trends in production, it is possible for companies to stay on top of the problem.



## Energy-Efficiency is Key to Cloud Services for the Internet of Everything

> Mark Adams, AMP Group

**Embracing traditional data services and the burgeoning requirements of the Internet of Things (IoT), the Internet of Everything (IoE), as it is now being referred to, is adding considerably to the pressure being applied to data communication networks and the storage capabilities of data centers. With the inevitable growth in this infrastructure that this rising demand is driving, the energy efficiency of these various Cloud services is inevitably and deservedly coming under increased scrutiny. Any measure that realizes valuable energy savings, including efficiency improvements in the supply of power to the many, many servers in these data centers, will not only help operators keep costs down but will also benefit the environment.** Collaboration

**between leading companies in the power space, with each bringing to bear their own unique experiences, is one initiative that is providing a way forward.**

### **Introduction: An Imminent Explosion of Data**

Retail operations already generate significant volumes of data - according to Cisco, a large store may collect 10GB of data every hour and transmit 1GB of that to a data center. Industrial operations can generate vastly higher levels of data, for example, automated manufacturing plants can generate 1TB per hour while a large mining operation can easily exceed 100TB per hour. With the addition of connected "Things", such as sensors and controls enabling infrastructure management and security applications in commercial and residential properties, a veritable

explosion of data is imminent. Capturing all this data continuously is the easy part. Transforming it into useful information is what really counts and is where Cloud services are key. Data centers are at the heart of Cloud services and while their processing and storage capabilities continue to benefit from improvements in technology, it is their energy consumption that has increasingly become a matter of public concern. Over the typical three-year life of a server, the cost of powering it can exceed its purchase price. On top of this is the energy cost for running the cooling systems needed to maintain safe operating temperatures for all the electronic equipment. This is why there is now a major industry trend to siting new data centers in cooler climates, even undersea, and also close to plentiful sources of renewable energy such as hydroelectric power plants.

## IoT IS DRIVING UP DATA EXPONENTIALLY



**Figure 1. Connected devices are expected to produce 500 zettabytes of data annually by 2020.**

### Alleviating the Energy Consumption Concern

While looking at potentially establishing higher maximum equipment operating temperatures to save on cooling costs, operators also recognize the importance of improving the overall energy efficiency of data center equipment; to reduce the direct energy consumed but also the heat generated and hence the cost of cooling.

Maximizing efficiency at every point is vital, throughout the servers, their power supplies and through the system-management software. Despite this, peak power consumption continues to increase to meet the demands for increased computing capability and the consumption of a typical server board has increased from a few hundred watts to 2kW or 3kW today, and could reach 5kW or more in the future. As a result, there

is a growing difference between the server's minimum power at light load and its power at full-load. Fortunately power distribution architectures are becoming more flexible, with real-time adaptive capabilities that maintain optimal efficiency under all operating conditions.

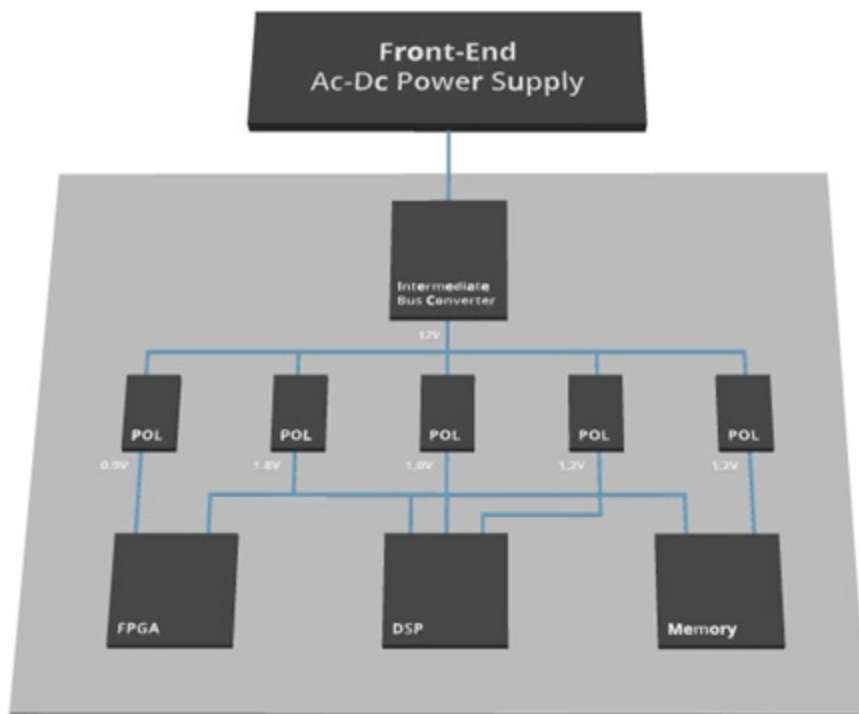
### Adapting the Power Architecture

A distributed power architecture typically comprises an Intermediate Bus Converter (IBC) that operates from a 48Vdc input supplied by a front-end AC/DC converter, as shown in figure 1. The IBC provides a 12V intermediate bus that supplies low-voltage DC-DC point-of-load (POL) converters positioned close to major power-consuming components on the board, such as processors, System on Chips or FPGAs. Multiple POLs may be used to supply core, I/O and any other voltage rails. The IBC's

48Vdc input and 12V output voltages were historically chosen to minimize down-conversion losses and losses proportional to current and distance when supplying typical server boards. However, given the changes in core voltage, current draw, maximum power and the difference between full-load and no-load power, these fixed voltages are less suited to maintaining optimal efficiency in modern systems. The ability to set different voltages, and change these dynamically in real-time, is needed to allow a system to adapt continuously for best efficiency.

### Adaptive Control Requires a Common Protocol

PMBus is an industry-standard protocol for communicating with digitally controllable power supplies from the front-end, through the advanced bus and to the point-of-load converters (figure 2). By monitoring the status of



**Figure 2. The traditional fixed distributed power architecture suited earlier generations of servers**

these converters a host controller can optimize input and output voltages and send commands to manage other aspects of device operation, such as enable/disable, voltage margining, fault management, sequencing, ramp-up, and tracking.

The controllability enabled by PMBus is allowing system designers to power architectures that are increasingly software defined and able to respond in real-time for optimum efficiency. Some of today's most powerful techniques for optimizing efficiency include Dynamic Bus Voltage (DBV) optimization, Adaptive Voltage Scaling (AVS), and multicore activation on demand.

DBV provides a means of adjusting the intermediate bus voltage dynamically to suit prevailing load conditions. At higher levels of server-power demand, PMBus instructions can command a higher output voltage from the IBC in

order to reduce the output current and hence minimize distribution losses.

AVS is a technique used by leading high-performance microprocessors to optimize supply voltage and clock frequency to ensure processing demands are always satisfied with the lowest possible power consumption. This also provides automatic compensation for the effects of silicon process variations and changes in operating temperature. To support AVS, the PMBus specification has recently been revised to define the AVSBus, which allows a POL converter to respond to AVS requests from an attached processor.

Multicore activation on demand provides a means of activating or powering down the individual cores of a multicore processor in response to load changes. Clearly, de-activating unused cores at times of low processing load can help to gain valuable energy

savings.

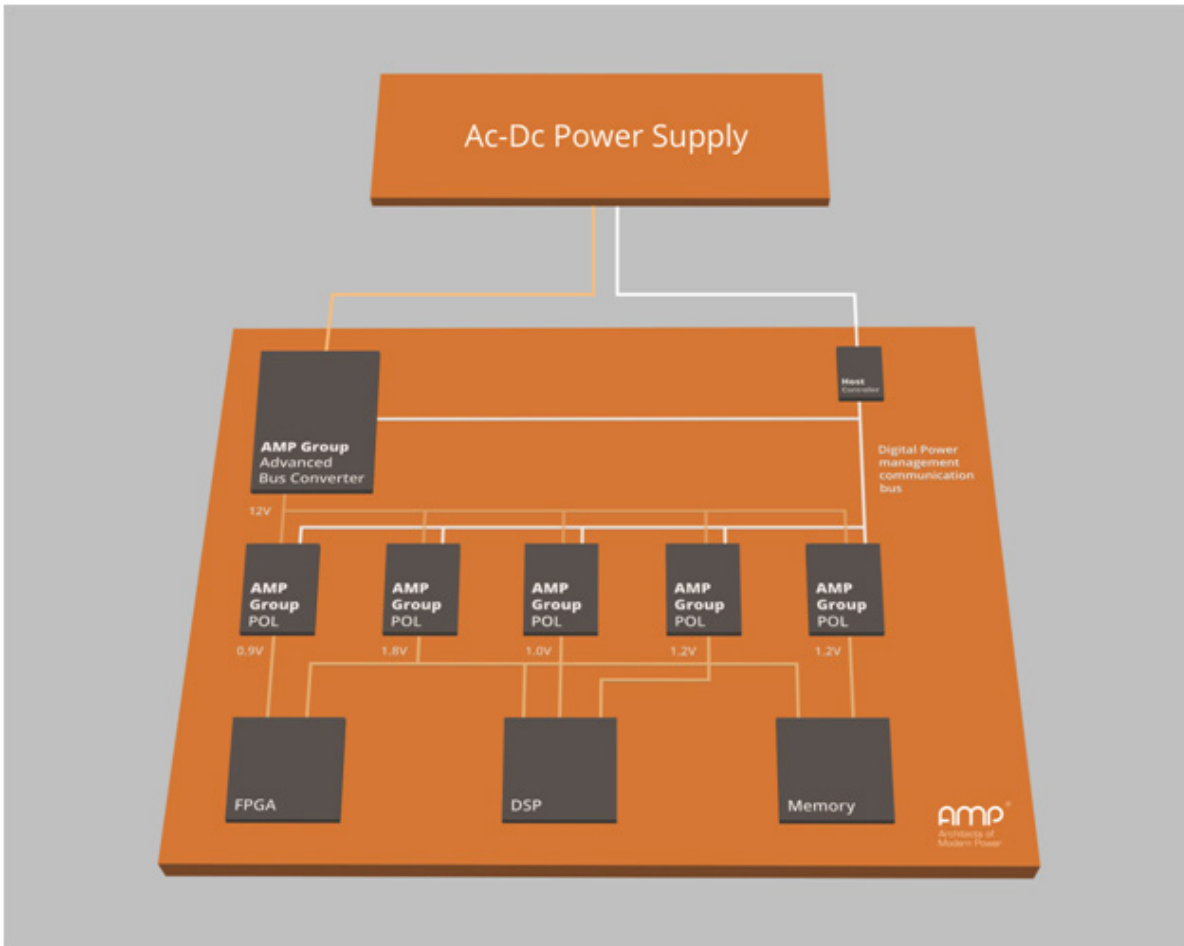
Continuously optimizing the power-conversion architecture and bus voltages will yield improvements in each converter. In a power supply comprising an IBC operating at 93% and a POL operating at 88%, an improvement of just 1% in each stage can reduce the power dissipated from 18.1% of the input power to 16.3%. This not only represents a 10% reduction in power losses, but also relieves the load on the data-center cooling system thereby delivering extra energy savings.

## Software Defined Power Requires Collaboration

While these first adaptive control features mark the beginning of software-defined power architectures, many additional and even more powerful techniques are expected to emerge, assisted by the arrival in the market of digitally-controllable PMBus-compatible IBC and POL supplies from a range of vendors. PMBus is vital in supporting the power supply designs that are needed to meet the IoT challenge. However an issue that still has to be addressed is the "plug and play" compatibility between supplies that appear to offer similar specifications but behave differently when sent the same PMBus command.

The formation of the Architects of Modern Power® (AMP) Group in October 2014 has further strengthened the case for digital control through its activities in specifying standards for the interoperability of IBC and POL supplies. This includes standardizing the interpretation of PMBus commands to ensure that all supplies that comply with AMP Group® standards will operate in the same way in response to a given command.

One of the key objectives of the AMP



**Figure 3. Energy efficiency can be optimized on the fly with PMBus-compatible converters**

Group in streamlining the design of digital power was to enable true second-source flexibility for system OEMs. In going beyond the standards set by power industry bodies such as POLA and DOSA, the AMP Group has not only created standards that provide mechanical, electrical and software compatibility, but each of its standards is represented by commercially available products from at least two of its founding member companies: CUI, Ericsson Power Modules and Murata. Furthermore, the members have set out to collaborate on a technology and product roadmap to keep one step ahead the IoE power challenge. The AMP Group classically demonstrates the adage that “the sum is greater

than the parts” as collaboration between its members each, with their own unique experience, benefits not just those member companies but also the industry at large.

### Conclusion

Industry and commerce, driven by the needs of the consumer, are increasingly dependent on Cloud data services as we rapidly move towards the Internet of Everything. The resulting huge quantities of data need to be communicated and processed quickly to provide useful information and then stored for future reference. As the demands on Cloud data centers increase, energy efficiency is becoming an increasingly

important factor governing operating costs. At the board level, energy lost during power conversion can be reduced by adjusting bus voltages as load conditions change. PMBus-compatible converters allow real-time software-based control to achieve a valuable reduction in these losses. At the system-level, this combination of optimized hardware and software will greatly improve power utilization in data centers as capacity demands continue to rise. To fully realize the promise of software defined power, it is going to require collaboration between organizations with unique technologies and competencies, like the AMP Group, to meet this looming IoE power challenge head-on.

# SOFTWARE TESTING

## Life-Cycle Management Is All About Software

› **Kevin Flanagan, NI**

**In 2015, the US Department of Defense announced that the B-52 bomber, originally introduced in 1952, will be in operation until 2044 - a life cycle of nearly 100 years.**

One of the largest operational costs associated with automated test systems, especially in the aerospace and defense industry, is the support and maintenance cost over the life of the system. Proactive life-cycle management requires designing maintainable testers, diligently monitoring automated test equipment (ATE), and tracking instrument and component end-of-life (EOL) notifications.

While life-cycle management might not be a novel concept, the reality is that

the evolution of mobile technology, accelerated hardware obsolescence, and sheer volume of test software are making this task increasingly difficult. Best-in-class organizations are rearchitecting test strategies to gain a competitive advantage amid the growing challenge of life-cycle management.

### Evolution of OS Life Cycles

Within a decade, OS providers have transitioned from releasing a single OS and maintaining it for several years, such as Microsoft Windows XP (which was supported for 13 years), to today's paradigm that targets mobile users that expect constant upgrades. This requires OS providers to frantically release new versions

and retroactively fix bugs in daily updates. Global market intelligence firm IDC forecasts that smartphones and tablets will control 88.4 percent of the smart-connected device market by 2019, leaving portable and desktop PCs with only 11.6 percent.

As mobile devices control vast majority of the market, OS providers will continue to prioritize the mobile user. This shift poses a monumental hurdle for test systems that rely on a stable OS to eliminate the need for system revalidation. As a result, some organizations are moving to Linux-based systems to have more control over the OS. Another approach is to minimize the number of OSs to reduce the burden for test engineering and IT organizations. Many legacy test systems contain several OSs (one for

each unique box instrument), which introduces the risk of revalidation due to individual OS updates. One major benefit of modular platforms, such as VXI or PXI, is the single OS controlling all instruments in the chassis or system.

#### Accelerated Decay of VXI and Legacy Instruments

In the late 1980s and early 1990s, the aerospace and defense community standardized on VXI as the modular commercial off-the-shelf platform for ATE systems. However, as VXI grows obsolete and support diminishes for legacy instruments, programs are under increased pressure to migrate to a stable alternative.

This is compounded by a looming RoHS conversion deadline, which will increase the rate of component and instrument EOLs.

Over the past decade, PXI has replaced VXI as the de facto modular platform for ATE systems due to the size, performance, cost, and level of innovation in the platform. Global consulting firm Frost & Sullivan expects PXI to grow by 17.6 percent annually, which accounts for most of the expected growth for the test and measurement industry. With nearly 70 vendors offering more than 1,500 PXI instruments and a steady stream of innovation, PXI will continue to provide increased value to long-life-cycle ATE systems.

### TPS-Compatible Migration Paths

As teams migrate from VXI-based to PXI-based test systems, the investment required to modernize hardware will typically pale in

comparison to that of updating and revalidating software. Due to the criticality of the system and the tight regulations for requirements tracking and software validation, simply opening, saving, and revalidating a test program set (TPS), or test sequence, can cost hundreds of thousands of dollars. This has created an environment where companies must rethink their software strategies or risk hemorrhaging money to sustain legacy testers.

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**“The cost to rewrite a TPS due to the replacement of legacy/obsolete instrumentation in a test system is approximately \$150k/TPS. When multiplied across dozens of TPS per test system and three to five generations of test equipment over the life of a test system, the potential savings in TPS costs alone are very significant - any efforts that vendors can make to smooth this transition will prove to be invaluable.”**

**- David R. Carey, PhD, Associate Professor of Electrical Engineering, Wilkes University**

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Since minor software changes can greatly impact TPS compatibility, instrument vendors should offer

offer TPS-compatible hardware migration options. This includes preserving driver functionality, APIs, and dependencies between driver versions to minimize the impact on the hardware abstraction layer. For example, NI is collaborating with Astronics Corporation to bring remaining VXI instruments into the PXI platform, such as the Astronics PXIe-2461 frequency time interval counter, which preserves TPS compatibility with legacy systems. Despite their best efforts, vendors cannot always provide TPS-compatible alternatives. In these situations, a common approach is emulating legacy instrument functionality. Recently, engineers have adopted software-designed instruments with user-programmable FPGAs to augment standard instrument capabilities with custom functionality to emulate legacy behavior. For example, filters and triggers that were common in instruments 20 years ago and obsolete in today's instruments can be reengineered.

### Coming Full Circle

Whether you're managing the B-52 bomber platform or introducing a new line of infotainment systems for the connected car, life-cycle management is critical. It can be either an expensive afterthought or a competitive advantage. In the face of market dominance of mobile technologies, the accelerated decay of legacy instrumentation, and the rising costs of software validation, scalable test architectures and strategies will distinguish best-in-class organizations.

# Wideband High Dynamic Range Limiting Amplifier

› Adam Winter and Jerry Cornwell, Analog Devices, Inc.

Many modern EW systems require low noise receivers capable of withstanding wide input power variations over a multi-octave bandwidth. These receivers are necessary to protect sensitive components from RF overdrive or to remove AM modulation from incoming signals. Further, multi-channel system designs and proximity to the receiver antenna generate requirements for low power and small package size. Applications include IFM and direction finding front ends, DRFM, and jammer systems. These systems must operate over a wide thermal range, and require a flat frequency response with low harmonic content under all operating conditions. ADI's limiting amplifiers are ideal for many of these applications due to industry leading package size, electrical/RF performance, and ease of integration into higher level

assemblies. A microwave limiting amplifier is a high gain, multi-stage amplifier that "limits" output power by successively compressing internal gain stages as input power increases. Gain stages compress from the output stage toward the input, with the design optimized to avoid overdriving individual gain stage under all operating conditions. Challenges associated with wideband limiting amplifier design include effective power limiting, thermal compensation, and frequency equalization over a multi-octave bandwidth. In addition, system requirements for low noise, low power, and a small package size add to the complexity of the design. This paper reviews design considerations and techniques for a 2-18 GHz limiting amplifier with requirements for  $45 \pm 1.5$  dB gain, an operational temperature range of

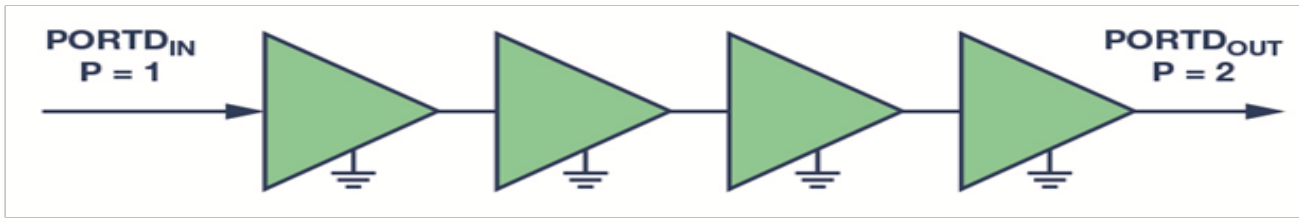
-40 to 85°C, less than 1.5 Watts DC, and a 40 dB limiting dynamic range. Limiting dynamic range is defined as the input power range over which RF output power is fixed. ADI offers a wideband 2-18 GHz limiting amplifier product, the HMC7891, that meets these requirements. This amplifier includes internal voltage regulation in a hermetically sealed connectorized package.

## Construction and Amplifier Considerations

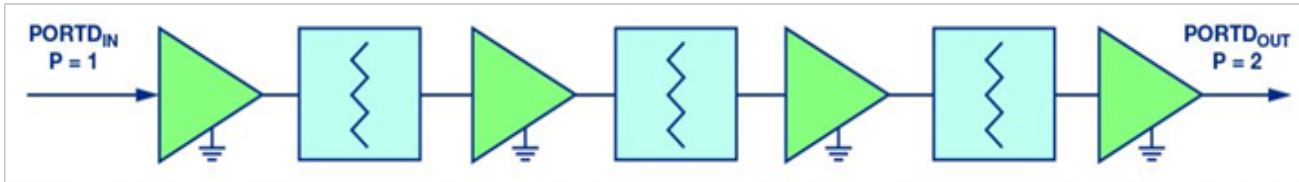
Microwave limiting amplifier design begins with down-selection of preferred construction methods and internal gain stage amplifiers. Hybrid chip-and-wire assemblies are often preferred over surface mount designs for high frequency applications in order to minimize detrimental performance impacts caused by



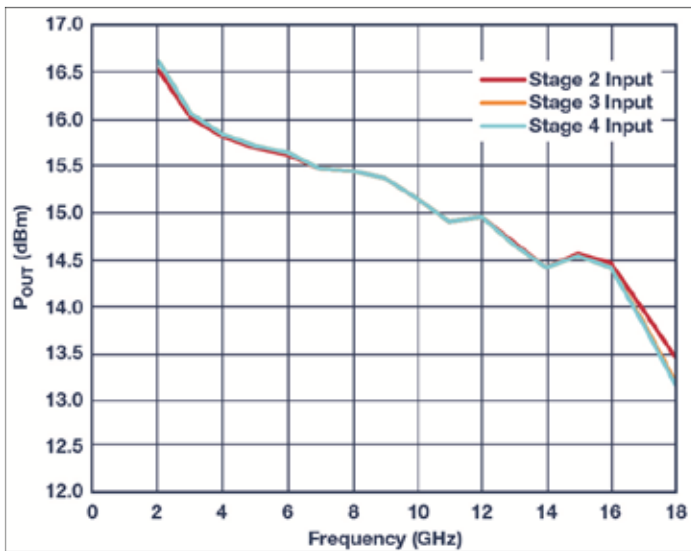




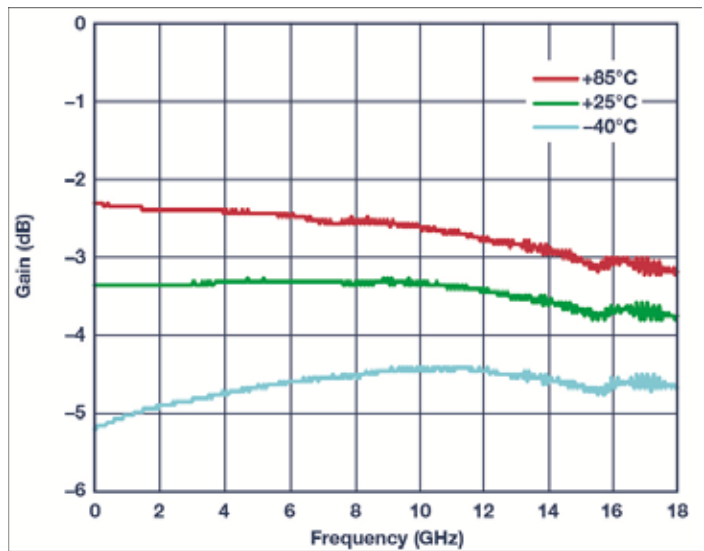
**Figure 1. Preliminary block diagram**



**Figure 2: Block diagram, RF overdrive correction**



**Figure 3: Simulated Pout vs frequency, RF overdrive correction**

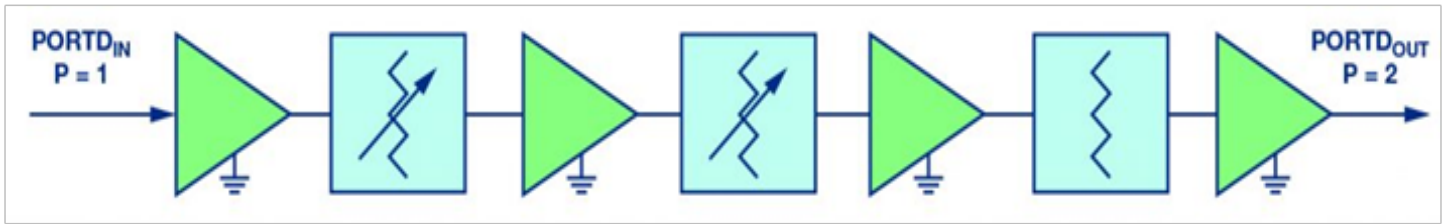


**Figure 4: Thermopad loss over temperature**

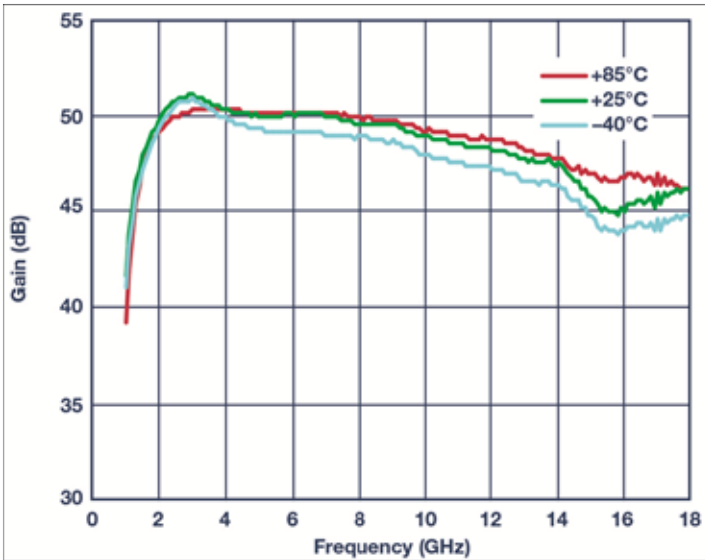
package parasitics. Also, reliability of hybrid chip-and-wire assemblies is considered superior because hybrid assemblies are thoroughly inspected and are well suited to handle environmental stress. Further, these assemblies are small, lightweight, and easy to hermetically seal. Hybrid chip-and-wire assemblies consist of die form Monolithic Microwave Integrated Circuits (MMICs), thin film technology, and wire bondable

passive components. Primary considerations for selection of internal gain stages include operational frequency range, gain vs temperature, gain flatness, saturated harmonic content, and non-linear performance. A successful limiting amplifier design minimizes gain stages and unique part count to reduce thermal compensation and flatness challenges. Also, success largely depends on device maximum input

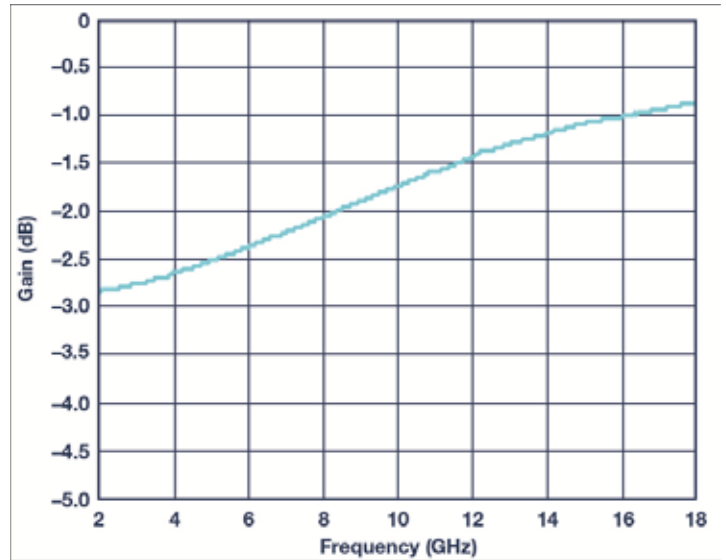
power ratings and the compression characteristics of the selected gain stages. To complete a design with a 40 dB limiting dynamic range requirement, a minimum of four gain stages is recommended so that ideally each amplifier stage will operate no more than 10 dB compressed. Four gain stages should also be sufficient to achieve the 45 dB small signal gain requirement over temperature. Wideband MMIC gain block amplifiers



**Figure 5: Block diagram, thermal compensation**



**Figure 6: HMC7891 simulated small signal gain over temperature**



**Figure 7: Measured frequency equalizer loss**

or low noise amplifiers (LNA's) are good candidates for limiting amplifier designs due to their high gain and low power performance. A noise figure requirement will typically establish the need to utilize low noise amplifiers over gain block amplifiers. However, LNA gain stages can create design challenges due to their generally lower RF input power rating. An ideal gain stage device has a high maximum RF input power rating and can safely operate at high levels of compression. Also important is the saturated harmonic content of each gain stage. Harmonic content requirements depend on the limiting amplifier's application. For example, an application meant to generate a

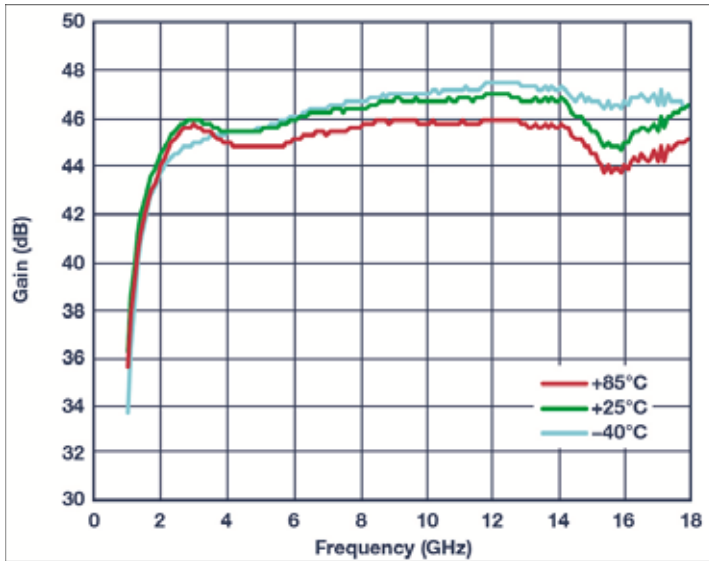
square wave output waveform needs to utilize gain stage amplifiers with low even harmonic output and strong odd harmonic output. To avoid corrupting the output waveform, it is useful to utilize the same part in all four gain stage locations. Finally, selected MMIC amplifiers must be unconditionally stable and ideally lack bias sequencing requirements to simplify the design.

The HMC462 is an ideal MMIC to complete a limiting amplifier design. The HMC462 is a self-biased LNA requiring a single +5V supply with greater than 13 dB gain, excellent 2-18 GHz gain flatness, and an average 2.5 dB noise figure. The device has an 18 dBm saturated output power

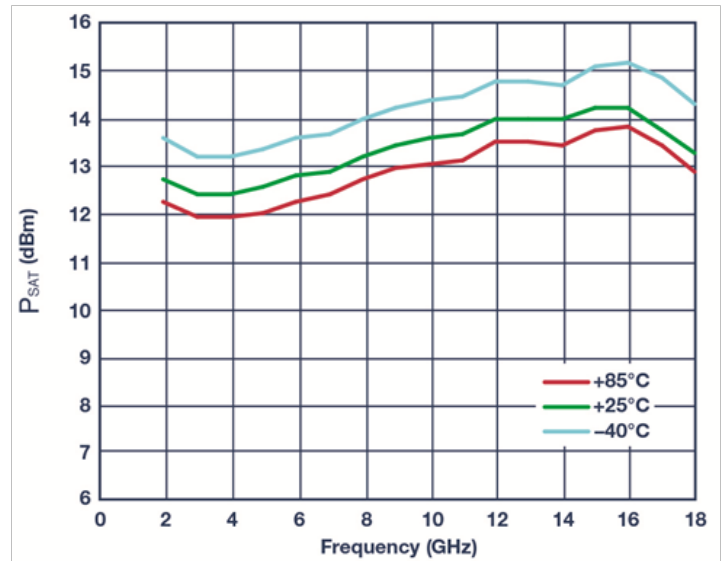
level and can safely operate greater than 14 dB into compression across the frequency band. Maximum input power rating is nearly equivalent to the device's saturated output power, making it ideal to operate in a cascaded series of gain stages. While second order harmonics are low, the MMIC has a strong, flat third order harmonic. Saturated DC power is less than 400 mW.

### RF Budget Analysis

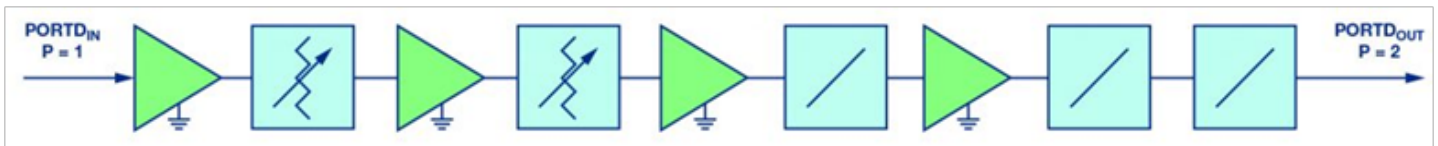
Following the selection of limiting amplifier gain stages, it is necessary to consider the RF system budget analysis. RF budget analysis examines the broadband frequency response and RF power levels at various test points within the limiting amplifier.



**Figure 8: HMC7891 simulated frequency equalized small signal gain over temperature**



**Figure 10: HMC7891 simulated PSAT vs. frequency over temperature**



**Figure 9: Block diagram, frequency equalization**

Analysis must be completed to correct for worst case operational temperatures, gain slope, and a wide RF input power range. As discussed, the basic layout for a limiting amplifier with 40 dB limiting dynamic range is a cascaded series of four gain block amplifiers or LNAs. An ideal design utilizes only one or two unique amplifier part numbers to reduce power variations vs frequency and to minimize thermal/slope compensation requirements.

Figure 1 illustrates the first pass preliminary limiting amplifier block diagram prior to temperature correction and slope compensation. A recommended technique to complete the wideband limiting amplifier design is to:

1. Manage the limiting power dynamic range and eliminate RF overdrive conditions.
2. Optimize performance over temperature.
3. Complete the design by correcting the power roll-off and flatten the small signal gain.
4. A final minor correction may be necessary to revisit temperature compensation after frequency equalization has been included in the design.

### Power Limiting

The primary issue with the preliminary design illustrated in Figure 1 is that RF overdrive will likely occur at the output gain stages as RF input power increases. RF overdrive will occur when the saturated output power of

any gain stage exceeds the absolute maximum input of the succeeding amplifier in the lineup. Further, the design is susceptible to VSWR associated ripple and there is a strong potential for an oscillation to occur due to high, undamped gain within the small RF package.

To prevent RF overdrive, diminish VSWR effects, and decrease the risk of an oscillation, add fixed attenuators between each gain stage to reduce power and gain. Eccosorb may also be required on the RF cover to eliminate oscillations. Sufficient attenuation is required to reduce the maximum input power of each gain stage below the MMIC's rated input power level. It is necessary to include enough attenuation to accommodate



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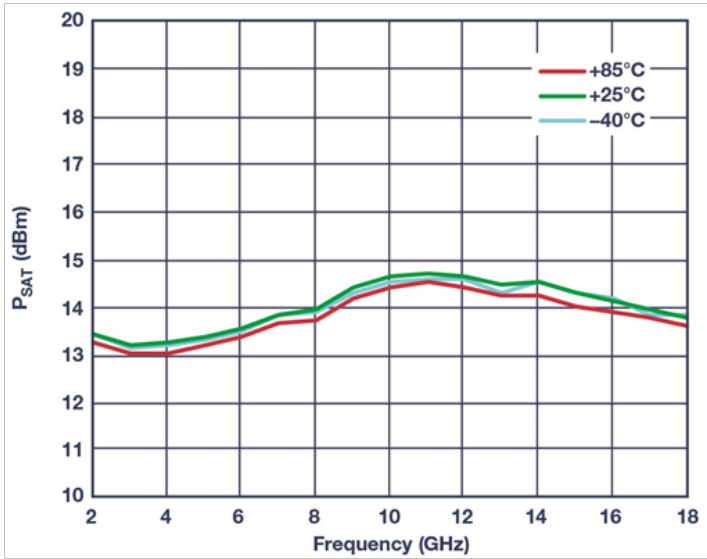


Figure 11: HMC7891 measured PSAT vs frequency over temperature

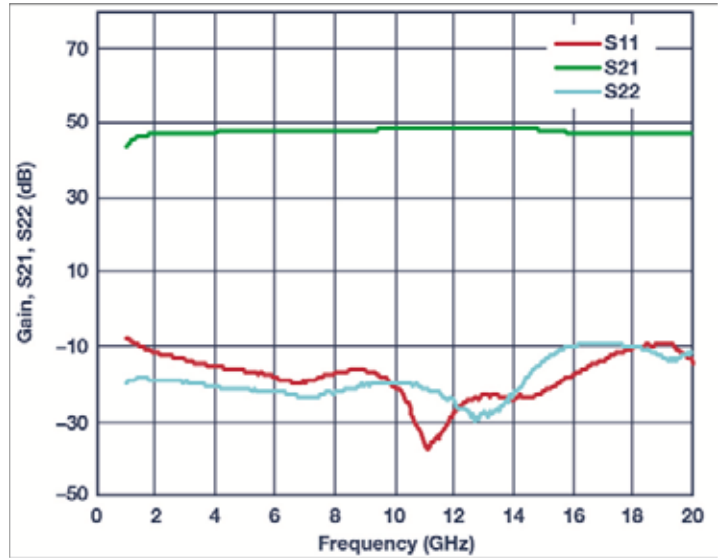


Figure 12: HMC7891 measured gain and return loss

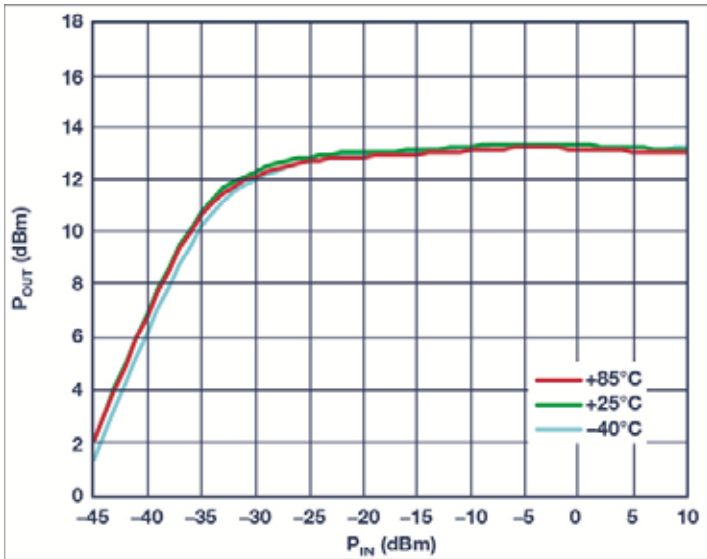


Figure 13: HMC7891 measured Pout vs Pin at 2 GHz over temperature

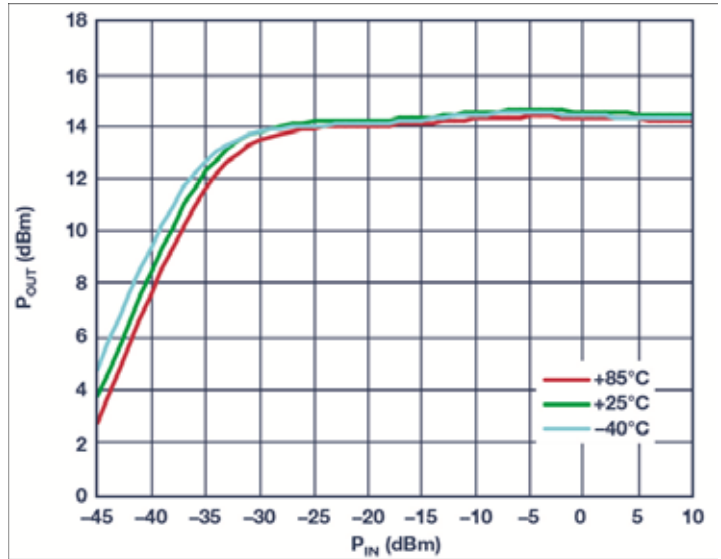


Figure 14: HMC7891 measured Pout vs Pin at 10 GHz over temperature

top level input power margin and to account for thermal and part-to-part variations. Figure 2 illustrates the locations where RF attenuators are necessary within the limiting amplifier chain.

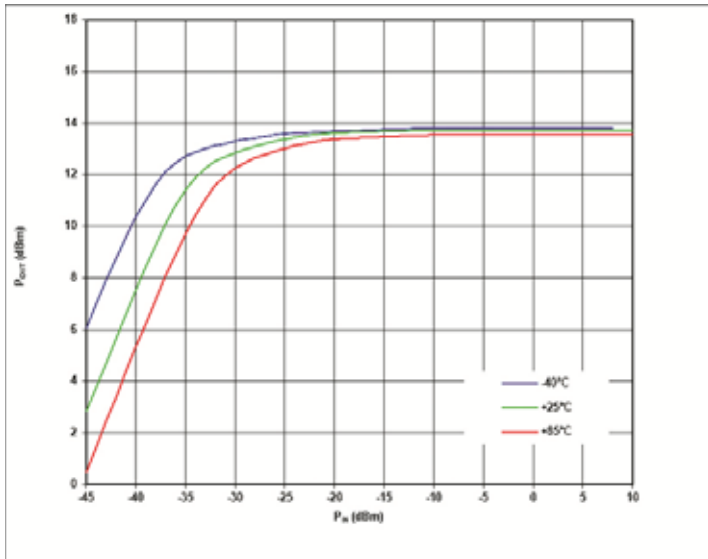
The ADI broadband limiting amplifier, HMC7891, utilizes four HMC462 gain stages and is designed to operate up

to 10 dBm. Absolute maximum input power is 15 dBm. Each gain stage can withstand a maximum RF input of 18 dBm. Per the design step outlined in the preceding paragraph, attenuators were added between gain stages to ensure maximum amplifier input power levels do not exceed 17 dBm. Figure 3 illustrates the maximum

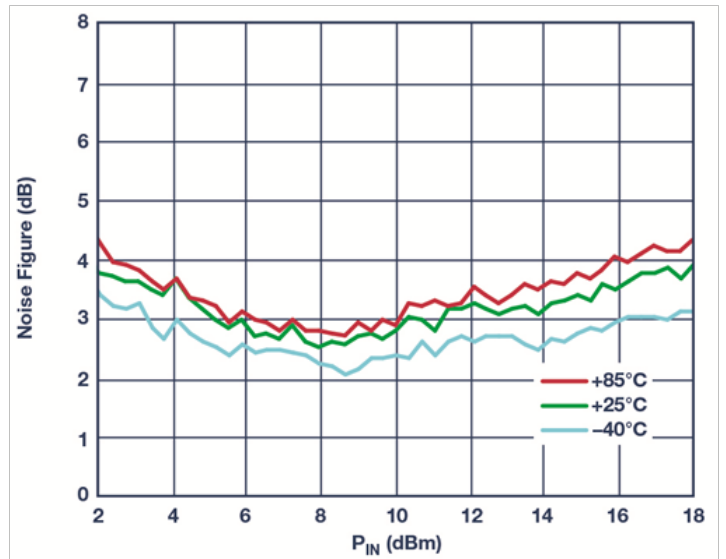
power level at the input to each gain stage with fixed attenuators added to the design.

### Thermal Compensation

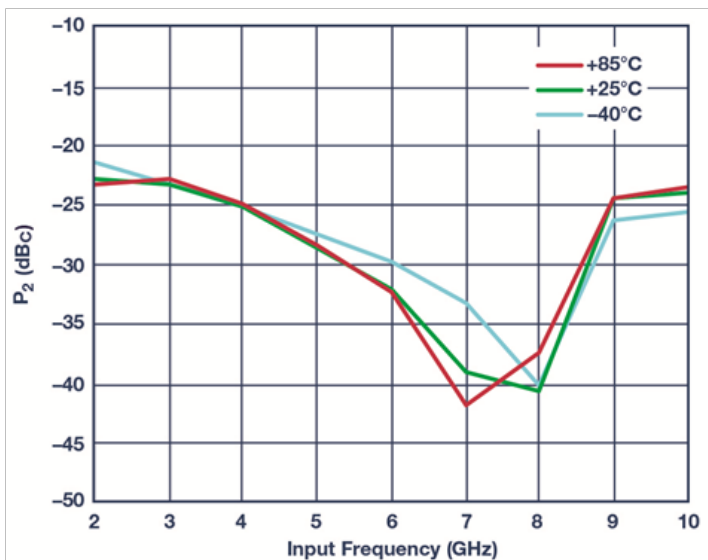
The second step is to thermally compensate the design in order to increase the operational temperature range. A common thermal range



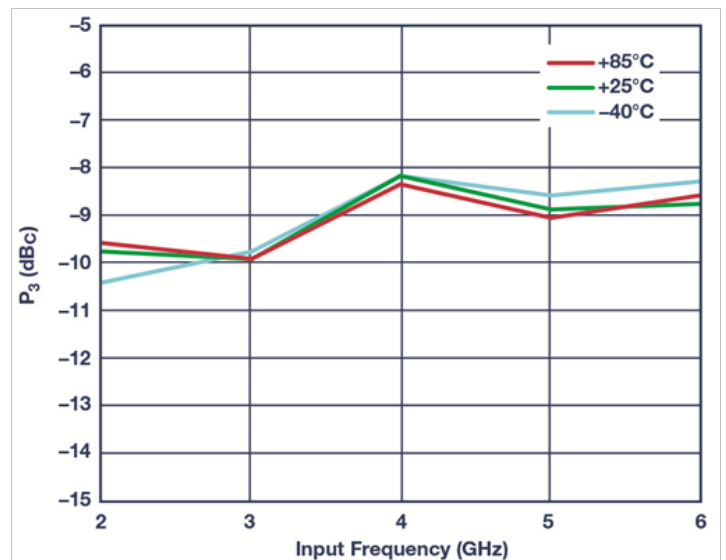
**Figure 15: HMC7891 measured Pout vs Pin at 18 GHz over temperature**



**Figure 16: HMC7891 measured NF vs frequency over temperature**



**Figure 17: HMC7891 measured second harmonic vs frequency at PSAT over temperature**

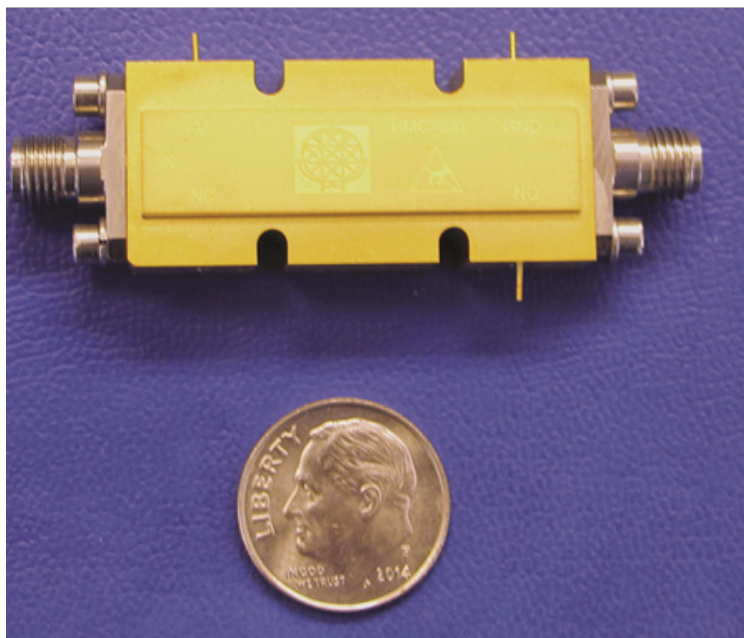


**Figure 18: HMC7891 measured Third Harmonic vs Freq at PSAT over Temperature**

requirement for limiting amplifier applications is -40 to 85°C. A rule-of-thumb gain variation formula of 0.01dB/degree/stage can be used to approximate the gain variability of a four stage amplifier design. Gain increases as temperature decreases and vice versa. Using ambient gain as a baseline, the total gain is

expected to decrease 2.4 dB at 85°C and increase 2.6 dB at -40°C. To thermally compensate the design, commercially available Thermopad temperature variable attenuators can be inserted in place of the fixed attenuators. Figure 4 illustrates test results of a wideband commercially available Thermopad attenuator.

Based on Thermopad test data and the approximated gain variation, it is clear that two Thermopad attenuators are necessary to thermally compensate a four stage limiting amplifier design. Deciding where to insert the Thermopads is an important decision. Due to the increased loss of Thermopad attenuators, especially at



**Figure 19: HMC7891**

cold temperatures, it is good practice to avoid adding the components near the output of the RF chain in order to maintain a high limiting output power level. Ideal Thermopad locations exist between the first three amplifier stages, as highlighted in Figure 5.

Simulation results of ADI's thermally compensated HMC7891 small signal performance is illustrated in Figure 6. Gain variation is reduced to a maximum of 2.5 dB prior to frequency equalization. This is within the  $\pm 1.5$  dB gain variation requirement.

### Frequency Equalization

The final design step is to improve gain flatness by incorporating frequency equalization. Frequency equalization compensates for the natural gain roll-off found in most wideband amplifiers by introducing a positive gain slope to the system. Various equalizer designs exist including passive GaAs MMIC die. Passive MMIC equalizers are ideal for limiting amplifier designs due to their

small size and lack of DC and control signal requirements. The number of required frequency equalizers depends on the uncompensated gain slope of the limiting amplifier and the response of the selected equalizer. A design recommendation is to slightly overcompensate the frequency response to account for transmission line loss, connector loss, and package parasitics which have a greater impact on gain at higher frequencies than lower frequencies. Test results for a custom ADI GaAs frequency equalizer are found in Figure 7.

ADI's HMC7891 limiting amplifier requires three frequency equalizers to correct the thermally compensated small signal response. Figure 8 illustrates the thermally compensated and frequency equalized simulation results of the HMC7891. Deciding where to insert the equalizers is critical for a successful design. Prior to adding any equalizers, it is important to remember that an ideal

limiting amplifier evenly distributes maximum amplifier compression across all gain stages in order to avoid oversaturation. In other words, each MMIC should be equally compressed under worst case conditions.

At the current stage of the design, shown in Figure 5, equalizers can be added at the device input, in series with Thermopad attenuators, in place of the fixed attenuator, or at the device output. Adding equalizers to the limiting amplifier input decreases power at the first gain stage. As a result, stage 1 compression decreases. A decrease in gain stage compression is equivalent to a decrease in limiting dynamic range. Further, due to the equalizer's attenuation slope, the limiting dynamic range disperses over frequency. Dynamic range decreases more at lower frequencies than at higher frequencies. To compensate for the decreased limiting dynamic range, the RF input power must increase. However, uniformly increasing input power adds to the risk of overdriving an amplifier gain stage due to the equalizer's slope. It is possible to add an equalizer at the device input, but this is not an ideal location.

Next, adding an equalizer in series with the Thermopad will reduce the compression of the succeeding amplifier. This creates an uneven distribution of amplifier compression among gain stages and decreases overall limiting dynamic range. Equalizers in series with Thermopad attenuators are not recommended.

Third, substituting an equalizer (or equalizers) in place of the fixed attenuator changes only the compression level of the output stage amplifier. To minimize this change and avoid RF overdrive, the equalizer







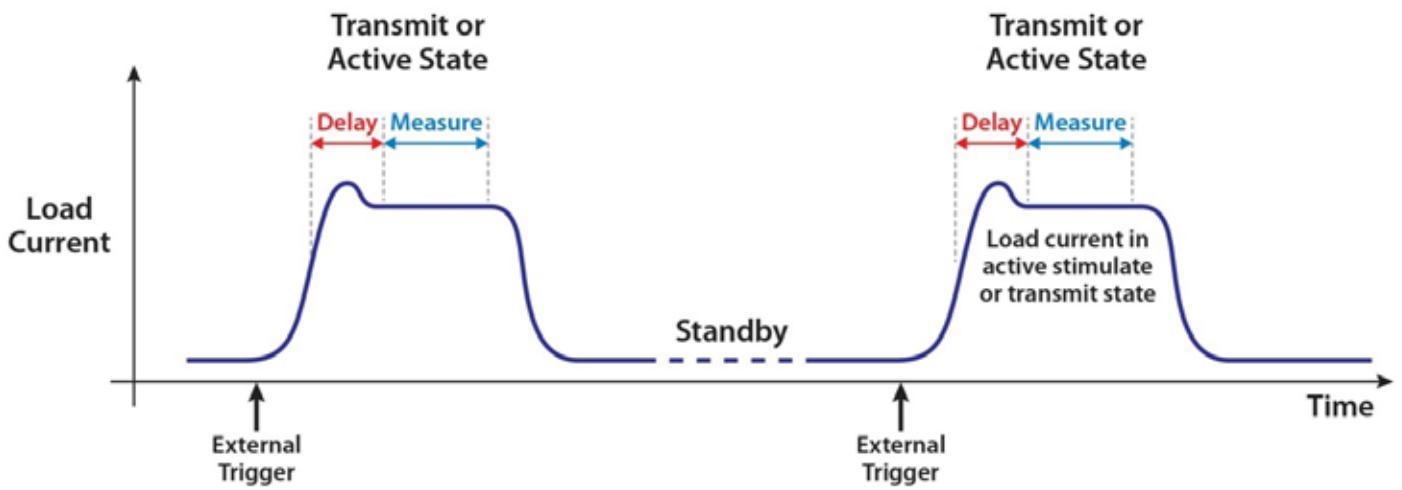


Figure 1. The load current profile for a typical wireless device includes long periods of low current consumption with short bursts of high current consumption when the device is stimulating or transmitting data

off some measurement accuracy and resolution to get speed.

Figure 1 illustrates a typical load current profile for a wireless IoT device. In sleep mode, the current is very low, but when the device is transmitting, the load current rises dramatically for a short period. To measure this current, the test instrumentation must respond to control signals that indicate when the device is transitioning into the active state so that the instrumentation can initiate the high-speed measurement. The instrument should also allow flexibility in selecting a measurement time so that the best measurement can be acquired.

Because the requirements for making accurate low current measurements during sleep and standby modes and those for making very fast high current measurements during the active mode are so different, one might assume that multiple instruments would be required to make these measurements. For example, it would be possible to put a sense resistor in series with the test lead that connects a power supply to the device-under-test and measure

the voltage across the sense resistor with a digital multimeter (DMM). However, it would be very challenging to choose the appropriate value for the sense resistor. A small resistor value adds only a small additional error to the load current measurement, but if

the value is too small, the DMM might lack sufficient sensitivity to measure the low sleep mode current, or even the standby mode current, accurately. Although an oscilloscope is well suited to the task of capturing the magnitude of short, active-mode load current



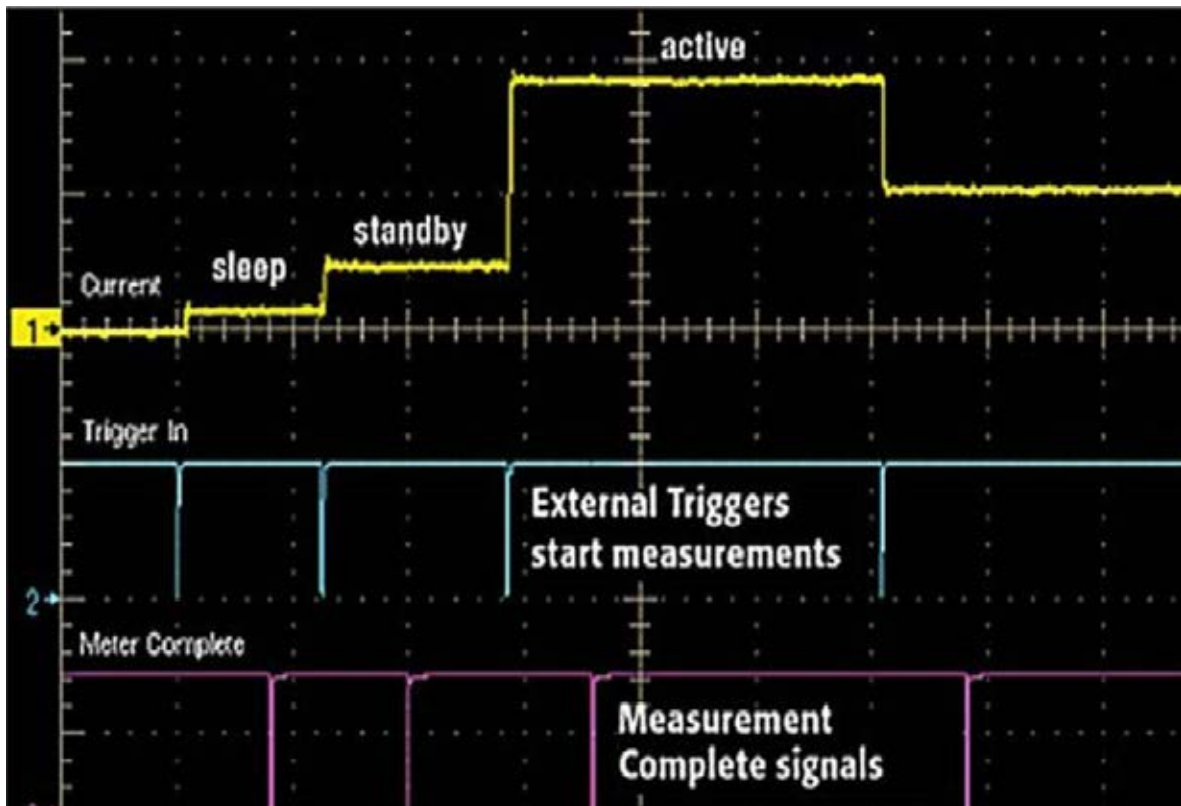
Figure 1. The load current profile for a typical wireless device includes long periods of low current consumption with short bursts of high current consumption when the device is stimulating or transmitting data.



**Figure 3. Keithley's Series 2280S Power Supplies can characterize small load currents with 10nA resolution and measure up to 6A very accurately. Four load current measurement ranges—10A, 1A, 100mA, and 10mA—allow measuring both full load currents and standby/sleep mode currents with 6 1/2 digit resolution. It can also capture dynamic load currents as short as 140µs.**

pulses, DMMs offer much greater precision when making voltage measurements. A power source, a DMM, and an oscilloscope might be required to make all the necessary measurements.

A source measure unit (SMU) instrument could be another possible option for this application. They can measure very low currents (down to picoamps or less) accurately; unfortunately, they are not typically designed to capture narrow pulses. Also, SMUs are generally low power instruments and so might not have sufficient total power to deliver the peak current necessary to characterize a device that draws a large amount of peak power. In addition, because of their extraordinary sensitivity, SMU instruments can be relatively expensive solutions for testing low-



**Figure 4. As a device is powered up during characterization or production testing, the load current increases as it cycles through the sleep, standby, and active modes. To characterize this start-up sequence, the test setup must be capable of making fast measurements synchronized to the device's state changes.**

cost parts.

## A single instrument solution for multiple measurement challenges

Obviously, most design and test engineers would prefer a solution that's less complicated to implement than configuring a test setup with a DC power supply to provide the source voltage, a sense resistor, a DMM, an oscilloscope, an SMU instrument, and a switching system to tie them all together. If they can make the measurements they need with only a single instrument, testing can begin sooner because there is less equipment to set up (Figure 2). Automating the measurement is simpler as well with

only one instrument to program. This eliminates the need to synchronize multiple instruments and allows the engineer to focus on making the measurement. However, instrument designers are only beginning to take on the challenge of creating instruments capable of providing the level of power needed to energize a wireless IoT device without sacrificing the ability to measure both very low load currents and much higher active load currents accurately and with high resolution. Such instruments are only now entering the market in the form of power supplies with integrated precision measurement capabilities (Figure 3).

In order to measure very low standby

or sleep mode currents accurately, a power supply/measurement instrument must be capable of DMM-quality measurements with up to 6½ digits of resolution. When making high current measurements, it has to capture current pulses as short as hundreds of microseconds. Also, because some devices, such as implantable medical sensors or other portable, battery-powered devices, have a power-up load sequence and a power-down sequence, similar to the one shown in Figure 4, the instrument chosen must have the triggering capabilities needed to make multiple, synchronized measurements at each state of the power-up or power-down cycle.

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## OrbitOutlook Integrates Largest and Most Diverse Network of Space Sensors Ever to Help Avoid Collisions in Space

### > DARPA

More than 500,000 pieces of manmade space debris—including spent rocket stages, defunct satellites, and fragments as small as flecks of paint—currently hurtle around the Earth at roughly 17,000 miles per hour. At those speeds, impacts involving even the smallest of those items can damage satellites and spawn chain reactions of collisions, increasing the amount of orbital flotsam and creating “minefields” in space that can remain unpassable for centuries. Tracking debris is thus essential—not just to protect existing commercial and government satellites but also to ensure that paths to critical locations in low Earth orbit (LEO), geosynchronous orbit, and orbits in

between stay clear and safe for future space assets.

Debris tracking requires knowing the location and behavior of space objects through persistent monitoring of the satellite population from as many sensor sources as possible. The historical steward of this responsibility has been the U.S. Air Force, which operates the United States Space Surveillance Network (SSN), a worldwide network of 29 military radar and optical telescopes. Over the last few years, the growing commercial space community has developed its own cost-effective networks incorporating hundreds of different sensors. These networks and the SSN cannot easily or quickly

share data with each other, however, because such sharing requires manual fusion of data in different formats. Additionally, the SSN can accept data collected only from certified, high-accuracy sensors.

Providing a way for all these networks to quickly acquire and process large amounts of high-quality data from diverse sources—including civil, commercial, academic, and international partners—would enable everyone monitoring space debris to better understand the quickly evolving space environment and evaluate when satellites are at risk. DARPA’s OrbitOutlook (O2) program is working toward that capability to improve overall space safety. This

month, the program completed integration of live data feeds from seven space situational awareness (SSA) data providers that together have more than 100 sensors around the world—the largest and most diverse network of space situational networks ever assembled. DARPA will soon start testing scalable, automated algorithms on this integrated feed, in an effort to identify and extract relevant data that SSA experts could use to make decisions in near real time.

“By including new telescopes and radar facilities based in diverse locales, and by revolutionizing how we process different data types, we anticipate vast improvements in our tracking of potentially hazardous objects and our ability to efficiently avoid collisions in space,” said Lt. Col. Jeremy Raley, DARPA program manager. “If we’re successful, OrbitOutlook could revolutionize how the U.S. military and the global space-debris-monitoring community collect and use space situational awareness data, through a framework based on partnerships and fee-for-service arrangements that would enable all parties to share and purchase data from hundreds of sensors. Not only could we double or triple the amount of useful data, but we could also generate indications and warnings in hours instead of weeks and provide orders-of-magnitude improvements in accuracy and affordability.”

Four of the seven data providers are networks that DARPA has developed to integrate SSA data from specific communities of interest:

StellarView, which uses optical telescopes and passive radio frequency (RF) telescopes at six academic institutions

SpaceView, which uses privately owned optical telescopes  
EchoView, in which DARPA is developing the technology to leverage commercial and civil radars and passive RF telescopes

The Low Inclined LEO Object (LILO) detection effort, which is deploying a suite of optical telescopes to Ascension Island in the South Atlantic Ocean to improve detection of space objects in equatorial orbits

Three commercial and government networks are providing data on a fee-for-service basis:

ExoAnalytic Solutions, a commercial network of optical and passive RF telescopes

Raven, a U.S. government network of small optical telescope systems composed of inexpensive commercial off-the-shelf (COTS) components under development at the Air Force Research Laboratory (AFRL)

Rincon, a commercial network using passive RF telescopes

DARPA will be testing algorithms designed to validate the quality of diverse data sets from non-certified SSA sensors in real time and determine if those data sets contain information that human experts can confidently use. If successful, the algorithms will monitor multiple sensors’ position estimates to dynamically detect and compensate for any corrupted or inaccurate measurements. Performance feedback will be provided to sources deemed inaccurate to inform corrective action. These algorithms also reduce the burden on data providers by translating their data from its native format into the official O2 format.

The algorithms are part of the OrbitOutlook data archive, which stores both the observation data received

from sensors and the processed data that the algorithms produce. DARPA can rapidly reconfigure the archive’s data storage as needed to facilitate the algorithms’ ability to query and index the enormous and ever-growing data sets the networks provide.

The archive and the algorithms reside in a sophisticated data center based on one developed by DARPA’s Insight program, which aims to create an adaptable, integrated systems for intelligence, surveillance, and reconnaissance (ISR) information to augment intelligence analysts’ support of time-sensitive operations on the battlefield. OrbitOutlook’s custom facility uses a specialized world model for space situational awareness.

Algorithm testing on real data is scheduled to begin in fall 2016. Upon successful demonstration of the algorithms, DARPA intends to share them and the data archive with the broader space-debris-tracking community through the DARPA Open Catalog. The Agency would then transition the O2 network to one or more stakeholders in the SSA community, such as the Air Force, NASA, the Federal Aviation Administration (FAA), industry, and other U.S. Government agencies. DARPA also intends to use OrbitOutlook’s products and technologies in the Agency’s Hallmark program, which has the overarching goal to provide breakthrough capabilities in U.S. space enterprise command and control.

## Robot earns its shoes, walks like a person

**What do you give a robot when it takes its first steps like a human? Its first pair of shoes.**

Georgia Institute of Technology researchers have created what they say is the most efficient-walking humanoid ever created. While most machines these days are hunched at the waist and plod along on flat feet, Georgia Tech's DURUS strolls like a person. Its legs and chest are elongated and upright. It lands on the heel of its foot, rolls through the step and pushes off its toe. It's even outfitted with a pair of size-13 shoes as it walks under its own power on a treadmill in the team's AMBER Lab.

"Our robot is able to take much longer, faster steps than its flat-footed counterparts because it's replicating human locomotion," said Aaron Ames, director of the Georgia Tech lab and a professor in the George W. Woodruff School of Mechanical



Engineering and School of Electrical and Computer Engineering. "Multi-contact foot behavior also allows it to be more dynamic, pushing us closer to our goal of allowing the robot to walk outside in the real world." As Ames tells it, the traditional approach to creating a robotic walker is similar to an upside-down pendulum. Researchers typically use comparatively simple algorithms to move the top of the machine forward while keeping its feet flat and grounded. As it shuffles along, the waist stays at a constant height, creating the distinctive hunched look. This not only prevents these robots from moving with the dynamic grace present in human walking, but also prevents them from efficiently propelling themselves forward. The Georgia Tech humanoid walked with flat feet until about a week ago, although it was powered by fundamentally different algorithms than most robots. To demonstrate the power of those methods, Ames



# Out Of the box



for a walking gait that stores mechanical energy from a heel strike to be later reclaimed as the foot lifts off the ground.

This natural gait makes DURUS very efficient. Robot locomotion efficiency is universally measured by a “cost of transport,” or the amount of power it uses divided by the machine’s weight and walking speed. Ames says the best humanoids are approximately 3.0. Georgia Tech’s cost of transport is 1.4, all while being self-powered: it’s not tethered by a power cord from an external source.

This new level of efficiency is achieved in no small part through human-like foot behavior. DURUS had earned its new pair of shoes.

and his team of student researchers built a pair of metal feet with arched soles. They applied their complex mathematical formulas, but watched DURUS misstep and fall for three days. The team continued to tweak the algorithms and, on the fourth day, the robot got it. The machine walked dynamically on its new feet, displaying the heel-strike and toe push-off that is a key feature of human walking. The robot is further equipped with springs between its ankles and feet, similar to elastic tendons in people, allowing

“Flat-footed robots demonstrated that walking was possible,” said Ames. “But they’re a starting point, like a propeller-powered airplane. It gets the job done, but it’s not a jet engine. We want to build something better, something that can walk up and down stairs or run across a field.”

He adds these advances have the potential to usher in the next generation of robotic assistive devices like prostheses and exoskeletons that can enable the mobility-impaired to walk with ease.

## **Toshiba Launches Photorelays for Semiconductor Testers in Industry's Smallest Package**

Toshiba Corporation's (TOKYO: 6502) Storage & Electronic Devices Solutions Company today announced the launch of photorelays in the industry's smallest[1] package. Shipments start from today.

The new product, "TLP3406S", utilizes the industry's smallest package for photorelays, the Toshiba-developed S-VSON4 package. Compared to Toshiba's previous products in a VSON4 package, the new photorelay has an approximately 22.5%[2] smaller assembly area, which can contribute to the development of smaller test boards and also make it possible to increase the number of photorelays on a board to increase density. Since the new photorelay can drive large currents of up to 1.5A, in spite of its small package, it can be used in device power supplies (DPS) that make up the power supply circuits in various testers. As a further positive, the operating temperature range has been enhanced from 85 degrees Celsius (max.) to 110 degrees Celsius (max.).



## **STMicroelectronics Releases Development Ecosystem and Adds New Devices in Low-Power STM32L4 Microcontroller Series**

STMicroelectronics has introduced the development ecosystem for its latest low-power, high-performance STM32L4 microcontrollers (MCU) and expanded the series with five new product lines comprising a range of package and memory-density options. STMicroelectronics Releases Development Ecosystem and Adds New Devices in Low-Power STM32L4 Microcontroller Series

The expanded STM32L4 ecosystem builds on ST's free and easy-to-use STM32Cube platform. This comprises the STM32CubeMX initialization-code generator and configurator with easy-to-use power estimation for ultra-low-power design, and the STM32CubeL4 package that contains middleware components, Nucleo-32 Board-Support Package (BSP), Hardware Abstraction Layer (HAL), and Low-Layer APIs (LLAPIs). For a quick start to new projects, the slim-form-factor NUCLEO-L432KC board – the first Nucleo-32 board to integrate an MCU in the tiny QFN32 package - includes an STM32L432KCU6 device (UFQFPN32) and provides direct access to ARM® mbed™ online tools. Its Arduino Nano pin layout simplifies function extensions, and the integrated ST-Link debugger/programmer supports mass storage and allows probe-free debugging.

Five new STM32L43x and STM32L44x MCU product lines comprise variants with versatile combinations of an integrated USB controller, an LCD controller, and cryptography for security-conscious applications. Up to 256KByte of Flash and low-pin-count-package choices make them ideal for cost-sensitive applications. The new devices also offer rich digital peripherals including a True Random-Number Generator (TRNG) and smart analog features such as a 12-bit 5Msamples/s ADC, internal voltage reference, and ultra-low-power comparators.

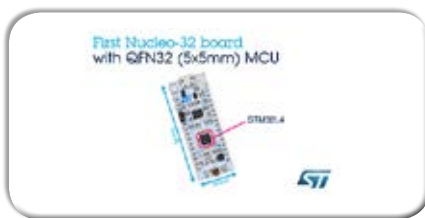
All devices deliver the advantages of ST's innovative low-power technology, which includes FlexPowerControl (FPC) with features such as separate supply-voltage domains for gating power individually to analog peripherals, USB circuits, and I/Os. Batch-Acquisition Mode (BAM) enables energy-efficient data capture and seven reduced-power modes with further sub-modes maximize energy savings in a wide range of operating conditions.

ST's low-power technologies, combined with the performance of the 32-bit ARM Cortex®-M4F core, ensure high efficiency according to EEMBC™ ULPBench™ tests. The STM32L433 is certified at 177 ULPMark™-CP[1] at 3.0V, tested without the aid of a step-down converter. Aided by ST's innovative ART Accelerator™, outright performance is also high at 273 CoreMark®.

The new devices are available

immediately, in small-form-factor packages from 5mm x 5mm QFN-32 to 14mm x 14mm LQFP-100, including 3.14mm x 3.13mm WLCSF. Prices start from \$2.045 for the STM32L431KBU6 with 128KByte Flash and 64KByte SRAM in QFN-32, for orders of 10,000 pieces.

[1] ULPMark-CP: microcontroller efficiency score, calculated as (1000/median energy per second for 10 ULPBench cycles). A larger number implies better efficiency.



### **Conrad Business Supplies to introduce twelve user-friendly handheld test and measurement devices from Testo**

Ficosa, a top-tier global provider Conrad Business Supplies has introduced five families of handheld test and measurements devices from leading manufacturer Testo. The twelve new products of the 770, 760, 755, 750 and 745 families provide intuitive and user-friendly means to measure electrical current and voltage in different settings and environments. They join over 700 products from Testo already stocked by Conrad.

The three devices that make up the Testo 770 range are clamp meters, ideally suited for current measurement in switching cabinets. A unique mechanism which retracts one of the two pincer arms ensures

that cables, even in constrained cabinets, can still be easily grabbed. Similarly innovative are the three Testo 760 automatic multimeters that boast function keys in the place of dials, to provide easier operation. They also feature automatically detected measurement parameters that make it impossible for the user to enter incorrect settings.

Of the remaining three new families, there are the two Testo 755 voltage testers, which are first of their kind to be capable of measuring both voltage and current. Next are the three models of the 750 range that incorporate novel all-round LED displays, permitting the results to be seen from any angle. Finally the Testo 745 is a non-contact voltage tester with a range of up to 1,000 V, with both sound and visual voltage warnings, plus a filter for high-frequency interference signals.

Benedikt Sehr, Product Manager, Category Business Supplies at Conrad commented: "With the available range of test and measurement products from Testo now at Conrad, we are determined to meet our customer's requirements for any task, in any location and at a price that works for them. The new and carefully selected products for measurement parameters complements the available environment measurement product portfolio perfectly."



### **Ricoh Europe (Netherlands) B.V. Semiconductor Support Centre has launched the R5112, a voltage regulator plus voltage detector designed to minimise current consumption**

At the upcoming FashionTech Ricoh Europe (Netherlands) B.V. Semiconductor Support Centre has launched the R5112, a voltage regulator plus voltage detector designed to minimise current consumption. The device offers a wide operating temperature range and accommodates a variety of high demanding applications for consumer, automotive and industrial use.

The R5112 features 42V maximum input voltage and 200mA output current with an absolute maximum rating of 50V and is able to tolerate load-dump peak voltages of 60V (<200ms) and has a consumption of only 3.8µA long stand-by time of the battery is guaranteed. The operating temperature range varies from -40°C to 105°C for consumer applications and up to 125°C for automotive and industrial use. Meanwhile, the output voltage and threshold voltage has an excellent accuracy of ±0.6%, as well as a low temperature drift coefficient of ±60ppm/°C, which make the device suitable as a high reliable power source.

As for protection circuits, the R5112 comprises an output short-circuit, an overcurrent and a thermal shutdown protection circuit in addition to the basic voltage regulator circuits. The fold-back type output short circuit

protection ensures that the output current is reduced to typically 80mA during a short circuit event. The regular over-current protection limits the output current to typically 350mA and the protection is automatically released once the excessive load has been removed.

The thermal shutdown circuit detects when the voltage regulator becomes overheated and disables the device when exceeding a temperature threshold to protect it from damage.

The additional embedded voltage detector is used to monitor a voltage level and provides a reset signal on the output as soon the voltage drops below a specified threshold voltage. The designer has the option to select between a version monitoring the output of the voltage regulator and a version monitoring a voltage source of preference by an individual sense pin. The output of the voltage detector can be used to reset a processor IC when its supply voltage drops below a critical minimum level. The actual length of the reset period can be specified by the value of an external capacitor.

This device is offered in an 8-pin HSOP-8E package with high power dissipation capability.

Ricoh Electronic Devices Co., LTD. (REDC) recently expanded its product portfolio, now consisting of three main application categories: Consumer, Industrial and Automotive. All semiconductor devices are standard tested at 25°C for consumer use. The products for industrial and automotive applications both passed an

additional screening at high temperature and exposure to an extended reliability test period. Automotive products are ranked upon purpose: Safety-critical parts, General equipment or Accessories. These devices (except the latter category) are also tested at low temperature. The R5112 is designed for general equipment as well as accessories and is scheduled to become AEC-Q100 compliant.



### Alliance Memory Launches New Monolithic High-Speed, Low-Voltage 1G x 8 CMOS DDR3L SDRAM in 78-Ball FBGA Package

Alliance Memory today introduced a new monolithic high-speed, low-voltage CMOS double data rate 3 synchronous DRAM (DDR3L SDRAM) with an 8-Gb density in the 78-ball, 9-mm by 13.2-mm, lead (Pb)-free FBGA package. Delivering increased power efficiency for high-end computer and storage systems, the 1G x 8 AS4C1G8MD3L offers a double data rate architecture for extremely fast transfer rates of up to 1600 Mbps/pin and clock rates of 800 MHz.

The AS4C1G8MD3L's transfer rates are twice as high as DDR and

DDR2 SDRAMs, providing higher bandwidth for newer-generation microprocessors in industrial, medical, networking, telecom, and aerospace applications. The 8-GB DDR3L SDRAM operates from a single +1.35-V power supply and is backwards-compatible with +1.5-V power supplies to enable large memory subsystems. The device is a logical choice for customers that require increased memory yet face board space constraints.

The AS4C1G8MD3L is available with an extended commercial temperature range of 0 °C to +95 °C (AS4C1G8MD3L-12BCN). Internally configured as eight banks of 1G x 8 bits, the DDR3L SDRAM features a fast 64-ms, 8192-cycle refresh from 0 °C to +85 °C and 32 ms from +85 °C to +95 °C.

The device released today offers fully synchronous operation and provides programmable read or write burst lengths of 4 or 8. An auto precharge function provides a self-timed row precharge initiated at the end of the burst sequence. Easy-to-use refresh functions include auto- or self-refresh, and a programmable mode register allows the system to choose the most suitable modes to maximize performance.

In addition to the 1G x 8 AS4C1G8MD3L, Alliance Memory also offers the 512M x 16 AS4C512M16D3L in the 96-ball FBGA package, which is available in an extended commercial temperature range (AS4C512M16D3L-12BCN) and an industrial temperature range from

-40 °C to +95 °C (AS4C512M16D3L-12BIN). Alliance Memory is one of the few suppliers of monolithic DDR3L SDRAMs with high densities to 8 Gb. In addition, with minimal die shrinks, the single-die AS4C1G8MD3L provides a reliable drop-in, pin-for-pin-compatible replacement for a number of similar solutions - eliminating the need for costly redesigns and part requalification.

Samples and production quantities of the new 8-GB DDR3L SDRAM are available now, with lead times of six to eight weeks. Pricing for U.S. delivery starts at \$18.00 per piece.



### Next Generation Dual-Mode Bluetooth® Audio Products from Microchip

Microchip Technology Inc. (NASDAQ: MCHP), a leading provider of microcontroller, mixed-signal, analog and Flash-IP solutions, today announces the next generation of dual-mode Bluetooth® audio products. The IS206X family builds on Microchip's successful IS202X portfolio of highly integrated system-on-a-chip (SoC) devices and modules by introducing Bluetooth Low Energy (BLE) capability. Uniquely engineered for speakers, headsets and gaming headphones, this Flash-based

platform offers ample flexibility and powerful design features, allowing audio manufacturers to easily incorporate wireless connectivity in streaming music and voice command applications.

A high-performance 32-bit Digital Signal Processing (DSP) core provides the framework to develop sophisticated algorithms for advanced audio and voice processing. The 24-bit digital audio support delivers high-resolution audio to consumers for a richer listening experience. Sound systems comprised of multiple Bluetooth speakers benefit from ultra-low latency audio streaming, resulting in tightly synchronized audio playback amongst each speaker. Applications such as professional headsets benefit from high definition voice, achieved with a robust implementation of 16 kHz wideband voice with noise suppression and echo cancellation. The added firmware update capability allows for product software and configuration features enhancements over time.

Qualified for Bluetooth v4.2, the IS206X family supports Enhanced Data Rate (EDR) links and the standard audio profiles. The powerful combination of BLE and Advanced Audio Distribution Profile (A2DP) enables smartphone-to-speaker communication via a mobile app. Customized apps enrich the consumer's experience by providing creative control features such as pairing, remote control and real-time audio effect adjustments.

"In addition to expecting high-

quality sound, consumers are increasingly demanding a rich user experience that streamlines their communication and interaction with their audio equipment. Our IS206x family is designed to combine the convenience of wireless, portable speakers with a simplistic interface to easily connect and control multiple end devices," said Steve Caldwell, vice president of Microchip's Wireless Solutions Group.

The IS206X family is available in several offerings, allowing customers to tailor their wireless needs. For designs that require a turn-key solution for fast time-to-market, customers can take advantage of the chip's powerful features by choosing a module configuration with either a Class 1 or a Class 2 device. All modules are fully certified with the following regulatory bodies: United States (FCC) and Canada (IC), European Economic Area (CE), Korea (KCC), Taiwan (NCC) and Japan (MIC).

To learn more about Microchip's Bluetooth technology and products, visit: [http://www.microchip.com/IS206X\\_Bluetooth2149](http://www.microchip.com/IS206X_Bluetooth2149)

Development Support

Microchip also introduced three Evaluation Boards for the IS206x family in order to enable easy development. The BM-62-EVB (\$99.99), BM-63-EVB (\$124.99), BM-64-EVB-C2 (\$124.99), and BM-64-EVB-C1 (\$124.99) are available today. To purchase the boards, visit [microchipDIRECT](http://microchipDIRECT) or contact any of Microchip's authorized worldwide distributors.

For additional information, contact

any Microchip sales representative or authorized worldwide distributor, or visit Microchip's Web site at [http://www.microchip.com/IS206X\\_Bluetooth2149](http://www.microchip.com/IS206X_Bluetooth2149). To purchase products mentioned in this press release, go to microchipDIRECT (<http://www.microchipdirect.com>) or contact one of Microchip's authorized distribution partners.



### **NXP, Tongji University, SAIC and Partners Launch First Large-Scale Road Test for Intelligent Connected Vehicles in China**

NXP Semiconductors (NASDAQ:NXPI) and Tongji University recently announced their support for the launch and implementation of China's first ever large-scale road test initiative for intelligent connected vehicles through the NXP-Tongji University Joint Lab. As part of the Shanghai Intelligent and Connected Vehicle Demonstration Program, the road testing initiative will serve as a foundation for China's development of smart transportation and vehicle-to-vehicle communications standards.

NXP and its partner Cohda Wireless will provide secure vehicle-to-vehicle and vehicle-to-infrastructure (V2X) communications technology for cars and roadside infrastructure.

Road testing will collect V2X communications data in real time from multiple test scenarios, including measures of active safety, traffic management and information services.

The launch of road testing represents a significant milestone for the Shanghai Intelligent and Connected Vehicle Demonstration Program. Launched in October 2015, the first phase of this program now will involve approximately 200 vehicles from the Shanghai Automotive Industry Corporation (SAIC), one of China's largest domestic auto manufacturers, as well as from other participating automakers. As additional carmakers join the program, the aim is to have 1,000 intelligent and connected vehicles by 2017, 5,000 vehicles by the end of 2019, and 10,000 vehicles by 2020.

Today's announcement of joint NXP/Tongji University support for the V2X road-testing initiative is the latest of many milestones following the foundation of the NXP-Tongji University Joint Lab last year. Dedicated to developing customized connected car solutions for the Chinese market, the lab leverages advanced technologies and products from NXP, as well as the company's deep automotive expertise.

Both the vehicles and transportation infrastructure units involved in the road tests utilize the newest generation of NXP's RoadLINK™ solution. RoadLINK technology is based on the IEEE 802.11p wireless communication protocol, and is proven by ten years of testing by multiple European and U.S. government and professional institutions. Utilizing the proven

802.11p wireless protocol instead of slower and less reliable cellular networks, the RoadLINK solution delivers deterministic performance for safety-critical applications, while also providing higher levels of security and privacy protection.

"We are pleased to partner with SAIC and Tongji University to further advance the Shanghai Intelligent and Connected Vehicle Demonstration Program," said Li Zheng, President of NXP Greater China. "Developing intelligent transportation systems is vital for building sustainable cities. As a global leader in secure connected vehicle solutions and autonomous driving platforms, NXP is truly honored to offer the proven reliability of RoadLINK technology and our deep automotive expertise for the creation of world-class intelligent transportation systems in China."

"SAIC was one of the first companies to deploy intelligent and connected vehicles, and has been actively promoting the development and application of V2X technology in China," said Zou Qingquan, SAIC's Head of the Intelligent and Connected Vehicle Program. "We look forward to working with our industry partners to advance the development of the Shanghai Intelligent Connected Vehicles Demonstration Program."

"A large-scale road test is a significant step in the progress of the demonstration program," said Professor Wang Ping, Director of the Intelligent and Connected Vehicle program at Tongji University. "We will continue cooperating with NXP and SAIC in order to satisfy the demands of the Chinese market, and to support the development of the intelligent vehicle industry in

China.”

Intelligent, connected vehicles and intelligent transportation infrastructure can effectively reduce accidents, improve traffic efficiency and reduce traffic pollution. NXP is a global leader of secure connected vehicle technologies through its RoadLINK solution. RoadLINK has been widely acknowledged for its high level of security, scalability and interoperability, with verified road test results in major global markets including the United States and Europe, and more than one million testkilometres driven. In March 2016, NXP was named a partner of the U.S. Department of Transportation to provide V2X solutions for the Smart City Challenge. And in April, RoadLINK-equipped automated trucks successfully demonstrated self-driving technology during the European Truck Platooning Challenge in four out of six OEM truck platoons, during an event organized by the Dutch Ministry of Infrastructure and the Environment held to showcase the economic, traffic management and safety advantages inherent in sophisticated vehicle-to-vehicle communications solutions. Furthermore, NXP and Cohda Wireless will supply their V2X technology to Delphi for implementation in the first V2X-equipped production vehicles in the U.S. planned for later this year.

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 **Cypress Now the Leading Internet of Things Supplier with Acquisition of Broadcom’s Wireless IoT Business**

Cypress Semiconductor Corp.

(Nasdaq: CY) today announced that it has closed its previously announced acquisition of the Wireless Internet of Things (IoT) business and related assets of Broadcom Limited in an all-cash transaction valued at \$550 million. Cypress now offers state-of-the-art Wi-Fi, Bluetooth® and ZigBee® IoT product lines, along with supporting intellectual property and the WICED™ brand Software Development Kit (SDK), developer ecosystem and community. These technologies, combined with Cypress’s existing microcontroller (MCU), PSoC® programmable system-on-chip, analog and memory products, provide customers with complete solutions for connected embedded systems in its key automotive and industrial markets. The low-power products also position Cypress as a leader in the high-growth consumer IoT market, a segment that includes wearable electronics and home automation solutions. More information on Cypress’s IoT portfolio is available at <http://www.cypress.com/welcome-iot>.

“The world’s leading innovators across the automotive, industrial and consumer markets are looking to connect their products, and starting today with the close of this acquisition, Cypress is now an IoT leader that can offer customers the industry’s most advanced wireless radios and the ability to design products and get to market faster with the support of our WICED SDK and developer ecosystem,” said Badri Kothandaraman, Executive Vice President of Cypress’s Data

Communications Division, which now includes the IoT Business Unit. “We are making world-class wireless radio technology used by top device manufacturers available to our broad, global customer base, adding to the versatility of our existing embedded solutions portfolio.”

“When it comes to supporting customers in the fast-growing IoT market, there is no one-size-fits-all approach; you need a scalable platform that allows for innovation,” said Stephen DiFranco, Senior Vice President of the IoT Business Unit at Cypress and former General Manager of Broadcom IoT. “WICED delivers a uniquely scalable ecosystem of module makers, value-added resellers (VARs), technology partners and ODMs to developers, along with the ability to quickly customize solutions for everything from connected cars to industrial automation equipment to wearables to smart home appliances. With Cypress’s established track record as a supplier of MCUs, memories and Power Management ICs (PMICs) in the various segments these products represent, we are excited by the significant cross-selling opportunities now open to us.” More information on Cypress’s WICED community is available at [www.cypress.com/wicedcommunity](http://www.cypress.com/wicedcommunity).

Technology Roadmap and Radio Integration

The Cypress wireless radio portfolio includes products based on advanced 40nm process technology, and the company is developing next-generation products on

smaller, ultra-low-power technology nodes. This technology enables unparalleled integration of multiple radios that will allow Cypress to expand its wireless combinations, including its Wi-Fi and Bluetooth offerings that are ideal for a broad range of IoT products.

“Our multi-protocol Wi-Fi and Bluetooth products provide exceptional system value to our customers,” added Kothandaraman. “We will continue to expand these offerings, and we will also look at ways to integrate our radios with our ARM®-based PSoC programmable system-on-chip and MCU solutions, building on the success of our PSoC 4 BLE chips and EZ-BLE™ modules.”

#### Driving Connected Cars

Cypress now holds a leadership position in connected cars with more than a decade of delivering industry firsts, including the first Bluetooth and first Wi-Fi in vehicles. The Cypress portfolio is now the first to offer Wi-Fi-Bluetooth combinations to upgrade legacy Bluetooth audio with Internet connectivity, and it includes the first simultaneous 2.4-GHz and 5-GHz 802.11ac radios.

“Our robust automotive-grade wireless portfolio is transforming the connected car experience by powering simultaneous usage of multiple displays and media sharing,” added DiFranco. “In addition to Internet connectivity, our radios fit right in with Cypress’s Traveo™ automotive MCUs and high-performance flash memories that enable firmware over-the-air updates, which greatly reduce implementation costs and save

car owners a trip to a dealership mechanic.”

#### Toshiba Launches Large-current Control Photorelays in Small Packages

Toshiba Corporation’s (TOKYO: 6502) Storage & Electronic Devices Solutions Company today announced the launch of large-current control photorelays, for currents in the range of 1.7A to 4A, in 2.54SOP4 and 2.54SOP6 small packages. Shipments start from today. Applications for the new line-up of four products, TLP3106, TLP3107, TLP3109 and TLP3127, include programmable logic controllers (PLC), battery management systems (BMS) and factory automation inverters. The new photorelays utilize Toshiba’s latest generation trench MOSFETs to control large currents at levels equivalent those usually handled by mechanical relays[1]. Compared to mechanical relays, which have mechanical contacts, photorelays have the advantages of producing less noise and no deterioration caused by the contacts wearing.

In the case of the new 2A product, TLP3109, use of a 2.54SOP6 package reduces mounting volume by approximately 40% and the product height by approximately 50%, against Toshiba previous products in DIP packages. The small size allows mounting on the back surface of printed circuit boards and can contribute to smaller sets. Furthermore, the line-up includes products with terminal voltages (blocking voltages) of up to 100V for

use in various applications.



#### STMicroelectronics Unveils Free and Feature-Rich Simulator to Aid Design for Electromagnetic Compatibility (EMC)

STMicroelectronics (NYSE: STM) , a global semiconductor leader serving customers across the spectrum of electronics applications, is helping protect today’s smart devices by making shirt pockets, car dashboards, office desks, and other statically dangerous locations safer through the introduction of a new software tool that guides the selection of the right protection components for integrated-circuit designs right from the beginning. People, clothing, and objects can easily accumulate static charges of many thousands of volts that may give a minor shock to the human body but present a growing threat to increasingly delicate chips in devices like smartphones and tablets, computers, or televisions. Exposed ports such as USB or HDMI™ sockets are especially vulnerable to these electrostatic discharges (ESD). The protection circuitry needed to handle ESD energy often requires testing with a real prototype where late design changes add to costs and cause delays.

ST’s new free online software tool, ESD-SIM, answers this challenge. It



is capable of assessing both circuit protection and signal integrity, to help select the right ESD-protection components from ST's portfolio before hardware is built.

"ESD-SIM delivers a significant boost to circuit-board design efficiency, enabling engineers to evaluate electrical performance of protection-circuitry components online and jumpstart their designs by using Keysight's simulation technology with ST component models," said Ricardo De Sa Earp, ASD and IPAD Division Manager, STMicroelectronics.

ST has adopted Keysight EEs of EDA software, including ADS, for design and simulation as it is the gold standard for high-frequency and high-speed simulation. Now, ESD-SIM makes the ADS simulator available online, for evaluation of ST's protection components.

ESD-SIM now allows engineers to finalize their choice of ESD protection at an early stage and move on to design higher-value product features without fear of encountering extra costs and delays later in the project.

ESD-SIM has been created for ST by tools specialist Transim, with simulation powered by Keysight's ADS. ESD-SIM provides a quick and easy way to evaluate the performance of ST devices using the industry-standard high-speed/high-frequency SPICE simulation engine in ADS. The validation output of the online tool is free of charge, and it further provides an ADS workspace to jumpstart the design process in commercially available design software. "As a free tool, the revolutionary ESD-SIM will change the way all engineers design their circuit boards, and eliminate the hassles

associated with last-minute changes to correct unforeseen problems," said Torsten Goebner, Development and Engineering Manager at Transim.

The tool uses ST's TVS (Transient Voltage Suppressor) SmartSelector to choose suitable protection components, whether the application is digital, analog, automotive, or power. ESD-SIM then runs ESD and signal-integrity simulations, using Transmission Line Pulse simulation, eye diagrams, time-domain reflectometry and S-parameters to ensure high-speed signals such as USB 3.1, HDMI, DisplayPort™, or SATA satisfy the applicable specifications. This can be done quickly and easily, requiring only seven mouse clicks. Pre-configured simulation setups and signal tests are included, which saves any need for the user to create tests and ensure compliance with the relevant standards. The simulations are also customizable, and users can save and share designs with local teams or the ESD-SIM community.

ESD-SIM is available now, free of charge to any user registered at my.st.com.

For further information please go to [www.st.com/esd-design-pr](http://www.st.com/esd-design-pr)

About STMicroelectronics

ST is a global semiconductor leader delivering intelligent and energy-efficient products and solutions that power the electronics at the heart of everyday life. ST's products are found everywhere today, and together with our customers, we are enabling smarter driving and smarter factories, cities and homes, along with the next generation of mobile and Internet of Things devices.

By getting more from technology to get more from life, ST stands for life.

augmented.

In 2015, the Company's net revenues were \$6.90 billion, serving more than 100,000 customers worldwide. Further information can be found at [www.st.com](http://www.st.com).

### **Microchip Launches Lowest Power, Cost-Effective PIC32 Family With Core Independent Peripherals**

Microchip® Technology Inc. (NASDAQ: MCHP), a leading provider of microcontroller, mixed-signal, analog and Flash-IP solutions, today announced the company's lowest power and most cost-effective family of 32-bit PIC32 microcontrollers (MCUs). The Microchip PIC32MM family bridges the gap between the company's popular PIC24F XLP and PIC32MX families. The new family is the first PIC32 to feature core independent peripherals, designed to offload the CPU for lower power and lower system design. The PIC32MM devices are supported by the Microchip MPLAB® Code Configurator (MCC) to help simplify and accelerate designs.

Today's embedded applications targeting the Internet of Things (IoT), consumer, industrial control, and motor control require flexible MCUs that consume less power, are more cost effective and have smaller form factors. For applications demanding low power and longer battery life, the PIC32MM has sleep modes down

to 500 nA. Applications with space constraints will benefit from the small 4 x 4 mm package options. The PIC32MM devices include core independent peripherals such as Configurable Logic Cells (CLC) and Multiple-output Capture Compare PWMs (MCCPs) which help enable sensorless BLDC motor control applications.

“With volume pricing starting at \$0.60, sleep modes down to 500 nA, and compact 4 x 4 mm packages, the PIC32MM family offers a compelling solution for applications with budget, power and size constraints,” said Joe Thomsen, vice president of Microchip’s MCU16 business unit. “Supported by the popular MPLAB Code Configurator tool, these PIC32MM devices are easy to set up, accelerating design schedules for rapidly changing markets.”

#### Development Support

To help accelerate evaluation and development, a new PIC32MM processor plug-in module is available (MA320020, \$25), which plugs into the Explorer 16 Development Board (DM240001, \$129.99). The entire family of PIC32MM devices is supported by Microchip’s professional tool ecosystem that includes MPLAB X IDE and the MPLAB XC compiler. The MPLAB Code Configurator, a plug-in to the MPLAB X, helps with easy peripheral setup, device configuration and pin mapping.

For a limited time, if you buy a PIC32MM PIM (MA320020) for \$25, you can get an Explorer 16 board (DM240001) for \$89.99, a \$40 savings. Visit [www.microchip.com](http://www.microchip.com)

for details.

#### Pricing and Availability

The PIC32MM family is available in mass production today in 20-pin QFN and SSOP; 28-pin uQFN, QFN, SOIC, SSOP, SPDIP; 36-pin QFN; and 40-pin uQFN packaging. Devices are available in 16 KB, 32 KB, and 64 KB Flash variants, with volume pricing starting at \$0.60 USD.

For additional information, contact any Microchip sales representative or authorized worldwide distributor, or visit Microchip’s Web site at [www.microchip.com/PIC32MM](http://www.microchip.com/PIC32MM).

To purchase products mentioned in this press release, go to [microchipDIRECT](http://microchipDIRECT) or contact one of Microchip’s authorized distribution partners.



#### Tough new hydrogel hybrid doesn’t dry out

If you leave a cube of Jell-O on the kitchen counter, eventually its water will evaporate, leaving behind a shrunken, hardened mass — hardly an appetizing confection. The same is true for hydrogels. Made mostly of water, these gelatin-like polymer materials are stretchy and absorbent until they inevitably dry out.

Now engineers at MIT have found a way to prevent hydrogels from

dehydrating, with a technique that could lead to longer-lasting contact lenses, stretchy microfluidic devices, flexible bioelectronics, and even artificial skin.

See how MIT researchers designed a hydrogel that doesn’t dry out.

Video: Melanie Gonick/MIT

The engineers, led by Xuanhe Zhao, the Robert N. Noyce Career Development Associate Professor in MIT’s Department of Mechanical Engineering, devised a method to robustly bind hydrogels to elastomers — elastic polymers such as rubber and silicone that are stretchy like hydrogels yet impervious to water. They found that coating hydrogels with a thin elastomer layer provided a water-trapping barrier that kept the hydrogel moist, flexible, and robust. The results are published today in the journal *Nature Communications*. Zhao says the group took inspiration for its design from human skin, which is composed of an outer epidermis layer bonded to an underlying dermis layer. The epidermis acts as a shield, protecting the dermis and its network of nerves and capillaries, as well as the rest of the body’s muscles and organs, from drying out.

The team’s hydrogel-elastomer hybrid is similar in design to, and in fact multiple times tougher than, the bond between the epidermis and dermis. The team developed a physical model to quantitatively guide the design of various hydrogel-elastomer bonds. In addition, the researchers are exploring various applications for the hybrid material, including

artificial skin. In the same paper, they report inventing a technique to pattern tiny channels into the hybrid material, similar to blood vessels. They have also embedded complex ionic circuits in the material to mimic nerve networks.

The paper's lead author is MIT graduate student Hyunwoo Yuk. Co-authors include MIT graduate students German Alberto Parada and Xinyue Liu and former Zhao group postdoc Teng Zhang, now an assistant professor at Syracuse University.

#### Getting under the skin

In December 2015, Zhao's team reported that they had developed a technique to achieve extremely robust bonding of hydrogels to solid surfaces such as metal, ceramic, and glass. The researchers used the technique to embed electronic sensors within hydrogels to create a "smart" bandage. They found, however, that the hydrogel would eventually dry out, losing its flexibility.

Others have tried to treat hydrogels with salts to prevent dehydration, which Zhao says is effective, but this method can make a hydrogel incompatible with biological tissues. Instead, the researchers, inspired by skin, reasoned that coating hydrogels with a material that was similarly stretchy but also water-resistant would be a better strategy for preventing dehydration. They soon landed on elastomers as the ideal coating, though the rubbery material came with one major challenge: It was inherently resistant to bonding with hydrogels.

The team tried to bond the materials

together using the technique they developed for solid surfaces, but with elastomers, Yuk says, the hydrogel bonding was "horribly weak." After searching through the literature on chemical bonding agents, the researchers found a candidate compound that might bring hydrogels and elastomers together: benzophenone, which is activated via ultraviolet (UV) light.

After dipping a thin sheet of elastomer into a solution of benzophenone, the researchers wrapped the treated elastomer around a sheet of hydrogel and exposed the hybrid to UV light. They found that after 48 hours in a dry laboratory environment, the weight of the hybrid material did not change, indicating that the hydrogel retained most of its moisture. They also measured the force required to peel the two materials apart, and found that to separate them required 1,000 joules per square meters — much higher than the force needed to peel the skin's epidermis from the dermis.

#### Expanding the hydrogel toolset

Taking the comparison with skin a step further, the team devised a method to etch tiny channels within the hydrogel-elastomer hybrid to simulate a simple network of blood vessels. They first cured a common elastomer onto a silicon wafer mold with a simple three-channel pattern, etching the pattern onto the elastomer using soft lithography. They then dipped the patterned elastomer in benzophenone, laid a sheet of hydrogel over the elastomer, and exposed both layers to ultraviolet light. In experiments,

the researchers were able to flow red, blue, and green food coloring through each channel in the hybrid material.

Yuk says in the future, the hybrid-elastomer material may be used as a stretchy microfluidic bandage, to deliver drugs directly through the skin.

The researchers also explored the hybrid material's potential as a complex ionic circuit. A neural network is such a circuit; nerves in the skin send ions back and forth to signal sensations such as heat and pain. Zhao says hydrogels, being mostly composed of water, are natural conductors through which ions can flow. The addition of an elastomer layer, he says, acts as an insulator, preventing ions from escaping — an essential combination for any circuit.

To make it conductive to ions, the researchers submerged the hybrid material in a concentrated solution of sodium chloride, then connected the material to an LED light. By placing electrodes at either end of the material, they were able to generate an ionic current that switched on the light.

This research was funded, in part, by the Office of Naval Research, Draper Laboratory, MIT Institute for Soldier Nanotechnologies, and National Science Foundation.



## New mid-infrared laser system could detect atmospheric chemicals

Researchers at MIT and elsewhere have found a new way of using mid-infrared lasers to turn regions of molecules in the open air into glowing filaments of electrically charged gas, or plasma. The new method could make it possible to carry out remote environmental monitoring to detect a wide range of chemicals with high sensitivity.

The new system makes use of a mid-infrared ultra-fast pulsed laser system to generate the filaments, whose colors can reveal the chemical fingerprints of different molecules. The finding is being reported this week in the journal *Optica*, in a paper by principal investigator Kyung-Han Hong of MIT's Research Laboratory of Electronics, and seven other researchers at MIT; in Binghamton, New York; and in Hamburg, Germany.

Hong explains that such filaments, as generated by lasers in the near-infrared part of the electromagnetic spectrum, have been widely studied already because of their promise for uses such as laser-based rangefinding and remote sensing. The filament phenomenon, generated by high-power lasers, serves to counter the diffraction effects that usually take place when a laser beam passes through air. When the power level reaches a certain point and the filaments are generated, they provide a kind of self-guiding channel that keeps the laser beam tightly focused.

But it is the mid-infrared (mid-IR)

wavelengths, rather than the near-IR, that offer the greatest promise for detecting a wide variety of biochemical compounds and air pollutants. Researchers who have tried to generate mid-IR filaments in open air have had little success until now, however.

Only one previous research team has ever succeeded in generating mid-IR laser filaments in air, but it did so at a much slower rate of about 20 pulses per second. The new work — which uses 1,000 pulses per second — is the first to be carried out at the high rates needed for practical detection tools, Hong says.

“People want to use this kind of technology to detect chemicals in the far distance, several kilometers away,” Hong says, but they have had a hard time making such systems work. One key to this team's success is the use of a high-power femtosecond laser with pulses just 30 femtoseconds, or millionths of a billionth of a second, long. The longer the wavelength, the more laser peak power is needed to generate the desired filaments, due to stronger diffraction, he says. But the team's femtosecond laser, coupled with what is known as a parametric amplifier, provided the necessary power for the task. This new laser system has been developed together with Franz X. Kaertner in Hamburg and other group members for last several years. At these mid-IR wavelengths, Hong says, this device produces “one of the highest peak-power levels in the world,” producing 100 gigawatts (GW, or billion watts) of peak power.

It takes at least 45 GW of power

to generate the filaments at these mid-infrared wavelengths, he says, so this device easily meets that requirement, and the team proved that it did indeed work as expected. That now opens up the potential for detecting a very wide range of compounds in the air, from a distance.

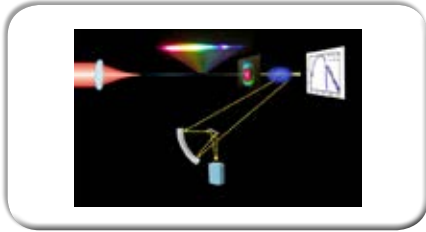
Using spectrally broadened mid-IR laser filaments, “we can detect virtually any kind of molecule you want to detect,” Hong says, including various biohazards and pollutants, by detecting the exact color of the filament. In the mid-IR range, the absorption spectrum of specific chemicals can be easily analyzed.

So far, the experiments have been confined to shorter distances inside the lab, but the team expects that there's no reason the same system wouldn't work, with further development, at much larger scales. “This is just a proof-of-principle demonstration,” Hong says.

This research “is one of the very first investigations of self-channeling of ultraintense mid-IR laser pulses in the air,” says Pavel Polynkin, an associate research professor of optical sciences at the University of Arizona, who was not involved in this work. “Whether there will be new and exciting applications, time will show.”

The research team also included MIT postdoc Houkun Liang; doctoral student Peter Krogen PhD '16; alumnus Chien-Jen Lai PhD '14; adjunct professor and group leader Franz X. Kaertner at the University of Hamburg, Germany; and Assistant Professor Bonggu Shim and his doctoral students at Binghamton University in New York.

This work was funded by U.S. Air Force Office of Scientific Research.



### TI's synchronous DC/DC buck regulators eliminate switch-node ringing in automotive applications Technology

Texas Instruments (TI) (NASDAQ: TXN) today introduced two 36-V, 2.1-MHz synchronous buck regulators that eliminate switch-node ringing to reduce electromagnetic interference (EMI), improve power density, and operate in deep drop-out conditions. The 2.5-A LM53625-Q1 and 3.5-A LM53635-Q1 regulators are designed for high-voltage DC/DC step-down applications such as automotive infotainment, high-end cluster, advanced driver assistance systems (ADAS) and body power-supply systems. Wettable flank packaging enables optical inspection to reduce manufacturing costs. By using these step-down regulators together with TI's WEBENCH® Automotive Design tool, engineers can get their automotive designs to market faster. For more information, samples and an evaluation module, see [www.ti.com/lm53635q1-pr](http://www.ti.com/lm53635q1-pr). 36-V, 2.1-MHz synchronous buck regulators from Texas Instruments eliminate switch-node ringing to reduce electromagnetic interference (EMI), improve power density,

and operate in deep drop-out conditions. The 2.5-A LM53625-Q1 and 3.5-A LM53635-Q1 regulators are designed for high-voltage DC/DC step-down applications such as automotive infotainment, high-end cluster, advanced driver assistance systems (ADAS) and body power-supply systems.

Switch node ringing is inherent in all switch-mode power supplies. By reducing parasitic inductance and capacitance in the LM53625-Q1 and LM53635-Q1 regulators, these power solutions lower noise and EMI emissions by up to 15 dB at the system level, which requires less external EMI filtering, saves printed circuit board (PCB) area and simplifies compliance with CISPR 25 automotive EMI requirements. Watch a video that demonstrates how to solve automotive EMI, thermal and system challenges with TI's LM53635-Q1.

LM53625-Q1 and LM53635-Q1 key features and benefits

Wide 3.5-V to 42-V operating range handles start-stop and load-dump conditions for 12-V lead acid automotive batteries. Read the blog post, "What to consider when designing an automotive power supply."

Provides up to 93 percent efficiency at 2.1-MHz operation to support compact and high-temperature conditions in automotive applications.

Low 18- $\mu$ A quiescent current (IQ) in standby extends battery life in "always on" applications.

Wettable flank packaging enables post-solder optical inspection. Read the blog post, "The value of wettable flank-plated QFN packaging for automotive applications."

Deep drop-out performance of less than 0.6 V under full load and temperature conditions enables

compliance with stringent cold-crank and start-stop conditions, saving system cost and solution size.

The LM53625-Q1 and LM53635-Q1 join the recently released LM53600-Q1, LM53601-Q1, LM53602-Q1, LM53603-Q1 and LM5140-Q1 buck converters to create a complete family of controllers and regulators designed for automotive systems that draw less than 0.65 A of power to more than 10 A. All of these devices feature greater than 2-MHz switching frequency, low operating IQ and EMI reduction features.

Create an automotive infotainment power system

Download the "Infotainment Power System Reference Design for Automotive" to view a full off-battery front-end power supply for automotive infotainment systems. The reference design includes the LM53635-Q1 regulator, LM27313-Q1 boost converter and LM74610-Q1 smart diode controller. The reference design meets all industry tests including ISO 7637 pulse, cold crank, reverse battery, input over-voltage and CISPR 25 Class 5-conducted EMI.

Availability, packaging and pricing The new DC/DC regulators are available in volume now from TI and its authorized distributors. Offered in a 22-pin, 4-mm-by-5-mm very thin quad flat no-lead (VQFN) package, the LM53625-Q1 is priced at US\$2.79 in 1,000-unit quantities and the LM53635-Q1 is priced at US\$3.22. Order the LM536253QEVM evaluation module and download a PSpice transient model.

Find out more about TI's power-management portfolio:

Get more information on TI's DC/DC regulator portfolio for any power-supply application.

Search for solutions, get help and share knowledge in the TI E2E™ Community Power Management forum. Download power reference designs from the TI Designs reference design library.



### **New synchronous rectification ICs for simplicity and efficiency in SMPS applications**

Infineon Technologies AG (FSE: IFX / OTCQX: IFNNY) released the IR1161L and IR11688S secondary synchronous rectification (SSR) family of Controller ICs to complete Infineon's product offerings for SMPS applications.

The IR1161L and IR11688S SSR ICs meet the new 2016 standards set by the U.S. Department of Energy and the "European Code of Conduct for Energy Efficiency in Data Centre" which demand a 1 to 3 percent efficiency improvement over previous requirements. Taking 2 percent saving as an average for new adapters, US adult notebook users alone can save 525 GWh per year – which is enough to power New York City for at least 40 days. Together with Infineon's best in class energy saving OptiMOS™ and StrongIRFET™ MOSFETs, this family of SSR ICs provides a simple solution for SMPS while improving the overall efficiency. The IR1161L is targeted for flyback SMPS in

chargers and adapters while the IR11688S is targeted for LLC SMPS in televisions, desktops, silver boxes and micro-servers.

Both, the IR1161L and IR11688S offer 200 V direct sensing which eliminates the need for external voltage dividers. The family also features programmable MOT (minimum on time) ensuring reliable operation from no-load to full-load. The low quiescent current capability meets the standby requirements of the new 2016 efficiency standard in the industry.

#### Availability

Volume production of the IR1161L and IR11688S has started. More information about the new SSR family is available at [www.infineon.com/sric](http://www.infineon.com/sric).



### **Snapdragon 821 builds on 820 processor success**

Since the beginning of the year, when the first Qualcomm Snapdragon 820 powered smartphones were announced, the 820 processor has been a leader in the mobile industry with over 115 premium smartphone and tablet device deployments, supporting the latest in cutting-edge mobile applications, and helping create more immersive user experiences while also being deployed in new and innovative ways, like supporting safer driving and navigation in cars.

One of the main reasons the 820 processor has been so successful in so many designs is because it introduced multiple new technologies, all tightly integrated and power optimized, designed to bring user experience innovation to the mobile industry.

But the innovation doesn't stop there.

This week, Qualcomm Technologies is announcing a follow-up to the successful Snapdragon 820 processor: the Snapdragon 821.

Building on the technology leadership introduced with the Snapdragon 820 platform, the 821 is engineered to deliver faster speed, improved power savings, and greater application performance, ensuring 821 powered devices keep pace with the growing performance demands of users to deliver the unmatched user experiences the Snapdragon 800 tier is known for.

The Snapdragon 821 is engineered to deliver a 10% performance increase over the 820 with the Qualcomm Kryo quad-core CPU, reaching speeds up to 2.4GHz. Why would you introduce something to replace what many consider the best mobile processor available today? Simple, we're not. Rather than replace the Snapdragon 820, the 821 is designed to complement and extend the competitive strengths of our Snapdragon 800 lineup.

The Snapdragon 820 introduced a number of highly optimized and custom-designed core technologies and established an early and clear leadership position in premium tier mobile computing. Consider, for example, the X12 LTE modem. It

is in a class of its own, designed to support download speeds up-to 600 Mbps, LTE uploads up-to 3x as fast with Snapdragon Upload+, vastly improved call quality and reliability with Ultra HD Voice, all tightly integrated to deliver wide areas connectivity to Snapdragon 820 to devices worldwide.

The Snapdragon 820 currently powers some of the most advanced, feature rich smartphones today, including the Samsung Galaxy S7 and Galaxy S7 Edge, Xiaomi Mi5, LG G5, HTC 10, LeEco LeMax 2, and Sony Xperia X. And because the Snapdragon 820 helped improve the user experience for mobile imaging, virtual reality, battery life, and connectivity speed and reliability, all the updates we've included in Snapdragon 821 will help keep devices powered by Snapdragon 800 premium-tier processors at the top of people's shopping lists into the foreseeable future.

We're excited to tell you more about just how the Snapdragon 821 will help set a new bar for smartphones, tablets, mobile VR head mounted displays and other new devices. You can expect commercial devices powered by the 821 in the second half of 2016. Stay tuned for more information on the Snapdragon 821 coming soon..



## **NXP Showcases Stunning i.MX 8 Multisensory Experiences at FTF 2016**

NXP Semiconductors (NASDAQ:NXPI), today debuted the potential of secure, vivid and interactive interfaces powered by next generation i.MX 8 applications processors. NXP also introduced a multisensory enablement kit (MEK) based on i.MX 8, a multisensory processor family that promises to transform everyday interactions by advancing multimedia and display interfaces across demanding compute and media-intensive applications.

The new i.MX 8 multisensory enablement kit combines the industry's most scalable applications processor family, high level of system security and exceptional power efficiency. It features system partitioning to make it easier for developers to focus on innovative application software-defined outcomes with hardware-defined security to ensure safety and privacy in various critical applications including connected vehicles, and connected medical or industrial machinery and tools. With the intelligent i.MX 8 architecture, data can be accessible and securely extracted for meaningful information and value to consumers and businesses.

"The era of supercharged computing is here and offers a lot of potential to transform the way we work, live and play," said Geoff Lees senior vice president and general manager for the microcontroller business line at NXP. "In this new world of

GPU-acceleration, consumers can anticipate amazing interactive experiences with machines and connected devices around them. The i.MX 8 architecture gives developers freedom to flex their imaginations and design natural human machine interactions for everyday activities with everything in life."

### **Multi-Sensory, Vivid Experiences with Any Object or Surface**

i.MX 8 is designed to enhance interactivity using a powerful media engine. It features 4K video and graphics performance that can be implemented in most surfaces or objects that may benefit from virtual or augmented reality-based experiences. The technology opens opportunities to develop human machine interactions like robotic and vision detection, personal drones for family or businesses and wearable devices that can enable scanning for modern industrial automation and efficiency.

### **Private and Personalized Interactions**

The smart i.MX 8 architecture balances consumer accessibility with the highest level of safety and security. Designed from the ground up for advanced security, the architecture features software and hardware platform separation and key fail/recovery options to protect digital personalities and enable engagement with connected, digital interfaces safely and securely.

### **Accessibility and Safety for Critical Applications**

i.MX 8 drives multisensory advancements for intuitive gesture control, voice recognition, natural speech recognition and audio

acceleration. In mission critical applications such as healthcare or industrial implementations such as connected vehicles the i.MX 8 technology configures its experience to match digital personalities. For example, in connected cars, key driving information is configured and presented in multiple displays covering infotainment to instrument clusters and advanced heads-up displays, personalized comfort with configured seats, volume for music and device connectivity can be designed to enhance driving enjoyment and safety. Availability

The NXP i.MX 8 MEK is available now. The MEK includes the processor, tool and software including BSPs and middleware. Contact your local NXP field applications engineer (FAE) or visit [www.nxp.com/iMX8-MEK](http://www.nxp.com/iMX8-MEK) for more details.



### Analog Devices' D/A Converter Improves Television Viewing Experience

Analog Devices, Inc. (ADI) today introduced a D/A converter that brings the future of television to today's home viewers, enabling them to enjoy ultra-high-definition (UHD) and 4K television across more channels at unprecedented streaming and download speeds. The new AD9162 D/A converter represents a breakthrough for the industry because it provides broadband and wireless service operators with the industry's highest bandwidth and dynamic range to satisfy rising consumer demand for

higher quality, always-on data and video streaming without requiring expensive, large-scale architecture or converter design changes.

View product page, download data sheet, order samples and evaluation boards: <http://www.analog.com/AD9162>

Learn about Analog Devices' D/A converter product portfolio:<http://www.analog.com/en/products/digital-to-analog-converters/da-converters.html>

Connect with engineers and ADI product experts on EngineerZone®, an online technical support community:[https://ez.analog.com/community/data\\_converters/high-speed\\_dacs](https://ez.analog.com/community/data_converters/high-speed_dacs)

The 16-bit, 12-GSPS AD9162 converter's best-in-class 2.5-GHz bandwidth exceeds the 1.794-GHz optional future requirement specified by the cable industry's DOCSIS 3.1 standard by nearly 40 percent. The wider bandwidth affords cable operators the ability to plan next-generation network upgrades and capacity expansions without changing converter designs, which reduces product development time and engineering resources.

The AD9162 converter's industry-best dynamic range (-82-dBc SFDR at -167-dBm/Hz NSD) allows designers to synthesize signals across a wide frequency spectrum from direct-to-RF up to 6 GHz. In wireless applications, this eliminates an IF-to-RF up-conversion stage and local oscillator generation, reducing base station component count, size and power consumption. The AD9162 supports all wireless communications infrastructure protocols (WCDMA, LTE, LTE-A, point-to-point), enabling advanced multiband and multi-standard radio designs.

### Additional Features and Benefits

The AD9162 converter features a 2x interpolator (FIR85) that enables configurations for lower data rates and converter clocking to reduce overall system power and ease filtering requirements. In mix-mode operation, the RF D/A converters can be configured to reconstruct RF carriers in the 2nd and 3rd Nyquist zones up to 7.5 GHz while maintaining exceptional dynamic range.



### Keysight Technologies Introduces Industry's First All-in-One Software for R&D Engineers Designing, Evaluating 5G Candidate Waveforms

Keysight Technologies, Inc. (NYSE: KEYS) today introduced its Signal Optimizer software—the industry's first and only all-in-one software for calibration, signal creation and signal analysis of 5G candidate waveforms. By simplifying calibration and the critical design tasks related to 5G signal creation and analysis, the software enables R&D engineers to focus more time on being first-to-market with their own designs. Calibration is essential to making accurate measurements of 5G signals; however, calibrating wideband channels at RF, microwave and millimeter wave frequencies is a challenging task. Keysight's new Signal Optimizer software overcomes this challenge by making fully-guided system calibrations easier than ever



before. The software also features task-based instructions that simplify complex system optimization and measurements, and allow engineers to more confidently validate their 5G designs.

“R&D engineers at major wireless infrastructure and device vendors are designing and evaluating 5G candidate technologies using a complex range of different tools,” said Mark Pierpont, vice president of Keysight’s Internet Infrastructure Solutions Group. “Our new Signal Optimizer software solves this problem by bringing together 5G measurement science and flexible wideband system calibrations in a single software solution. The result is a powerful 5G-focused solution for accelerating deployment of the fifth generation of mobile wireless services.”

Keysight’s Signal Optimizer software can generate and analyze a host of 5G candidate technologies, such as FBMC and F-OFDM. Enhanced LTE for 5G is also being developed along with new multiple access on existing LTE signals. Future additions are simply licensed and added to the Signal Optimizer software on an as needed basis.



## **NI Introduces Second-Generation Vector Signal Transceiver to Help Solve the Most Demanding RF Design and Test Applications**

NI (Nasdaq: NATI), the provider of

platform-based systems that enable engineers and scientists to solve the world’s greatest engineering challenges, today announced a second-generation vector signal transceiver (VST). The NI PXIe-5840 module is the world’s first 1 GHz bandwidth VST and is designed to solve the most challenging RF design and test applications.

“NI redefined instrumentation in 2012 by introducing the industry’s first VST with an FPGA programmable by LabVIEW to accelerate the pace of design and lower the cost of test,” said Olga Yashkova, program manager for communications test and measurement practice at Frost & Sullivan.

The NI PXIe-5840 combines a 6.5 GHz RF vector signal generator, 6.5 GHz vector signal analyzer, high-performance user-programmable FPGA and high-speed serial and parallel digital interfaces into a single 2-slot PXI Express module. With 1 GHz of bandwidth, the latest VST is ideally suited for a wide range of applications including 802.11ac/ax device testing, mobile/Internet of Things device testing, 5G design and testing, RFIC testing, radar prototyping and more.

Product Features:

1 GHz of instantaneous bandwidth for advanced digital pre-distortion (DPD) test and wideband signals such as radar, LTE-Advanced Pro and 5G

Measurement accuracy that enables systems based on the second-generation VST to measure 802.11ac Error Vector Magnitude (EVM) performance of -50 dB

Measurement speeds up to

10X faster than traditional instrumentation using FPGA-based measurement acceleration and highly optimized measurement software

Small size and tight synchronization allowing for up to 8x8 multiple input, multiple output (MIMO) configuration in a single 18-slot chassis

User-programmable FPGA that engineers can easily design with LabVIEW

The VST is a vital part of the NI platform and ecosystem that engineers can use to build smarter test systems. These test systems benefit from more than 600 PXI products ranging from DC to mmWave. They feature high-throughput data movement using PCI Express Gen 3 bus interfaces and sub-nanosecond synchronization with integrated timing and triggering. Users can take advantage of the productivity of the LabVIEW and NI TestStand software environments, along with a vibrant ecosystem of partners, add-on IP and applications engineers, to help dramatically lower the cost of test, reduce time to market and future-proof testers for tomorrow’s challenging requirements.

To learn more about the second-generation VST, visit [www.ni.com/vst/](http://www.ni.com/vst/).



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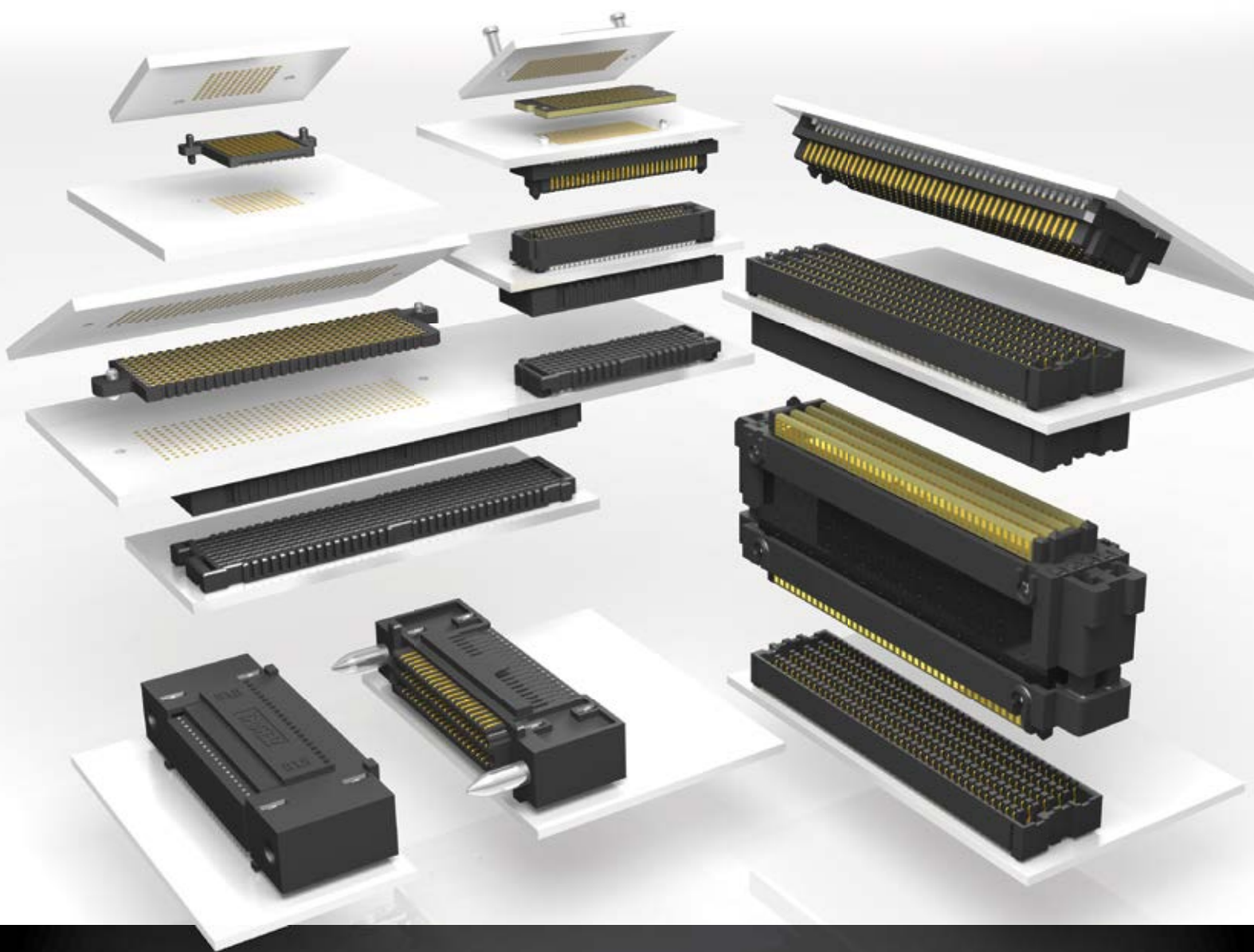
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      - Right angle and low profile systems
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